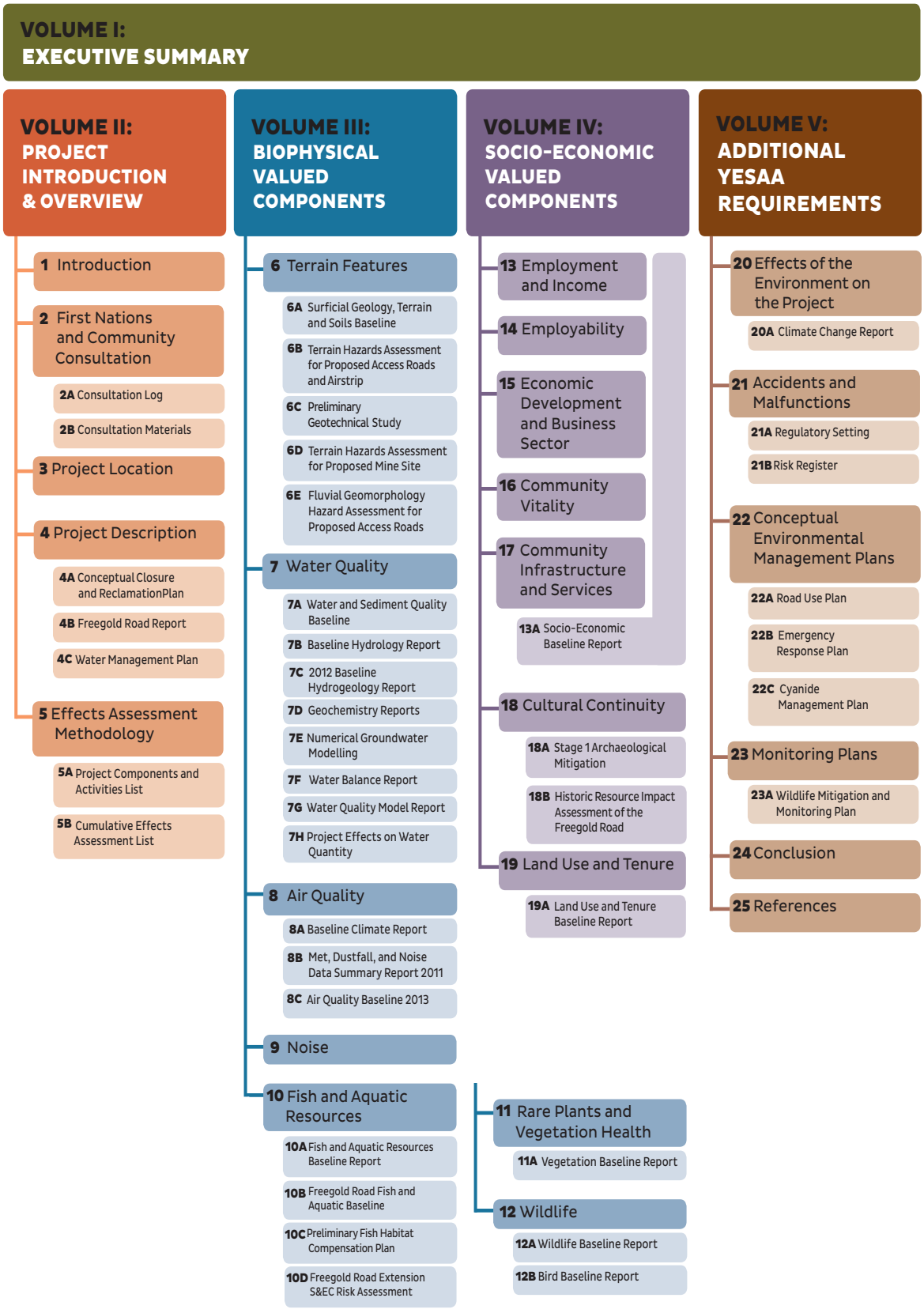

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ABBREVIATIONS

%	Percent
ARD	acid rock drainage
AADT	annual average daily traffic
AANDC	Aboriginal Affairs and Northern Development Canada
AEP	annual exceedance probability
ANFO	ammonium nitrate and fuel oil emulsion
ASDT	average summer daily traffic
B	billion dollar
BC	British Columbia
BC MOE	British Columbia Ministry of Environment
BCMELP	British Columbia Ministry of Environment Lands and Parks
BCP	Background Concentration Procedure
BLM	Biotic Ligand Model
BMP	best management practice
BMU	bear management unit
°C	Degrees Celsius
C	Construction
CAD	Canadian Dollar
CCME	Canadian Council of Ministers of the Environment
CD	Closure and Decommissioning
CDA	Canadian Dam Association
CDP	cyanide destruction plant
CEA	Cumulative Effects Assessment
CESCC	Canadian Endangered Species Conservation Counci
CFB	Circulating Fluidized Bed
CIC	carbon in column
CMC	Casino Mining Corporation
CMHC	Canada Mortgage and Housing Corporation
CNIM	Centre for Northern Innovation in Mining
CPUE	catch-per-unit-effort
CO	Carbon Monoxide
CO2e	Equivalent CO2
COC	Contaminants of Concern
COPC	constituents of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWBI	Community Well-Being Index
dBA	A-weighted sound pressure
DC	Decommissioning
DFO	Fisheries and Oceans Canada
DF	Dustfall
DOC	dissolved organic carbon
EDGM	Earthquake Design Ground Motion
EDI	Environmental Dynamics Inc.

EEM.....Environmental Effects Monitoring
EHS.....Environmental Health and Safety
EMP.....Environment Management Plan
EPCM.....Engineering, Procurement and Construction Management
EPT.....Ephemeroptera-Plecoptera-Trichoptera
FMEA.....Failure Modes and Effects Analysis
FN.....First Nation
FTEs.....full-time equivalents
GDP.....Gross Domestic Product
GHG.....Greenhouse Gases
GMA.....Game Management Area
GMS.....Game Management Subzone
ha.....hectare
HADD.....Harmful Alteration, Disruption, or Destruction of Fish Habitat
HDPE.....high density polyethylene
HDRDC.....Human Resources and Skills Development Canada
HE.....habitat effectiveness
HEP.....habitat evaluation procedure
HKPL.....Hallam Knight Piésold Ltd.
HLF.....Heap Leach Facility
HPA.....Habitat Protection Area
hr.....Hour
HSI.....habitat suitability index
HYP.....Low Grade Hypogene
IDF.....Inflow Design Flood
IEMA.....Independent Environmental Monitoring Agency
I-O.....Input/Output
ICSP.....Integrated Community Sustainability Plan
IJC.....International Joint Commission
ISQG.....Interim Sediment Quality Guideline
KCH.....Klaza caribou herd
KI.....Key Indicator
km.....Kilometre
km^2.....Kilometre squared
l.....Litre
ISO.....International Standards Organization
leq.....average weighted sound levels
L_{DAY}.....daytime noise levels
LDRS.....Leak detection and recovery system
LGO.....low grade ore
LLDPE.....linear low-density polyethylene
L_{NIGHT}.....nighttime noise levels
LNG.....liquefied natural gas
LOEL.....lowest observed effect level
LSA.....Local Study Area
LSCFN.....Little Salmon/Carmacks First Nation

Ltd ..... Limited
LT50 ..... Lethal Time for 50% of the test organisms
LWD ..... Large woody debris
m ..... Metre
m3 ..... Cubic Metre
mm ..... Millimetre
masl ..... metres above sea level
MAL ..... Maximum Allowable Level
MBCA ..... Migratory Birds Convention Act
MDE ..... Maximum Design Earthquake
MGO ..... marginal grade ore
ML ..... metal leaching
ML/ARD ..... Metal Leaching/Acid Rock Drainage
MMER ..... Metal Mining Effluent Regulations
MPERG ..... Mining and Petroleum Environment Research Group
MSC ..... Meteorology Service Canada
MTL ..... Maximum Tolerable Level
NA ..... Not applicable
NAAQO ..... National Ambient Air Quality Objectives
NAPS ..... National Air Pollution Surveillance
NBC ..... National Building Code
NGO ..... non-government organization
NHS ..... National Household Survey
NMP ..... northern mountain population
NO_2 ..... Nitrogen Dioxide
NOx ..... nitrogen oxides
NOC ..... National Occupation Code
Non-PAG ..... non-Potentially Acid Generating
NRCan ..... Natural Resources Canada
NS ..... Not sampled
NTS ..... National Topographic Systemx
O ..... Operation
OBE ..... Operating Basis Earthquake
OC ..... outfitting concession
OGC ..... British Columbia Oil and Gas Commission
P ..... Probability of making a Type I error
PEL ..... Probable Effects Level
PAG ..... acid generating potential
PDA ..... Potential Disturbance Area
PC ..... Post-Closure
PCIC ..... Pacific Climate Impacts Consortium
PGA ..... Values of Peak Ground Acceleration
Phase I ..... WMP Closure Phase I
Phase II ..... WMP Closure Phase II
Phase III ..... WMP Closure Phase III
$PM_{2.5}$ ..... Respirable Particulate

PM10 ..... Inhalable Particulate
PSL ..... Permissible Sound Levels
ROM ..... Run of Mine
RRC ..... Renewable Resource Council
RSA ..... Regional Study Area
RSF ..... Resource Selection Function
RWDI ..... RWDI Air Inc.
s ..... Second
SAG ..... semi-autogenous
SARA ..... Species at Risk Act
SART ..... Sulphidization, Acidification, Recycling and Thickening
SD ..... Standard deviation
SE ..... Standard error
SFN ..... Selkirk First Nation
SMA ..... Special Management Area
SO_2 ..... sulphur dioxides
SOX ..... supergene oxide
SSWQO ..... site-specific water quality objectives
SUS ..... supergene sulphide
SWE ..... snow water equivalent
T ..... tonne
TDS ..... total dissolved solids
TEK ..... Traditional Ecological Knowledge
TFSP ..... Temporary Freshwater Supply Pond
the Project ..... Casino Project
TK ..... Traditional Knowledge
TLU ..... Traditional Land Use
TMF ..... Tailings Management Facility
TSP ..... Total Suspended Particulate
TSS ..... Total Suspended Solids
UFA ..... Umbrella Final Agreement
USD ..... US Dollar
US EPA ..... United States Environmental Protection Agency
UTM ..... Universal Transverse Mercator
VC(s) ..... Valued Components)
WAD ..... Weak-Acid Dissociable
WCGC ..... Western Copper and Gold Corporation
WER ..... Water Effects Ratio
WERP ..... Water Effects Ratio Procedure
WGH ..... Whitehorse General Hospital
WMP ..... Water Management Plan
WMMP ..... Wildlife Mitigation and Monitoring Plan
WSMP ..... winter seepage mitigation pond
WQG ..... Water Quality Guidelines
WSC ..... Water Survey of Canada
YCDC ..... Yukon Conservation Data Centre

YCSR ..... Yukon Contaminated Sites Regulation
YGCCS..... Yukon's Climate Change Strategy
YESAA .....Yukon Environmental and Socioeconomic Assessment Act
YESAB ..... Yukon Environmental and Socioeconomic Assessment Board
YWCHSB ..... Yukon Workers' Compensation Health and Safety Board
YMTA .....Yukon Mine Training Association
ZOI .....Zone of Influence



CASINO PROJECT

PROPOSAL FOR EXECUTIVE COMMITTEE REVIEW

Pursuant to the Yukon Environmental and Socio-Economic Assessment Act

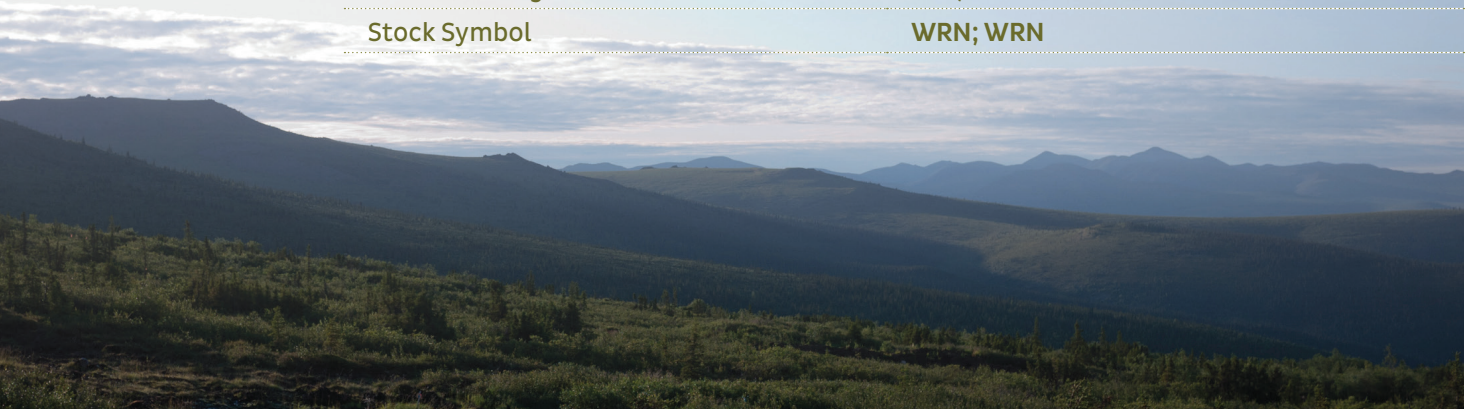
January 3, 2014

INTRODUCTION

Casino Mining Corporation (CMC) proposes to develop the Casino Project (the Project) 150 km northwest of Carmacks and 300 km from Whitehorse. The mine site and a portion of the access road are located within the traditional territory of the Selkirk First Nation (SFN). The access road will also pass through the traditional territory of the Little Salmon/ Carmacks First Nation (LSCFN). The Project is designed to process approximately 120,000 tonnes per day (t/d) or 43.8 million tonnes per day (t/y) of copper and gold ore over a 22 year mine life. During the life-of-mine operations, the Casino Project will produce an estimated 5.72 million ounces of gold, 30.26 million ounces of silver, 3.58 billion pounds of copper, and 325 million pounds of molybdenum.

The main components of the Project include the Open Pit, the Tailings Management Facility (TMF), the processing facilities, the Heap Leach Facility (HLF), temporary stockpiles, and associated mine infrastructure components. Access to the Project area will be from Whitehorse via a network of existing paved highways linking Northern British Columbia and the Port of Skagway in Alaska. From Whitehorse, the paved Klondike Highway (Yukon Highway 2) affords access to the Village of Carmacks. From Carmacks, the access road will follow for approximately 83 km on the existing gravel Freegold Road, which will be upgraded to accommodate Project requirements (referenced herein as the Freegold Road Upgrade). At the terminus of the Freegold Road, an extension (referenced herein as the Freegold Road Extension) will be constructed to provide all-weather gravel access over the remaining 120 km to the Project, generally following the existing and historic Casino Trail alignment.

Proponent Name	**Casino Mining Corporation**
Head Office Address	**1800 – 570 Granville Street Vancouver, BC V6C 3P1**
Telephone	**1-604-684-9497**
Fax	**1-604-669-2926**
Email	**info@casinomining.com**
Website	**www.casinomining.com**
Stock Exchange	**TSX; NYSE**
Stock Symbol	**WRN; WRN**

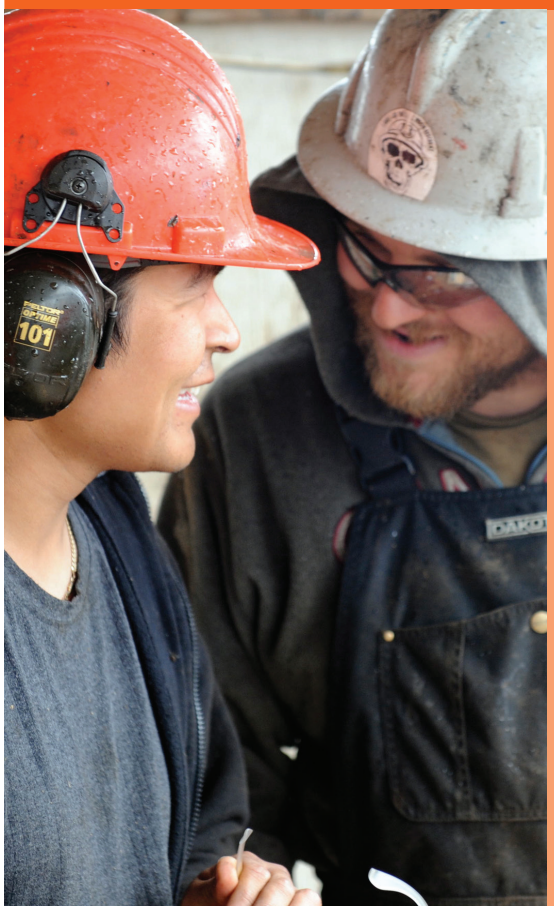


Benefits of the Project will extend beyond CMC to stakeholders including local communities, First Nations governments, and the Yukon as a whole by stimulating economic growth, creating local direct and indirect employment and providing tax revenues and royalties.

The Project will add value to many industries while minimizing effects to the environment.

A key objective of the Project is to build a modern mining operation that will minimize environmental impacts and leave the post closure mine site in conditions as close to baseline as possible. This key consideration has guided the design of all mine components such as the heap leach facility, which has been optimized to minimize environmental impacts.

ECONOMIC FACTS AND FIGURES



69%
of operational spending will occur in Yukon

$43 million
in annual wages and salaries in the operating phase of the Project

Approximately
1,000 people
will be required during the construction phase of the Project

$274 million
Annual GDP generated in Yukon by the operation of the Casino project is estimated at $274 million, equivalent to 10.3% of the Territory's 2011 nominal GDP

Casino Mining Corporation is committed to advancing the Project while operating in an environmentally responsible manner. In this respect, CMC will adhere to or exceed the Guiding Principles described in "Towards Sustainable Mining" advocated by the Mining Association of Canada (Mining Association of Canada 2004). The guiding principles include:

- **Protecting the health and safety of employees, contractors and communities;**
- **Practicing continuous improvement through the application of new technology, innovation and best practices in all facets of operations; and**
- **Being responsive to community priorities, needs and interests through all stages of mining exploration, development, operations and closure**



The Project Proposal consists of five volumes of information with numerous detailed technical appendices. The Proposal responds to the information and assessment requirements identified in the "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (YESAB 2005) and follows the format of this guide wherever possible.

LIST OF VOLUMES

VOLUME I: EXECUTIVE SUMMARY

VOLUME II: PROJECT INTRODUCTION & OVERVIEW

VOLUME III: BIOPHYSICAL VALUED COMPONENTS

VOLUME IV: SOCIO-ECONOMIC VALUED COMPONENTS

VOLUME V: ADDITIONAL YESAA REQUIREMENTS

YUKON ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT BOARD PROCESS

The Yukon Environmental and Socio-economic Assessment Act (YESAA) is the legislation which creates the basis for assessment in all Yukon, federal, territorial, and First Nation lands of the Yukon. Outlining responsibilities, requirements, and procedures for environmental and socio-economic assessment, YESAA provides guidance to the assessment process, outlining responsibilities, requirements, and procedures for environmental and socio-economic assessment. YESAA is regulated and administered by the Yukon Environmental and Socio-economic Assessment Board (YESAB) with periodic revisions. More information can be found at http://www.yesab.ca/.

Assessment of the project Project is subject to section 47(2)(c) of YESAA in accordance to the following:

> "47 (2) An activity listed under paragraph (1) (a) – and not excepted under paragraph (1) (b)—is subject to assessment if proposed to be undertaken in Yukon and if (c) an authorization or the grant of an interest in land by a government agency, an independent regulatory agency, municipal government or first nation is required for the activity to be undertaken"

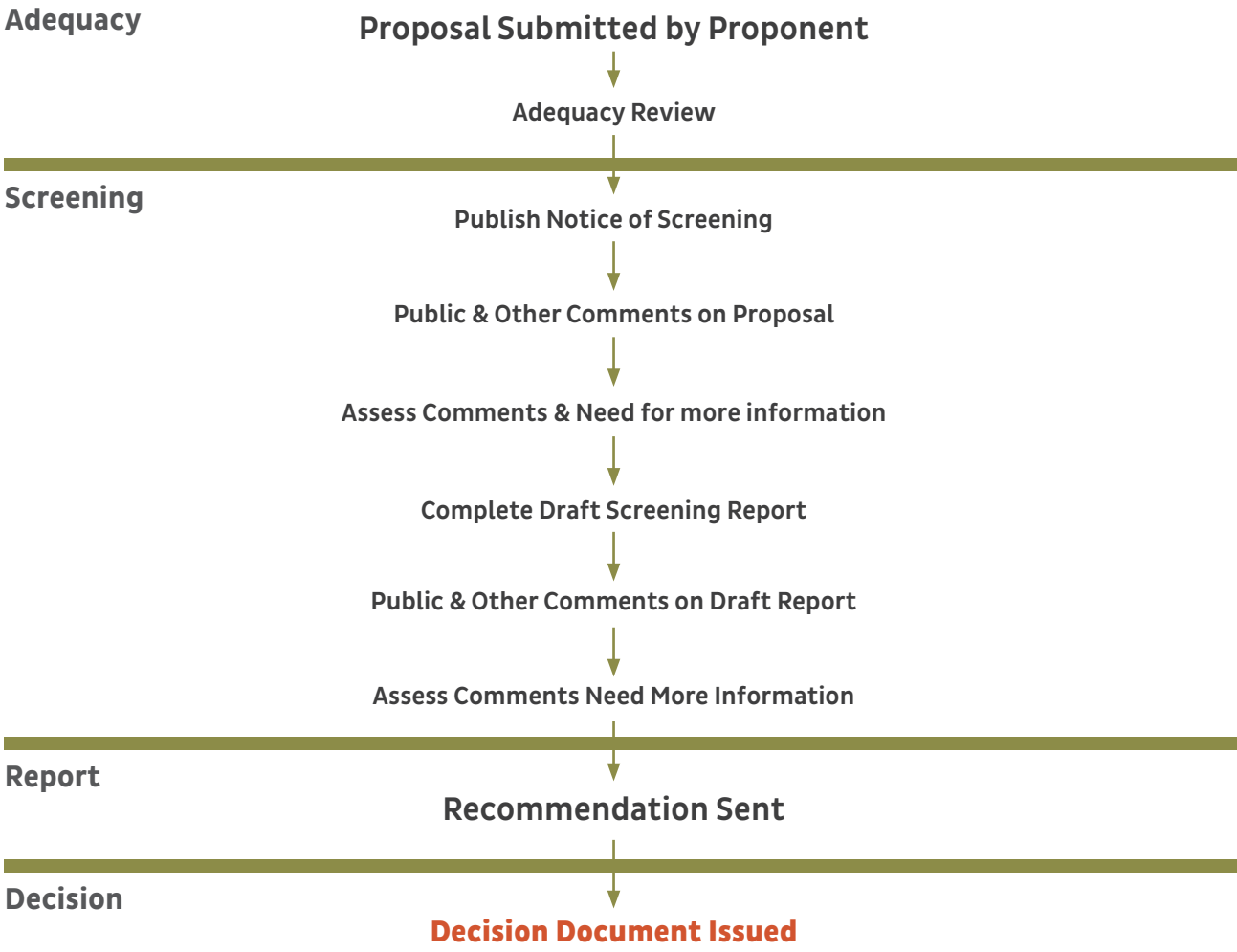
Additionally, the Project is subject to assessment under Schedule 3 item 3(b) of the Project Regulations, requiring an Executive Committee Screening for the construction, decommissioning, and closure of a gold mine with production capacity exceeding 300t/day.

YESAA requirements include the following:

- Section 47(2) of YESAA requires the proponent to gain approval through authorization or a grant of an interest in land by a government agency, independent regulatory agency, municipal government, or First Nations group for any activity undertaken in the Yukon Territories.
- Section 50(2) of YESAA requires a proponent to consider alternatives to the project or alternative ways of undertaking the project during the proposal stages. Consideration of alternatives and relative impacts facilitates the minimization of significant adverse environmental or socio-economic impacts. Section 42(1)(e) of YESAA directs the Executive Committee to make similar considerations in assessment.
- Section 50(3) outlines the proponent's responsibility to consult potentially affected First Nations and stakeholders. Consultation shall be conducted by providing: notice of the matter in sufficient form and detail to allow the party to prepare its views on the matter, a time period reasonable for the preparation and organization of views, as well as an opportunity to present the views of the affected party. Following the presentation of views they must all be considered fully and fairly by the proponent.

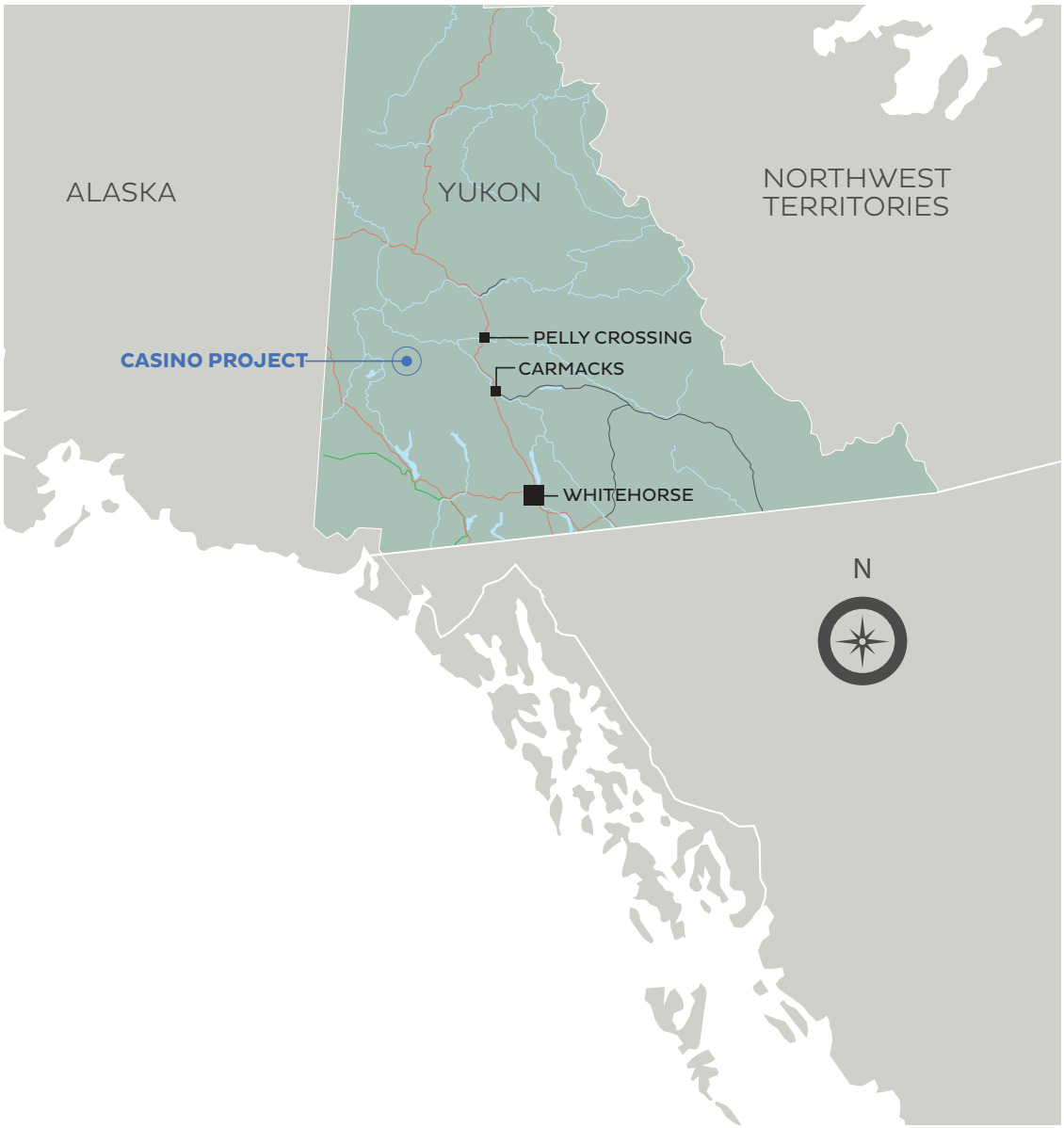
This Project will be subject to the legislation of federal and territorial legislation thus requiring many permits and approvals. A Quartz Mining Licence will be required pursuant to the Quartz Mining Act. Additionally CMC will be required to obtain a Type A Water Licence under the Waters Act for mine operations with use of water and deposit of waste, as well as tailings management according to the Project design.

EA PROCESS AND TIMELINE



Under YESAA, assessors consider the potential environmental and socio-economic effects of proposed activities by gathering and analyzing relevant information from various sources (federal, territorial and First Nation governments, experts in the field, the proponent, and the public) and by conducting research to allow for a complete and thorough assessment.

Casino Mining Corporation has been actively engaging since 2008, and will continue to engage, First Nations, YESAB, other Yukon and federal agencies, renewable resource councils, city and village leadership, and other public stakeholders. The frequency and depth of these discussions varied depending on the scale and scope of First Nations' and stakeholders' interest in learning more about the proposed Project, providing input into the Project Proposal and as the status of the Project changed over time. The focus of CMC's efforts has been on those First Nations and other groups which are directly affected by the Project.



KEY PROJECT COMPONENTS & ACTIVITIES

OPEN PIT OPERATIONS

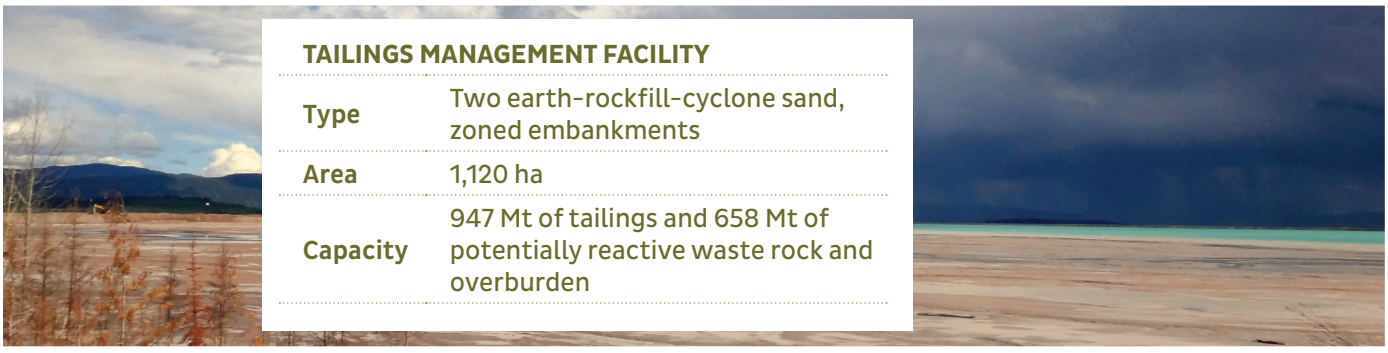


OPEN PIT	
Area	300 ha
Depth	600 m
Mill Reserves	965 Mt
Heap Leach Reserves	157 Mt
Waste Rock	658 Mt

The proposed Casino Project is an open pit mine in the Dawson Mountain Range of the Klondike Plateau in the Yukon Territory, approximately 300 km from Whitehorse.

The Casino Project's open pit mine will be located between the headwaters of Casino Creek and Canadian Creek. The pit will ultimately occupy an area of approximately 300 hectares and will extend to a depth of approximately 600 metres. The mine has a total of 965 million tonnes of proven and probable mill ore reserves and 157 million tonnes of proven and probable Heap Leach reserves that have been identified. Additionally, 658 million tonnes of waste material will be excavated during the 22-year mine life of the Project.

TAILINGS MANAGEMENT FACILITY



TAILINGS MANAGEMENT FACILITY	
Type	Two earth-rockfill-cyclone sand, zoned embankments
Area	1,120 ha
Capacity	947 Mt of tailings and 658 Mt of potentially reactive waste rock and overburden

The Casino Project's Tailings Management Facility (TMF) will be located southeast of the Open Pit, in the valley formed by the headwaters of Casino Creek. The principal objectives of the TMF area are to safely store the required volume of tailings and potentially reactive waste materials, while in a manner that protects the regional groundwater and surface waters throughout the mine life. The TMF is designed to fulfill the reclamation requirements of the Project at closure.

PROCESSING FACILITIES

The Casino Project will have two ore processes:

- A sulphide ore process, consisting of primary crushing followed by a single-line semi-autogenuous (SAG) mill, ball mill circuit and conventional copper-molybdenum flotation circuits
- An oxide ore process, which will use cyanide leaching followed by Adsorption Desorption and Recovery (ADR) to recover gold and silver, and Sulphidization Acidification Recycle and Thickening (SART) to recover copper sulphide precipitate within the HLF process unit.

TEMPORARY STOCKPILES

Temporary stockpile areas for gold ore, supergene oxide ore, low-grade ore and marginal grade ore will be utilized in order to achieve a desired mill feed schedule. Topsoil and overburden stockpiles will also be generated to store material for reclamation use at the end of the mine life.

Mine Site Infrastructure Components and Activities

A number of components and activities have been designed for the purposes of mine site infrastructure, including:

- Mine Site Airstrip
- Freegold Road Extension
- Ancillary support features (e.g. admin offices, warehouses, etc.),
- Power Generation and Distribution (power plants, generators and transmission lines),
- Fuel Supply & Distribution,
- Accommodations Camp,
- Service Roads,
- Water Supply and Distribution (including make-up water supply),
- Wastewater treatment and disposal, and
- Communications infrastructure



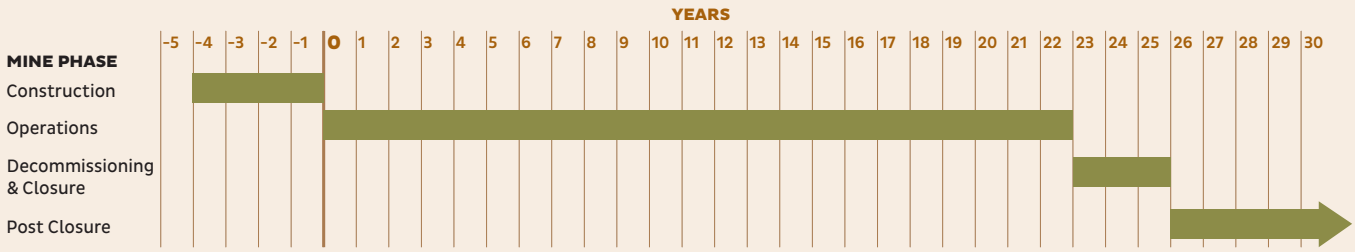
ACCESSORY ACTIVITIES

The existing Freegold Road from the village of Carmacks to the Big Creek crossing is the property of the Yukon Government and will remain a public road throughout the life of the Casino Project. The existing Freegold Road extends approximately 83 km northwest from the Village of Carmacks towards the mine site where it ends and meets the proposed Freegold Road Extension near an old washed out bridge on Big Creek.

From where the existing Freegold Road ends, CMC will construct a new, all-weather, gravel road to the mine site designated as the Freegold Road Extension. The Freegold Road Extension will be a 120 km, two-lane, gravel resource road designed to accommodate double-trailer and Tridem trucks. In general, the Freegold Road Extension will follow the existing historic Casino Trail that has been used in the past to service the mine site; however closer to the mine site, the road will deviate from the Casino Trail in order to ensure better grades and alignment for the mine traffic.

PROJECT PHASES AND SCHEDULING

There are four major phases identified for the Casino Project: the Construction Phase (lasting four years), Operation Phase (spanning 22 years post-construction), Closure and Decommissioning Phase (spanning three years after operations), and the Post-Closure Phase (lasting approximately five years).



A. CONSTRUCTION PHASE

Construction will commence when the necessary permitting and financing is in place for the Casino Project and is planned to span four years prior to the commissioning of mill operations (Years -4 to -1). The first stage will involve the establishment of road and air access facilities, followed by the Plant Site and the Stage 1A Starter Embankment for the TMF. Operation of the HLF and process unit will commence at the end of the second year of construction and continue through into the Operation Phase.

B. OPERATIONS PHASE

The Operation Phase commences at the end of commissioning of the sulphide mill and associated components (start of Year 1) and is projected to last for 22 years. Production is expected to be below full capacity in Year 1 (processing 34.5 Mt of ore) before ramping up to full production (120,000 tpd) for the remaining mine life (Year 2 to Year 22). Throughput will vary on a yearly basis from 44.7 Mt to 46.2 Mt. The mine site will operate 24 hours per day and 365 days per year for the duration of the Operation Phase.

C. CLOSURE AND DECOMMISSIONING PHASE

The active Closure and Decommissioning Phase is scheduled to commence at the end of operations and last three years. During this phase, surface facilities will be removed and the Casino mine site will be fully reclaimed according to the reclamation objectives in CMC's Conceptual Closure and Reclamation Plan. This Plan also include a contingency for temporary closure.

D. POST-CLOSURE PHASE

Post-closure activities include monitoring of the effectiveness of closure and decommissioning activities in the Project area. For the purpose of the Proposal and assessment, the Post-Closure Phase is expected to last five years, or until the results of ongoing monitoring demonstrate that the closure objectives have been achieved and are self-sustaining. Monitoring is anticipated to evaluate the predicted results of reclamation within this phase. There will continue to be limited activities following the post-closure phase to ensure protection of the surrounding environment.

COLD CLIMATE VIABILITY



Heap Leach Technology

To enable year-round operation of the Heap Leach Facility, the Casino Project area conditions and associated potential challenges have been taken into consideration as part of the heap leach design process. This technology including buried lines and seasonal ore stacking has been proven to be viable in similar conditions, such as at the Brewery Creek Mine (Yukon) in the late 1990s, and the Fort Knox Mine (Alaska) in the 2000s.

TMF Operations

The Casino Project TMF has been designed to ensure that it has the ability to remain operational beneath ice under freezing conditions. This will involve incorporating design considerations to be able to maintain and operate the TMF with a frozen ice layer covering the supernatant pond.

Cyclone Sand

There is potential for freezing conditions to reduce operational periods for cyclone sand placement, to prevent ice entrainment in the sand fill or snow drifting into sand cells. The Casino Project has dealt with this issue by limiting the proposed schedule for the cyclone plant operation. Further, any excess non-PAG earth and rock fill materials will be incorporated into the dam wherever possible, thus limiting the cyclone sand requirements. Other considerations will involve the draining of slurry pipelines for long shutdowns (to avoid freezing) and the staging of cyclone sand placement to avoid freezing conditions as much as possible.

CONSULTATION SUMMARY

CMC has been sharing information with First Nations, local communities, Yukon Government, federal agencies, NGOs, and individuals since 2008. The consultation program included a range of techniques to identify concerns and methods to address these concerns, such as: one-on-one group and community meetings, Open Houses, presentations, field trips, general and Project Proposal meetings, interviews and questionnaires as well as phone calls, e-mails and letters.

FIRST NATIONS CONSULTATION

CMC consulted First Nations and their respective Renewable Resource Councils through Open Houses, meetings, letters, e-mails, and phone calls. Through consultation activities, CMC identified and addressed a range of issues, concerns and information requests.

Consultations began with meetings to introduce the Project in late 2008, early 2009 and also at later dates. When appropriate and prior to each meeting, CMC sent a letter and information package that included agendas, PowerPoint presentations and other information to support the proposed discussion. In many cases, the letters and contents of the information packages were also sent by e-mail or dropped off in hard copy, in accordance with the preference requested by the First Nation.

Where appropriate, First Nations were invited to group meetings with Yukon government, federal agencies and regulators.

After introductory meetings and initial consultation, Selkirk First Nation and Little Salmon/Carmacks First Nation were identified as the most likely to be potentially affected by the Project.

CMC or their consultants regularly contacted the Selkirk First Nation seeking their participation in field programs taking place in the Traditional Territory or Settlement Lands. Where Selkirk First Nation members were available they participated in field programs. In 2011, CMC's heritage and archaeology consultant provided on-the-job heritage assessment fieldwork training to a Selkirk First Nation member. In 2013, CMC's heritage and archaeology consultant provided on-the-job training to three Selkirk First Nation members.

CMC engaged with Little Salmon/Carmacks First Nation on a range of matters related to Little Salmon/Carmacks direct involvement. CMC and the Little Salmon/Carmacks First Nation have discussed gathering traditional knowledge. Little Salmon/Carmacks First Nation advised CMC that they would like to revisit the need for, and collection and use of traditional knowledge following their opportunity to review the Project Proposal.

CMC also engaged with a number of First Nations not considered as likely to be potentially affected as Selkirk and Little Salmon/Carmacks First Nations. The First Nations consulted, through meetings, e-mails, letters, phone calls, presentations and Open Houses, included: Tr'ondëk Hwëch'in First Nation, White River First Nation, Champagne and Aishinik First Nations, and Kluane First Nations.

PUBLIC CONSULTATION

During the early stage of the Project, CMC identified a number of public stakeholders that may be affected by or may have an interest in the Project. These stakeholders as well as those who self-identified as interested were consulted.

Based on consultations and information in the socio-economic impact assessment, two communities were identified as most likely to be affected by the Project; the Village of Carmacks and the City of Whitehorse.

Consultation with members of the public that self-identified as having an interest in the Project area was conducted. CMC communicated with and consulted in relation to the Project with the public through a number of activities.

On several occasions, CMC met with municipal government agencies to provide information about the Project and an update on the Project activities.

CMC also conducted community Open Houses between 2008 and 2013 to provide information to the public, to introduce the Company and the Project, and to discuss any interests or concerns. CMC and its consultants were available at these Open Houses to answer question and provide an overview presentation about the Project.

Interviews were conducted with municipal representatives, service providers, and members of the public such as guide outfitters and trappers, to gather pertinent information related to the Project. Information from the interviews was considered and incorporated into the socio-economic baseline report and effects assessment and, where concerns or issues were raised, they were considered by CMC in Project planning and developing mitigation measures.

CMC also developed and distributed a communication booklet to provide accurate, plain-language information about the Project. The booklet was developed and distributed by request, starting in May 2012.

GOVERNMENT AND AGENCY CONSULTATION

Consistent with CMC's commitment to incorporate social responsibility and to implementing a thorough and on-going consultation process in relation to the Project, CMC conducted two significant rounds of formal consultation in 2009 and 2013 with government agencies that will have assessment and regulatory authority on the Project.

The first round in 2009 focused on presenting and securing feedback on baseline data collection. The objective was to ensure data collection was appropriate and addressed the expectations of technical review agencies when the Project proposal was submitted. The second round in 2013 was to present the initial results from the baseline program, and the methodology and approach planned for the Project proposal submission to YESAB.

CMC consultations with government and regulatory bodies included all those Yukon and Federal government agencies and regulators that had a legislative or policy mandate in relation to the Project and Project-related activities, those that either self-identified as having an interest or were identified by other stakeholders as having an interest in the Project.

In 2008, CMC began providing information to and engaging with government agencies and regulators and did so through written correspondence (digital and hard copy), phone calls, in-person meetings, site visits and interviews.



Consultation Activities

- Introductory meetings
- General meetings
- Project Proposal meetings
- Project update meetings
- Socio-economic meetings
- Site visits
- Community open houses

CONCERNS RAISED

Through consultation and information sharing, CMC identified issues and concerns and, in response, identified accommodation, through mitigation or adjustments to the Project to address concerns.

The key issues and concerns raised by First Nations, government, and the public have been arranged into three general categories; summarised as follows:

- Biophysical Environment Concerns (e.g. Potential wildlife habitat loss, Climate change effects, etc.)
- Human Environment Concerns (e.g. Project feasibility and sustainability, economic benefits, etc.)
- Physical Environment Concerns (e.g. Baseline information and reporting, access and transportation options, etc.)

The issues raised were registered by CMC, who considered and responded in a wide range of ways including providing additional information and changing Project design among other considerations.

Observations on Identified Concerns

- Recognizing the importance of minimizing potential negative social and economic effects
- Recognizing that economic benefits, employment and training are a necessity
- Identification of cumulative effects as a common concern
- Emphasizing the importance of continued consultation

PROJECT BENEFITS

The construction of the Project is planned to occur over four years and cost a total of $2.5 billion in capital expenditures. According to a report prepared by Meyer Norris Penney LLP (MNP) in 2013, this will increase Yukon's GDP over that period by $363 million. During the operations phase, the Project is expected to increase GDP by $274 million, equivalent to 11.4% of Yukon's 2011 GDP of $2.4 billion. Government revenues from the Project are forecasted to amount to $219 million annually over the operations phase, of which $61.1 million annually is expected to be raised through the Yukon Mining Tax. Revenues for the Yukon Government are estimated to amount to 7.4% of Yukon's 2012 overall revenue. The magnitude of this increase in resource revenue would be sufficient to change the nature of the funding arrangement between the federal and territorial governments, allowing a greater share of resource revenues to be retained by the Yukon Government. Residual effects on the economy post-operations would be limited to closure expenditures, which are of a relatively low magnitude and not expected to be noticeable, as well as ongoing economic returns from infrastructure investments made by CMC (notably the Freegold Road upgrade), human capital investments retained by workers (training and education), and returns from public investments funded by increased government revenue.

MNP's analysis estimates that construction of the mine would support 5,091 full-time equivalents (FTEs) of employment in Yukon over 4 years, of which 3,275 FTEs would arise from direct expenditures. It would also bring $195 million in wages and salaries within Yukon, of which $137 million would come from direct expenditures.



CMC intends to employ as many people from Yukon as possible, including from First Nations communities. Additional personnel from outside Yukon may be necessary to fully staff the Project during the operations phase, but CMC plans to develop a rising share of Yukon-based employees as operations move to peak production.

CMC is committed to the continued recruitment, training, and advancement of Yukon workers and will work to increase the share of Yukon resident workers over the lifetime of the mine; however, to the extent that residency reflects worker preference and

given the competitive labour market for skilled workers, it is unlikely that the workforce would become fully resident. Workforce estimates may change based on changes in productivity, ongoing exploration activity, and changes in commodity prices.

In addition to direct employment opportunities, the operations of the Project are expected to impact Yukon's economy through expenditures on goods and services. MNP estimates that roughly 69% of operational spending will occur in Yukon. With this percentage and with projected annual operational spending data, MNP estimates that the operation of the mine would support an additional 313 FTEs of indirect and induced annual employment. In total, MNP estimates that operations of the mine would create annual employment of 855 FTEs and generate $43 million in annual wages and salaries in Yukon.

Revenue from the sale of minerals from the Project is forecasted at $25.1 billion over 22 years at a cash production cost of $11.4 billion. The Feasibility Study for the Project forecasts tax payments arising from the mine over the construction and operations phases. Over the construction phase, total government revenue paid by CMC averages $7.0 million annually, from Yukon mining royalties (on pre-production revenue). Over the operation phase, total government revenue from the project averages $219.1 million annually, mostly through corporate taxes ($130.8 million annually) and Yukon royalties (averaging $88.2 million annually). Taxes raised by the Yukon Government average $153.6 million annually while taxes raised by the Federal government average $65.4 million. These figures do not reflect the amounts ultimately retained by the respective governments, since these amounts are adjusted in accordance with agreements between the Federal and Yukon Government (i.e., through the Territorial Formula Funding and Resources Revenue Sharing agreements).

POTENTIAL EFFECTS OF THE PROJECT

Baseline conditions and background information on the physical, social, and economic environment of the Casino Project were documented through multi-year and multi-disciplinary studies. These studies are included as appendices. Based on these studies, 14 Valued Components (VCs) were selected to focus the effects assessment on aspects of the environment that have the potential to change due to direct or indirect interaction with the Casino Project. The VCs were also selected for environmental, scientific, social, aesthetic, or cultural reasons, as identified through consultation with First Nations, governmental organizations, regulatory authorities, and the public.

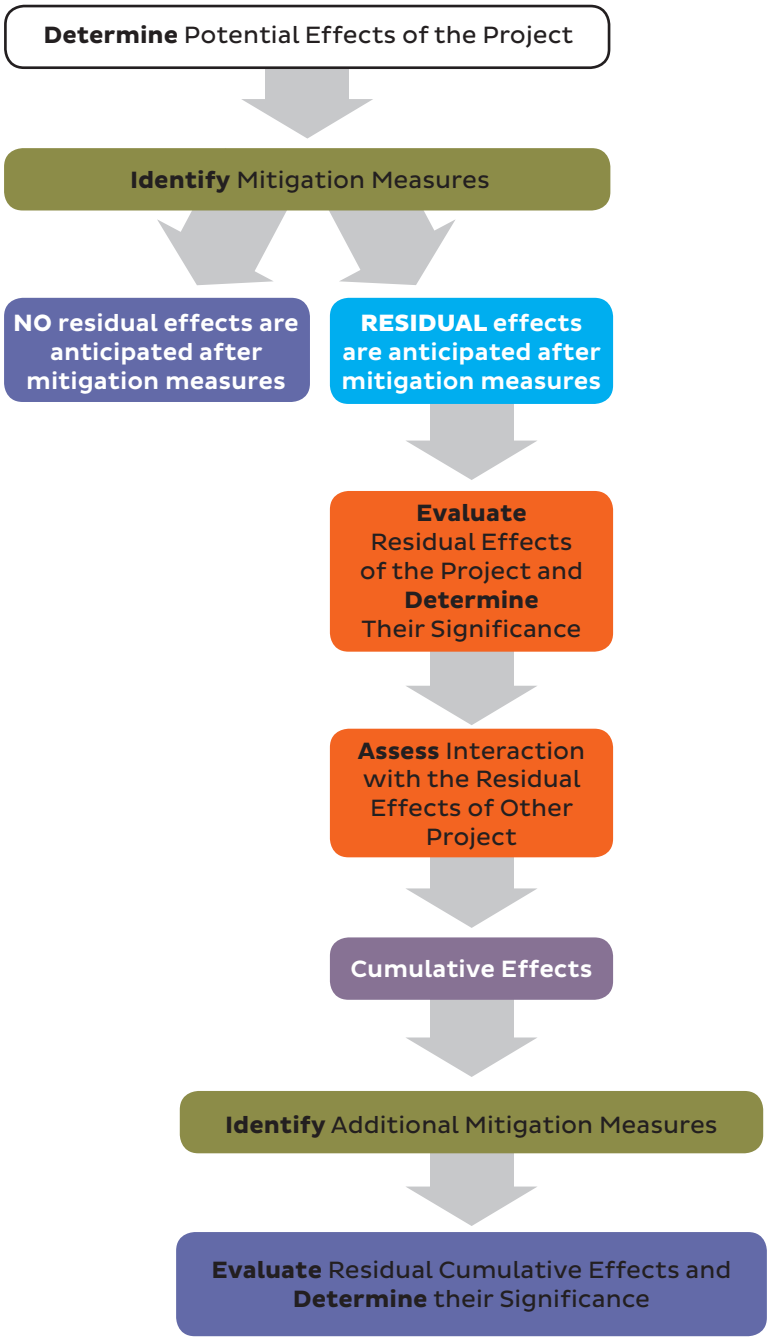
VALUED COMPONENT	DEFINITION	RATIONALE
Terrain Features	The geological surface features, topography, and layers of mineral and organic materials	Terrain features were selected as a VC because of the potential for the Project to result in the loss of unique Beringian landscape features. Alteration of the VC could also result in indirect effects on vegetation health and growth and aquatic ecosystems.
Water Quality	The chemical, physical and biological characteristics of surface water and ground water	Water is the foundation supporting and maintaining healthy ecological processes for fish, wildlife, and humans. Water quality parameters such as total suspended solids, acidity, alkalinity, metals, sulphate, cyanide and nutrients are assessed relative to the requirements of one or more biotic species or to any human purpose.
Air Quality	The composition of outdoor air	Clean air in the Yukon is valued unto itself. Fugitive dust and particulate matter resulting from mining activities could cause deterioration of ambient air quality and affect other VCs such as surface water quality vegetation and wildlife. Major air pollutants that will be assessed are sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter, as well as Greenhouse Gases (GHG).

VALUED COMPONENT	DEFINITION	RATIONALE
Noise	Disagreeable sound resulting from pressure vibrations	In the Yukon, the tranquility of the landscape and lack of intrusion from anthropogenic sound sources has intrinsic value; noise from the Project could affect the use of the surrounding area by humans and wildlife.
Fish & Aquatic Resources	Aquatic organisms and the biotic and abiotic environment on which they depend.	Fish have ecological, cultural, recreational and commercial value, and constitute a fundamental role in aquatic ecosystem functioning. Primary and secondary producers such as periphyton and benthic invertebrates are useful indicators of overall aquatic health. The Proposal will assess the potential effects of the proposed Project on aquatic habitat loss and alteration, and lethal and sub-lethal effects on fish and other aquatic organisms.
Rare Plants & Vegetation Health	Rare plants are plants and ecological communities considered at risk or of conservation concern by the Yukon Conservation Data Centre. Vegetation health refers to the ability of an ecological community to be self-sustaining.	Rare Plants and Vegetation Health were selected as VCs due to the potential loss in abundance within the Project footprint, and indirect effects on surrounding communities. Sensitive ecosystems such as wetlands and lichen-producing habitats are considered an indicator of Project effects on vegetation health.
Wildlife	Terrestrial mammals, songbirds, raptors and waterfowl.	Wildlife have intrinsic value and are also important for local communities that harvest them. The assessment is focussed on a number of Key Indicators, which are particular species or species groups. Key Indicators include the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, bird species at risk, and waterfowl.
Community Vitality	Demographic conditions and well-being of individuals, families, and communities	Potential change in community demographics, and new project-related income and work schedules, could affect the well-being of individuals, families, and communities.

VALUED COMPONENT	DEFINITION	RATIONALE
Community Infrastructure & Services	Municipal infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities); Housing; Transportation; Educational services; Health and Social Services; & Protective Services	Potential Project-related increased demands on regional infrastructure and services, and concern for the ability of the local infrastructure to cope with increasing demands.
Employability	Project-related employment opportunities	Employability was selected as a VC because of the potential effects of the Project on educational level and experience of study area residents.
Employment and Income	Ability to meet potential labour demands during the lifetime of the proposed Project	Employment and Income were selected as VCs to examine labour availability in the study communities, as well as direct, indirect and induced local employment and employment income derived from the proposed Project.
Economic Development & Business Sector	Economic Growth; Government Revenues; and Business Opportunities in the broader territorial economy	Economic Development and the Business Sector were chosen as VCs, since Project development would result in increased activity within the territorial economy.
Cultural Continuity	Defined by Traditional Language; Places of Historical and Archaeological Value; Traditional Knowledge; Social, Community and Cultural Activities; and Subsistence and Recreational Harvesting	Cultural continuity was selected as a VC to address the potential of the proposed Project to affect traditional activities and culture and existing heritage resources.
Land Use & Tenure	Human use of the land and the legal regime governing land ownership	Potential interactions of the Project with other land users in the area including Parks and Protected Areas, Trapping and Guide Outfitting, Hunting and Fishing, Recreation and Tourism, Permits and Licenses, Mining and Mineral Claims, Forest Uses (firewood collection and gathering), Transportation and Access, Energy and Utilities, and Traditional Land Use.

After the VCs were chosen, the spatial and temporal boundaries were defined typically as the Local Study Area (LSA) and Regional Study (RSA), and an effects assessment was undertaken, which was followed by a cumulative effects assessment. For each of the 14 VCs, the potential effects of the Project were characterized by determining how, when, and where the Project is anticipated to interact with the VC. These interactions are described based on how they could change one or more aspects of the VC, or components of the environment on which the VC depends, from pre-Project baseline conditions.

If an interaction is considered to be adverse, technically and economically feasible mitigation measures are described in terms of where and when they would be implemented and their effectiveness in eliminating or reducing the Project effect. Mitigation measures could include restitution, restoration, replacement, or compensation. After mitigation measures have been applied, residual effects may or may not be anticipated. If no residual effect is anticipated, the effects assessment for this effect is considered complete. If a residual effect is anticipated, it is evaluated to determine its significance based on the magnitude, geographic extent, duration, frequency, reversibility, and probability of occurrence of the effect, as well as the ability of the VC to accommodate the change. The residual effect is then rated as either Significant or Not Significant.



The residual effects of a VC are then carried over into a cumulative effects assessment. Cumulative effects are the combined impacts that accumulate from a series of similar or related individual actions, contaminants, or projects. The residual effects of the Casino Project on VCs are assessed in relation to the residual effects of other past, present or likely future projects and activities. These projects were compiled based on information from Yukon Government department websites, mining-related websites, resource use websites, and consultation with regulators, First Nations, and stakeholders. If the effects of other projects and activities overlap spatially or temporally with the effects of the Casino Project, then a cumulative effect is possible.

Once a cumulative effect is identified, additional mitigation measures are recommended. These mitigation measures can require stakeholder involvement, since regional initiatives may be the only method to address complex cumulative effects. After mitigation measures have been applied, the significance of these cumulative effects is assessed following the same methodology and criteria used for determining the significance of residual Project-specific effects.



TERRAIN FEATURES

SCOPE OF ASSESSMENT

The Project is located in an area of glaciated and unglaciated terrain, characterized by landforms and geomorphic processes modified by widespread discontinuous permafrost (frozen ground) and periglacial processes (geomorphic processes associated with ice and freeze-thaw cycles). The assessment of the Project on Terrain Features focuses on issues related to three unique landforms of geological or ecological interest: thaw lakes (lakes found in thermokarst that develop in a depression and accumulate either permafrost melt water or rain water), pingos (mounds of earth-covered ice which grow as a result of periglacial processes), and tors (isolated pillar-like rock outcrops situated on ridges, associated with unglaciated terrain). The interaction assessed was clearing and earth moving within the Project footprint, the key indicator being the partial or total loss of some of these features.



ASSESSMENT AREA

The LSA is the zone where there is a reasonable potential for immediate interaction between Project components and terrain features. The LSA for terrain features includes a 1.5 to 2.5 km boundary around the mine site, airstrip, airstrip access road,and the Freegold Road extension and upgrade, encompassing an area of 896 km^2.

BASELINE CONDITIONS

Baseline investigations for surficial geology and terrain were conducted between 2009 and 2013 and were comprised of desktop studies, reconnaissance terrain mapping, and field investigation. Surficial geology was interpreted from air photos, LiDAR, ground-truthing, test pits, trenching and geotechnical boreholes. A map-based inventory of surficial geology and terrain features was produced. Terrain mapping followed the Terrain Classification System for British Columbia; this classification system describes surficial geologic material, texture, surface expressions and geomorphic processes.

Thaw lakes form and disappear relatively rapidly. A total of 29 thaw lakes were identified throughout the LSA, six of which are within the potential disturbance area. Pingos are dynamic and relatively uncommon, since they only persist in permafrost landscapes. Collapsed pingos can serve as unique habitat for wildlife and year-round sources of water. Fifteen pingos were identified within the LSA. Tors are present on many of the ridges throughout the LSA, both along the road and near the airstrip. Tor occurrence was identified within the LSA, covering an area of 5.0 km^2; within the potential disturbance area, tors cover approximately 0.37 km^2.

Terrain features within the Project footprint maybe be removed or covered during the construction phase of the Project. The removal of terrain features during construction will be permanent. Mapping completed during the baseline work indicated that a total of six thaw lakes, 0.37 km^2 of tor area, and one pingo are present within the potential disturbance area and may be removed during footprint clearing. The percent loss of terrain features within the LSA is 21% for thaw lakes and 7% each for tors and pingos.

Potential Residual Effect	Key Mitigation Measures
Loss of or damage to terrain features	Where possible, CMC will realign or relocate footprint features to avoid removing/destroying unique terrain features
Covering existing terrain features	Avoidance, minimize footprint

CUMULATIVE EFFECTS

A qualitative effects assessment was conducted, since detailed regional terrain mapping is not available in sufficient detail. Mineral exploration, current and past producing quartz mines, and placer mining projects have occurred in, and are likely to continue to occur in the Project region. Active or historic quartz mines such as the Minto Mine and Mt Nansen Mine can have residual effects on terrain features within their project footprint, but the presence of terrain features like tors, thaw lakes and pingos within those project footprints is undocumented. The cumulative effect identified is the cumulative loss of terrain features in the Dawson Range within an additional 17.08 km^2 of footprint disturbance.

KEY FINDINGS

Project effects on terrain features are considered to be adverse and irreversible; however, the residual effect is considered Not Significant, since the impact will be on individual features and localized to the Project footprint. There is no indication that there are any particular concerns with the conservation and protection of these unique terrain features as a whole, nor protection of individual features.



WATER QUALITY

SCOPE OF ASSESSMENT

Water quality forms one of the vital links between the abiotic and biotic environments, and is the foundation for supporting and maintaining healthy ecological processes for a rich and varied community of users (e.g., fish, wildlife, humans). Changes in acidity, alkalinity, metals, sulphate, cyanide and nutrients were selected as key indicators to assess the potential Project effects on the water quality VC.



ASSESSMENT AREA

The water quality LSA is primarily defined by the boundaries of the two watersheds in which the Project components will be situated: the Britannia Creek watershed to the north, and the Casino Creek watershed to the south. The LSA also includes a 5 km-long reach of Dip Creek downstream of its confluence with Casino Creek, several Dip Creek tributaries within the airstrip and airstrip access road footprint, and several watersheds within the Freegold Road Extension and Freegold Road Upgrade corridor. The water quality RSA was defined as the LSA plus adjacent areas that have the potential to experience either indirect (mid-to-far field), or cumulative effects due to interactions with other projects.

BASELINE CONDITIONS

To understand potential effects on water quality, surface water sampling sites and groundwater wells were established in the Project area and monitoring was conducted. A total of 26 surface water monitoring stations were established between 2008 and 2012; the stations were concentrated in the Casino and Britannia Creek watersheds. A total of 20 groundwater quality monitoring wells were installed in the vicinity of and down-gradient from key Project facilities since the program began in 1993. Water samples were collected and analyzed for physical parameters, anions, nutrients and total and dissolved metals, cyanide, and organics. Minimum, mean, median and maximum concentrations were calculated for each parameter at all stations.

Several Project components and activities were identified as having potential interactions with water quality in the LSA. Potential effects focused on three key areas: discharges, seepages and runoff from the TMF; contaminant loading from blasting residues or atmospheric deposition; and erosion and sedimentation processes.

Potential Residual Effects	Proposed Mitigation Measures
Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage	• Water management pond will intercept 90-95% of seepage and pump it back to the TMF
Change in surface water quality in Casino Creek and Dip Creek due to project discharge	• Water Management, including Construction of two engineered wetlands
Changes in surface water quality due to blasting residues	• Divert all contact water to the TMF; • BMPs for explosives selection, drilling, handling and loading
Changes in surface water quality due to atmospheric deposition	• Divert all contact water to the TMF • BMPs for drilling, handling and loading ore • Traffic speed limits • Dust suppressants
Change in surface water quality from increased erosion and sedimentation	• Effective water management and BMPs for sediment mobilization and erosion as outlined in the Erosion and Sedimentation Control Plan • Modify culvert and bridge design for areas with increased sensitivity to disturbances

MONITORING

A water quality, sediment quality, and aquatic biota monitoring program will be developed for the Casino Project to verify the protection of water quality and fish habitat, and to meet the permitting and licence requirements of Yukon and federal regulatory agencies. During all project phases, the mine will be subject to monitoring requirements from the Yukon Water Board. Results from these monitoring programs will be used to confirm predictions made regarding downstream effects to water quality and aquatic biota.

CUMULATIVE EFFECTS

The projects and activities selected for the cumulative effects assessment on water quality were past mining in the Casino Creek watershed; present mining at the Minto Copper Mine; current development and future mining at the Carmacks Copper Mine; past, present, and future mineral exploration around the Casino Mine site and within watersheds along the Freegold access corridor; and past, present and future placer mining around the Casino Mine site and within watersheds along the Freegold access corridor. The only potential cumulative effect identified on water quality from the proposed Casino Project and the other identified past, present and likely future projects and activities was reduced water quality in Casino Creek via surface runoff to Meloy Creek from an old adit. Permanently sealing/plugging the adit to prevent the further discharge of water to surface was identified as a highly effective mitigation measure to address this cumulative effect; therefore, no significant cumulative effects on water quality are predicted to occur.

KEY FINDINGS

No significant water quality change or cumulative effects are predicted to occur due to the Casino Project with the implementation of mitigation measures. All residual effects are considered Not Significant due to the low geographical extent and low to medium magnitude of anticipated impacts.



AIR QUALITY

SCOPE OF ASSESSMENT

Air Quality was chosen as a VC since it could be used as an indicator of both environmental and human health due to the atmosphere's role in transporting air emissions to human, freshwater, and terrestrial environments. Air quality can be further subdivided into three key indicators: ambient air quality concentrations, particulate matter deposition, and greenhouse gasses in the atmosphere. The indicators used to assess the potential effects are ambient air quality concentrations, particulate matter deposition, and greenhouse gasses in the atmosphere.

Ambient air quality is assessed by focusing on major air pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter. The particulate matter deposition assessment focuses on particulate matter deposition rates. Greenhouse gases are assessed by determining the potential contribution of Project-related greenhouse gases into the atmosphere, and comparing it with national total greenhouse release statistics.



ASSESSMENT AREA

Two LSAs have been chosen to encompass the areas where the concentrations of compounds resulting from emissions from the Casino Project have the potential to exceed a standard threshold: the LSA for the mine site was established as a 60 x 60 km area to provide an understanding of the regional dispersion of air contaminants, based on similar large capacity industrial developments. An additional LSA consisting of a 20 km^2 area surrounding the village of Carmacks was established to account for the effects of the Freegold Road Upgrade and Extension.

The RSA was set as the LSA for the mine site and the LSA for the Village of Carmacks, along with a 4 km buffer along the Freegold Road Upgrade and Extension.

BASELINE CONDITIONS

Four dustfall collection canisters were installed at the Casino climate station in areas north, east, south, and west of the mine in August of 2010. Dustfall measurements were collected for a month from August to September of 2010, for three months in 2011 (from May to June and in August to September), and from July to August in 2013. Information on total Yukon and Canadian GHG emissions from 1990 to 2011 was obtained from the National Inventory Report.

Project-specific effects on air quality were assessed using the US EPA approved version of the CALPUFF air dispersion modelling system. An air emission inventory for the Project was compiled for input into the model. The worst-case conditions for air emissions were modelled for the assessment: the peak in construction activities and the year of operations with the maximum tonnage of waste rock moved. The CALPUFF model was run for the entire year to ensure that all climatic conditions were considered. The air quality assessment for the Project includes the predicted concentrations of suspended particulate matters (total suspended particulates, PM2.5, and PM10) and total particulate matter deposition (dustfall), as well as NO2, SO2, and CO. The results of the air quality model were compared with the Yukon Ambient Air Quality Standards, the Canadian Air Quality Objectives or the British Columbia Air Quality Objectives, as relevant.

Potential Residual Effects	Proposed Mitigation Measures
Exceedance of Yukon Ambient Air Quality Standards for SO2, NO2, CO	• Adhere to Occupational Health and Safety Act • Use ultra-low sulphur content fuel. Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance recommended by manufacturers • Institute a policy for all equipment and vehicles to reduce and limit idling
Exceedance of Yukon Ambient Air Quality Standards for TSP, PM10, PM2.5	• Adherence to Occupational Health and Safety Act • Cover or use water sprays at dust generating areas • Reduce drop heights for process plants • Minimize land disturbance, grubbing and clearing activities • Cover or use water sprays at dust generating areas
Exceedance of BC Air Quality Objectives for dustfall	• Adherence to Occupational Health and Safety Act • Minimize wind exposure at conveyors, drop-off points and truck load/unload locations • Establish blasting procedures for open pit activities to minimize dust • Reduce drop heights for process plants • Institute a policy for all equipment and vehicles to reduce and limit idling • Use well maintained vehicles to minimize air emissions • Minimize land disturbance, grubbing and clearing activities • Utilize dust suppressants and watering along access corridors and enforce speed limits • Enforce speed limits, staff training and road watering along truck hauling routes for mine site hauling
Contribute to global greenhouse gasses	• Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance • Institute a policy for all equipment and vehicles to reduce and limit idling

MONITORING

Monitoring requirements are based on the results of the air quality assessment, existing air quality regulations, Project permits, and commitments detailed in the Project Proposal. The following parameters will be monitored:

- Dustfall: construction and operation
- Nitrogen oxides (NOx): construction and operation
- Suspended Particulate Matter (PM10 and PM2.5): operations

Monitoring locations will be established based on the prevailing wind patterns identified in the baseline climate program. All data will be summarized and compared to applicable guidelines in an annual air quality compliance report.

CUMULATIVE EFFECTS

Projects located in the vicinity of the Freegold Road were selected for analysis as they could potentially share a spatial overlap with the Project. Of the three projects within the vicinity of the Freegold Road, two (Minto Copper Mine and Carmacks Copper Mine) were included in the cumulative effects assessment.

The potential residual cumulative effects on air quality that were identified were exceedances of Yukon Ambient Air Quality Standards for NO2, exceedances of Canadian Air Quality Objectives for PM10 and PM2.5, and elevated levels in the atmosphere compared to national total greenhouse release statistics. Additional mitigation recommended was the development and implementation of an Air Quality Monitoring Plan and a Road Use Plan.

KEY FINDINGS

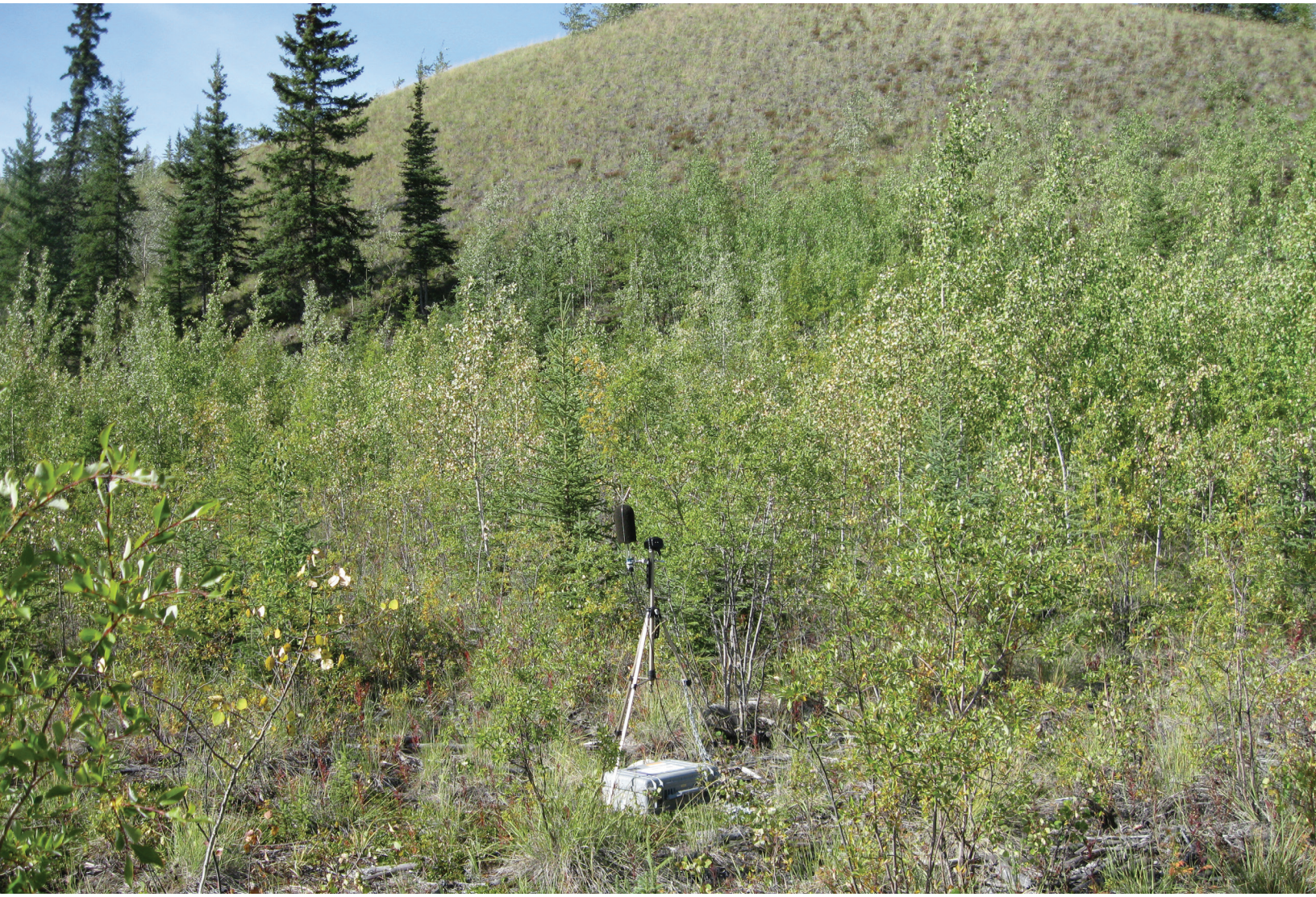
Dispersion modelling was used to assess the potential effects of SO2, NO2, CO, TSP, PM10, PM2.5, and dustfall associated with the Casino Project on air quality predicted concentrations of potential air contaminants for both the Casino mine site and the Freegold Road. With the implementation of mitigation measures concentrations of potential air contaminants would meet the applicable Yukon Ambient Air Quality Standards or Canadian/BC Air Quality Guidelines and thus any effects are considered Not Significant.



NOISE

SCOPE OF ASSESSMENT

Mining activities at the Casino project mine site will generate noise. This has the ability to affect sensitive receptors in the surrounding area via airborne sound propagation. Sound propagation is dependent on the atmosphere as it can be affected by wind speed, wind direction, and relative humidity. Noise has been chosen as a VC because airborne sound and ground vibration propagation can potentially affect human health.



ASSESSMENT AREA

Two LSAs were established for the effects assessment on noise: a 30 km^2 area surrounding the mine site and a 20 km^2 area surrounding the village of Carmacks to account for the sensitive receptors present in this area.

The RSA was set as the LSA for the mine site and the LSA for the Village of Carmacks, along with a 4 km buffer along the Freegold Road Upgrade and Extension.

BASELINE CONDITIONS

Sound levels around the mine site were assumed to be pristine at baseline. Sound levels were measured and recorded near the Freegold Road near Carmacks to establish baseline conditions in a disturbed environment: a Larson Davis 831 Sound Level Meter was used to determine ambient sound levels over a 22-hour period from August 25, 2011 to August 26, 2011. The results were compared to British Columbia Oil and Gas Commission published standards, since the Yukon does not currently have any published noise guidelines or regulations.

Project effects on sound levels were modelled using the outdoor sound propagation software Cadna/A. The inputs to the noise model include noise sources described in the Casino Project Feasibility Study, including road traffic, open pit and haul road vehicles, stationary sources such as crushers, conveyors, power plants, heat recovery steam generators, and use of off-site roads. Noise modelling was completed for both construction and operations phases in the mine site LSA.

Potential Residual Effects	Proposed Mitigation Measures
Increase in noise levels above baseline	• Ensure regular equipment maintenance, including lubrication and replacement of parts by following manufacturer's recommendations • Keep noisy equipment inside of buildings and sheds whenever possible • Equipment will be operated with covers, shields, and hoods if provided by their manufacturer • Site workers will be trained in proper machine use and maintenance • Adhere to a blasting plan developed by an explosives contractor • Optimisation of blasting operations by licensed staff which maximise localised rock breakage while minimising non-productive noise and vibration • Impose speed limits for all vehicles • Institute a policy for all equipment and vehicles to reduce and limit idling • Wherever practicable, noisy equipment will be located near ground level to minimize noise propagation

MONITORING

Noise monitoring or modelling was recommended if receptors exist at affected areas along the Freegold Road Extension.

CUMULATIVE EFFECTS

Projects located in the vicinity of the Freegold Road were selected for analysis as they could potentially share a spatial overlap with the Project. Of the three projects within the vicinity of the Freegold Road, two (Minto Copper Mine and Carmacks Copper Mine) were included in the cumulative effects assessment. The residual effects from these projects are assumed to be the same residual effects identified for the Casino Project; therefore, the cumulative residual effect would be an exceedance of Oil and Gas Commission published standards at the Freegold Road. Additional mitigation measures for cumulative effects could be either Project-specific mitigation which CMC can implement, or recommended mitigation measures for which other parties could implement. The additional mitigation measure recommended for the potential cumulative effects on the Noise VC was to conduct noise monitoring or modelling if receptors are present in the affected areas.



KEY FINDINGS

Sound modelling was used to predict noise levels and potential effects of Project activities. Casino Mining Corporation has proposed several mitigation measures to minimize the potential effects of the Project components and activities on noise; with the implementation of the measures noise levels are predicted to remain below existing guidelines. Therefore, the effects of the Casino Project on noise are Not Significant.

FISH & AQUATIC RESOURCES

SCOPE OF ASSESSMENT

In Yukon, fish have ecological, cultural, recreational and commercial value as they support various fisheries, and constitute a fundamental role in aquatic ecosystem functioning. Primary and secondary producers such as periphyton and benthic invertebrates are key components of the aquatic food web foundation, providing food sources for higher trophic levels, and are useful as indicators of overall aquatic health. The Project will interact with fish and aquatic resources through a variety of mechanisms that can influence fish and aquatic organism habitat and health. These mechanisms include effects that involve habitat losses and alteration associated with road and facility footprints, instream works, watercourse diversions, changes to water quality, and reductions in stream discharge. Any habitat losses not mitigated by design will be compensated through a No-Net-Loss Fish Habitat Compensation Plan which aims to ensure that there is no impact on the productive capacity of fish and fish habitat on a regional scale.



ASSESSMENT AREA

The LSA for the fish and aquatic resources assessment for the Project includes the direct footprint of the proposed Project mine and near-field affected areas which have the potential to be affected by the Project. The LSA is defined by the boundaries of the two watersheds surrounding the Project: the Britannia Creek watershed to the north and the Casino Creek watershed to the south. The LSA also includes a portion of Dip Creek downstream of its confluence with Casino Creek, several Dip Creek tributaries within the airstrip and airstrip access road footprint, and several watersheds along the Freegold Road corridor. The RSA was defined as the LSA plus adjacent areas that have the potential to experience either indirect (mid-to-far field), or cumulative effects due to interactions with other projects.

BASELINE CONDITIONS

Baseline surveys were focused on two general Project related areas; the Casino Mine site and the area encompassing the Freegold Road and Airstrip Access Road. Investigations conducted at the mine site were focused on describing the diversity, relative abundance, distribution, and habitat quality for fish and aquatic organisms in addition to assessing metal loadings in surface water and resident fish tissues. The objectives of the sampling efforts applied to the Freegold Road and Airstrip Access Road was to characterize aquatic habitat at each watercourse crossing and to determine fish bearing status in support of the design and permitting of watercourse crossings.

For the Casino mine site, baseline sites were concentrated in the Casino Creek and Britannia Creek watersheds as they have the potential to be directly affected by the Project. Fish and aquatic resource studies were conducted from 2008 to 2013 at 29 fish sampling sites, 18 fish habitat sites, and 14 aquatic biota sites throughout the Project LSA. Fish habitat in the Project area was surveyed relative to the potential for supporting rearing, spawning and overwintering activities of local fish species. No fish species at risk were caught within the Project LSA.

The fish and aquatic resource studies along the Freegold Road Upgrade, Freegold Road Extension and at sites associated with the Airstrip Access Road were conducted in 2010, 2011 and 2013. The Freegold Road Upgrade has 22 fish bearing streams, the Freegold Road Extension has 56 fish bearing streams, and the Airstrip Access Road contains six fish bearing streams.

Potential Residual Effects	Proposed Mitigation Measures
Effects due to dust and emissions from blasting, ore transport and vehicle traffic	• Traffic speed limits, deployment of dust suppressants • Erosion and Sediment Control Management Plan • Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan
Fish-bearing in-stream and riparian habitat loss	• Implementation of Fish Habitat Compensation Plan for quantified habitat losses
Increased erosion and sedimentation causing habitat loss and alteration	• Erosion and Sediment Control Management Plan • Adhere to guidelines for fisheries working windows
Increased stream flows	• Modification of closure spillway discharge, magnitude and timing
Deleterious effects to periphyton, benthic invertebrates, and fish eggs due to infilling	• Adhere to guidelines for fisheries working windows
Deleterious effects on fish and aquatic organisms due to blasting	• Adhere to DFO guidelines for The Use of Explosives In or Near Canadian Fisheries Waters • ML/ARD risk assessment and Management Plan • Best Management Practices for explosives selection, drilling, handling and loading
Effects on fish and aquatic organisms such as trampling, impingement or entrainment during water extraction and de-watering	• De-water construction areas and conduct fish salvage • Adhere to guidelines for fisheries working windows • Adhere to guidelines for Freshwater Intake End-of-Pipe Fish Screen to prevent fish impingement and entrainment into water pumps
Lethal effects on local fish populations due to increased fishing pressure	• Zero fishing policy for CMC workforce, the Freegold extension will not be open to the public

Potential Residual Effects	Proposed Mitigation Measures
Change in water quality	• Water Management, including a Reclamation Plan (i.e. construction of two engineered wetlands: North TMF wetland and South TMF wetland), construction of a Winter Seepage Mitigation Pond • ML/ARD risk assessment and Management Plan • Erosion and Sediment Control Management Plan
Habitat avoidance, elevated stress or impaired health of fish and aquatic organisms	• Adhere to guidelines for fisheries working windows

MONITORING

A monitoring plan will be designed and implemented to monitor water quality, fish habitat, and biological communities in the LSA.

All construction activities will adhere to CMC's Erosion and Sediment Control Management Plan, Environmental Management Plan and Water Management Plan, which aim to reduce or eliminate impacts on fish and aquatic resources by incorporating best management practices (BMPs).

Fish habitat compensation construction monitoring will minimize risks to fish and fish habitat during implementation of the compensation works. An environmental monitoring technician will be on-site throughout the period of in-water work to document compliance with all environmental protection measures.

Fish habitat compensation effectiveness monitoring will be established to ensure that compensation measures are functioning as designed and to assess their effectiveness at achieving No-Net-Loss over the long-term. Seasonal assessments of physical and biological aspects of the compensation works will be conducted.

Water quality monitoring will document contaminant levels and additional water quality mitigation measures are possible if monitoring indicates that these are required.

CUMULATIVE EFFECTS

Directly around the Casino mine site, there is the potential for cumulative effects as a result of historic mining in upper Casino Creek, past and present mineral exploration of upper Canadian Creek, and past and potential future placer mining in Canadian and Britannia Creeks. Historic mining on the Casino property has resulted in the frequent discharge from a historical adit into the upper watershed, subsequently lowering water quality in downstream Casino Creek. On the northern side of the Casino property, present and future mineral exploration activities may increase erosion and sedimentation into Canadian Creek headwaters, disturb riparian habitat, and lower water quality. There is also the potential for placer mining in Canadian and Britannia Creeks to produce cumulative effects on local aquatic communities. Along the Freegold Road corridor, there are numerous mining, mineral exploration, and placer mining projects and activities with the potential to interact with the Casino Project. Possible cumulative effects along the corridor include lowered habitat productive capacity, and the potential for reduced aquatic organism health and survival.

KEY FINDINGS

No significant habitat loss and alteration, lethal effects, sub-lethal effects, or cumulative effects on fish and aquatic organisms are predicted to occur due to the Casino Project. All residual effects were considered Not Significant due to the low geographical extent, and low to medium moderate magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including the Fish Habitat Compensation Plan.

The primary impacts of the Casino Project on fish habitat are anticipated in the upper Casino Creek watershed in association with tailings management facility construction. Smaller-scale, in-stream impacts are also expected along lower Casino Creek, Dip Creek; lower Canadian Creek lower Britannia Creek and within the footprint of a new bridge pier in the Nordenskiold River. Overall, the net habitat gain associated with the No-Net-Loss Fish Habitat Compensation Plan will ensure that there is no impact on the productive capacity of fish and fish habitat on a regional scale.

Impacts from mine effluent discharge are not anticipated to be significant based on the application of alternative water quality guidelines which take into account site-specific water chemistry including high water hardness, and elevated baseline metal concentrations. Monitoring of water quality and aquatic communities at near-field sites in Casino, Dip, Canadian and Britannia Creeks is required to identify and potentially mitigate/compensate any future impacts on the fitness of local fish species. Despite the uncertainty involved, potential project impacts are not predicted to yield far-reaching effects on regional productivity or diversity.



RARE PLANTS AND VEGETATION HEALTH

SCOPE OF ASSESSMENT

The Project may affect vegetation (vascular plants and lichens) and vegetation communities through clearing of the Project footprint (resulting in loss of individual plants or plant ecosystem associations), or through introduction of invasive species, or deposition of fugitive dust resulting from Project activities on surrounding vegetation (affecting vegetation health). Rare plants and vegetation health were selected as a VC because they may be particularly sensitive to disturbance. A rare plant is one that has a small population, either restricted to a small geographical area where it may be locally common or occur in low numbers over a wide area. Part of the Project area falls within Beringia, an area that has not been recently glaciated and that may have some unique plants and plant ecosystem associations. Rare plants included in the assessment are plant species on the Yukon Conservation Data Centre 'watch list' or 'track list'. Tracked species are those that are of global conservation concern identified by NatureServe, of specific conservation concern in the Yukon, or federally listed under the Species at Risk Act. The Watch List contains species for which there is not enough information to determine whether they are of conservation concern.



ASSESSMENT AREA

The assessment focussed on issues related to rare plants and vegetation health within the potential disturbance area of the Project and within the LSA. The potential disturbance area refers to the Project footprint and a surrounding buffer in which associated activities are assumed to occur; for the purpose of the assessment the buffer was set at 500 m around the mine site, 50 m on either side of linear component alignments (roads, pipelines) and 100 m around borrow sites. The Project footprint is estimated to be 23.5 km^2 while the potential disturbance area encompasses an area of 80.6 km^2.

The LSA is the zone within which there is a reasonable potential for immediate interaction with Project components. For the purpose of the rare plants and vegetation health effects assessment the LSA was set as the potential disturbance area with a 1 km buffer, for a total area of 536 km^2.

BASELINE CONDITIONS

Baseline inventories were completed in August 2010 and July 2012. Since there is no standardized system for classifying vegetation in the Yukon, the BC Terrestrial Ecosystem Mapping inventory standard was followed. The standard provides a uniform method of describing vegetation, soil, and terrain characteristics based on air photo interpretation and field data collection. Field sampling in the mine site LSA included reconnaissance surveys, full plots, ground inspections, and visual checks.

Populations of nine listed species were discovered during the 2010 and 2012 survey, three of which are on the Track List; the remainder were on the Watch List at the time of the surveys.

The Key Indicators used in the Rare Plant and Vegetation Health effects assessment were rare plant abundance, presence of invasive species, and vegetation health

Potential Residual Effects	Proposed Mitigation Measures
Loss of rare plants and rare plant habitat	• Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.
Loss of rare plant habitat due to introduction or expansion of invasive species	• Use of clean equipment, allowing vegetation to re-establish naturally or by using native seed mixes, and establishing a program for invasive plant detection
Dust deposition on vegetation, particularly rare plants	• Dust control measures will be implemented as per the Air Quality Management Plan.

CUMULATIVE EFFECTS

Within the LSA, human activity currently exists that may affect rare plants and/or vegetation health. These activities include mineral exploration, use of the existing section of the Freegold Road by various users, and active or historic quartz mines. Placer mining and other exploration activities are also likely to occur in the LSA. The assessment of cumulative effects on rare plants and vegetation health is qualitative because analysis is limited by the availability of detailed vegetation mapping in the region, making it difficult to quantify combined project effects in the region. The potential cumulative effects were identified as the cumulative loss of vegetation features in the Dawson Range within an additional 17.08 km^2 of footprint disturbance and the cumulative decrease in plant health due to emissions.



KEY FINDINGS

Construction and land clearing associated with the Project will cause a direct loss of terrestrial habitat. The residual Project effect on rare plants was rated as low significance primarily because it is localized and reversible. Dust deposition and emissions will have an adverse effect on vegetation throughout the life of the Project, but the residual effect was rated as Not Significant, since it was determined that effects will be localized to the Project footprint (therefore low magnitude), and will be reversible once the project is complete. The overall residual effect of the Project on rare plants and vegetation health is considered Not Significant.

WILDLIFE

SCOPE OF ASSESSMENT

The Project will interact with wildlife through potential effects to individuals, populations and their habitats. Wildlife was selected as a VC because it has intrinsic value, as a symbol of wilderness and a healthy ecosystem, and because it has cultural or economic value, since some species are harvested by subsistence and trophy hunters and trappers. Because the determination of effects on all species likely to interact with the Project is unrealistic and unlikely to provide information upon which to assess effects on wildlife as a whole, a sub-set of species, termed "Key Indicators", were selected to represent the likely range of potential Project effects on wildlife. The Key Indicators selected are the Klaza caribou herd (KCH), moose, grizzly bear, collared pika, cliff-nesting raptors, bird species at risk, passerine birds, and waterfowl. The measureable parameters used to assess the effects of the Project on the Key Indicators are habitat availability; changes to movement patterns; direct mortality risk; and animal health (for waterfowl only).



ASSESSMENT AREA

Three spatial boundaries were identified for the effects assessment: the potential disturbance area, the LSA, and the RSA. The potential disturbance area is the Project footprint and a surrounding buffer in which associated activities are assumed to occur; it is a conservative estimate used to represent the maximum potential loss of habitat from the Project footprint. For the purpose of the assessment, the buffer was set at 500 m around the mine site, 50 m on either side of linear component alignments (roads, pipelines) and 100 m around borrow sites, for a total area of 80.57 km^2. The RSA varies by the Key Indicator species; in general, the RSAs for wildlife with large home ranges are either the annual or seasonal range of the species or the Game Management Subzones that intersect or interact with the Project. For wildlife with small seasonal home ranges or seasonal territories the RSA was delineated as the Project infrastructure with a 5 km buffer.

BASELINE CONDITIONS

Preliminary wildlife surveys for the Project were completed in the late 1980s by the Government of Yukon and various consultants. Recent work was initiated in 2006 and continued until 2013. The objectives of the wildlife studies were to summarize available wildlife information in the study area (abundance and distribution of key species); identify critical and sensitive habitats and transportation corridors; and complete a baseline inventory of wildlife species to gain an understanding of regional wildlife ecology. Field studies for birds were conducted in 2010, 2011 and 2013, consisting of point count surveys for songbirds and other upland bird species, encounter transects, aerial surveys for cliff-nesting raptors, a stand-watch survey for short-eared owl, and collection of incidental sightings.

Potential Residual Effects	Proposed Mitigation Measures
Klaza caribou herd reduced habitat availability within the winter range	• Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) • Implementing a policy to ensure caribou approaching the road are given the right-of-way • Implementing snow bank management measures to facilitate caribou movement across the roadway • Designing road embankment heights and materials to allow for caribou movement • Placing construction camps and borrow pits to minimize or avoid disturbance to the KCH
Moose habitat loss	• Manage roadside vegetation along Project roads to discourage moose foraging
Reduce moose movement	• Designing pipeline to allow moose movement over or under

Potential Residual Effects	Proposed Mitigation Measures
Increased caribou mortality due to collisions with vehicles	• Installing signage that warns drivers of known caribou crossing or foraging areas along the road • Reducing speed limits where caribou interact with the road • Enforcing road speed limits by remotely tracking truck traffic • Snow plowing escape routes • Reporting and investigating all Project-related caribou near-misses and mortalities • Triggering adaptive management strategies if there is a Project-related caribou mortality
Increased Caribou mortality from harvest	• Managing the Freegold Road Extension as a private resource road • Decommissioning the Freegold Road Extension during the closure and decommissioning phase • Development of a wildlife management planning group including regulators, First Nations governments and stakeholders
Grizzly bear denning habitat loss	• Avoid active den sites during the denning season (November to May) • Avoid blasting within 500 m of active bear dens
Grizzly bear mortality	• Incorporating Best Management Practices for food, waste and fuel management into the design on the Project
Collared pika habitat loss	• General mitigation measures that aim to reduce the Project footprint and unnecessary sensory disturbances
Passerine and Bird Species at Risk habitat loss	• Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands
Cliff Nesting Raptors Nest-site Effects	• Nest-specific management plans within 500 m of the potential disturbance area, wherever possible, a 500 m no-disturbance buffer around nests
Waterfowl health effects	• Water quality monitoring, and if necessary, potential water quality mitigation, wildlife monitoring of tailings, and wildlife deterrence

MONITORING

The following programs will be initiated for the wildlife VC:

- Monitoring studies for caribou, moose, and grizzly bear to assess response to Project roads and road traffic
- Caribou, moose, and grizzly bear monitoring to determine distribution within the zone of influence
- Facility-wide monitoring for the presence of collared pika throughout the life of the Project
- Annual occupancy and productivity surveys of known cliff nests within 500 m of the potential disturbance area through the life of the Project to facilitate nest site management
- Water quality monitoring to document contaminant levels in contact water ponds

CUMULATIVE EFFECTS

Effects on habitat loss or reduced habitat effectiveness and increased mortality risk have the potential to overlap in time and space with other projects in the RSA, including past and ongoing quartz exploration, past and ongoing Placer mining, active and historic quartz mines, and harvesting activities. Residual effects on restrictions to movement and reduced waterfowl health are not expected to be measurable. Managing the cumulative effect of increased mortality risk to wildlife will need to have a multi-party approach that includes CMC, other stakeholders, communities and First Nation Governments. CMC will support the Yukon Government Environment and affected First Nations wildlife harvest management initiatives in the Project area but does not have the ability to manage the public's ability to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RSA.

KEY FINDINGS

The assessment suggests that the effects of the Project are Not Significant on the Klaza caribou herd. The effect of the Project on late winter moose habitat availability is not significant at the scale of the moose RSA, as the loss is less than the identified low threshold. The Project roads and water pipeline will act as filters to moose movement; however, mitigation measures and Project design features will be implemented. Residual effects of the Project on moose mortality at the population level are not expected. Project-related mortality will be minimized through proper food and garbage management, implementation of wildlife Right-of-Way and No Hunting Policies, and by restricting access on the Freegold Road Extension. Residual Project effects on grizzly bear mortality are not expected. By reducing the Project footprint and avoiding known pika habitat where possible, effects to collared pika habitat can be minimized. Project-related effects to habitat for passerines and bird species at risk is limited to the LSA, and within the LSA, direct habitat loss for all passerines and bird species at risk is estimated as less than 10%. The Project is not expected to have population-level effects on cliff-nesting raptors but could affect a few known nest sites in close proximity to Project infrastructure. Adverse health effects to waterfowl could result from the use of Project water bodies, particularly the TMF during closure and post-closure; however, residual effects are Not Significant at the population level.

There will be a cumulative loss of habitat in areas that cannot be reclaimed entirely to pre-Project conditions. However, given the scale of the range of moose and Klaza caribou, cumulative loss can be mitigated by the collective actions of individual project proponents, which could include minimizing/mitigating disturbances to wildlife and reclaiming key habitats. It is unlikely that there will be large-scale anthropogenic disturbances that reduce population viability as a result of habitat loss. The Project's adverse effects on wildlife mortality risk could be combined with the potential adverse effects of other past, present and future projects and have an overall cumulative effect on regional wildlife mortality; however, it is unlikely that Project-specific mortalities will be the cause of a significant effect on populations. Given that tools are available to wildlife managers to manage human-related mortality, the cumulative effect on wildlife mortality is Not Significant.



COMMUNITY VITALITY

SCOPE OF ASSESSMENT

Potential population changes are important in determining community character and demands on infrastructure and services. Population changes and new Project-related income could also affect the well-being of individuals, families, and communities in the area. The key indicators used to assess the VC are Population and Demographics, and Community Well-being. Changes in size and characteristics of the local population affect a range of community and regional services that are driven by use levels. Therefore, the assessment of this indicator is linked to the assessment of other socio-economic VCs.



ASSESSMENT AREA

The LSA includes communities in proximity to the Project site and the proposed access route, since they represent potential sources of direct labour, goods, and services needed for the Project. The communities within the LSA include the Settlement of Pelly Crossing (Selkirk First Nation), the Village of Carmacks, the community of Little Salmon/Carmacks First Nation and the City of Whitehorse.

It is expected that some of the Project employment and economic opportunities will be experienced at the territorial level, therefore the RSA comprises the entire Yukon to provide a broader geographic context for understanding potential Project socio-economic effects.

BASELINE CONDITIONS

Populations in the communities within the LSA range from 500 in Pelly Crossing to 27,753 in the City of Whitehorse. Members of the Selkirk First Nation comprise the majority of the population in Pelly Crossing, making up approximately 80% of residents. The community of Little Salmon/Carmacks First Nation has a total reported membership of approximately 630 people, including status and non-status beneficiaries. Based on Yukon Health Care Registration data, the total population in the Village of Carmacks as of 2012 was 513 people. Little Salmon/Carmacks First Nation members comprise the majority of the population in Carmacks. Population growth is identified as a key long-term goal in the Carmacks Integrated Community Sustainability Plan, which suggests that population growth is needed to increase the ability of local governments to finance community services and infrastructure and would aid development of a thriving business environment.

Potential Residual Effects	Proposed Mitigation Measures
Population changes from out-of-territory mine workers and their dependents moving residency to RSA	• Priority hiring for qualified local residents • Employing a community liaison staff member to focus on community relationships and working with community staff on housing/planning issues related to mine staff
Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	• Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA • Implementing a procurement process that gives preference to suppliers from the RSA and LSA
Employment opportunities and increased income would reduce economic hardship of local families and lead to positive economic well-being effects	• None proposed as it is a beneficial effect
Spending decisions of additional disposable income could affect family and community well-being: Negative spending decisions would reduce family and community wellbeing (e.g., crime, addictions)	• Direct deposit option for salaries • Identify money management training opportunities to employees who do not have experience with high wage earnings. • Implement a zero tolerance policy with respect to drug and alcohol at the Project site for Project employees and contractors
Potential lack of employment and income equity for Aboriginal peoples, women, people with disabilities, and visible minorities	• Implement a hiring policy that encourages the employment of workers from rural communities within the LSA • Work with Yukon Government agencies and Yukon College to identify barriers to employment and offer training programs to improve local hire and retention of staff

Potential Residual Effects	Proposed Mitigation Measures
Influx of workers and their families could create negative behavioural changes and reduce family and community well-being if the transient population engages in socially disruptive or illegal activities	• The Project will have a self-contained camp on site to house workers • A zero tolerance policy with respect to drug and alcohol use will be implemented at the Project site for Project employees and contractors.
Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships	• Facilitate communication between workers and their families by providing phone and Internet services on-site. • Explore shift schedules that meet the needs of the operation and that are attractive to local hires.
Loss of jobs and income and potential out-migration could negatively affect family and community well-being at mine closure	• CMC will work with the community to develop a plan that identifies strategies and actions to help minimize potential adverse effects from closing the mine.

CUMULATIVE EFFECTS

The effects assessment of the Project on Community Vitality takes into consideration past and existing actions and is based on forecasts for population growth incorporating those actions. Consequently, the assessment is already cumulative in nature.

KEY FINDINGS

The overall effect of the Project on Community Vitality is anticipated to be beneficial, since attracting and retaining skilled residents has been identified as a priority of the Yukon and some community governments. The magnitude of the change is expected to be low when considered in a regional context, therefore presenting a manageable challenge to the existing social structure. Yukon residents, and in particular LSA residents, are familiar with the cyclical nature and work schemes of the mining industry and also with the challenge of dealing with a rapidly growing population and can expect to be highly resilient in managing change. In general, the effects on community well-being from the Project are anticipated to be Not Significant.

Although some potential family and community well-being effects from construction and operations have the potential for adverse consequences, the net effects are expected to be slightly positive because Project-related employment incomes will reduce family economic hardship and enhance quality of life. The proposed mitigation and monitoring measures are anticipated to be effective as long as CMC, communities, and governments cooperate in management initiatives.

Direct income earned during the Project will reduce economic hardship and will also contribute to the retirement income of the workforce during operations and extend benefits beyond the operation phase of the Project. Investment in training and capacity-development will improve the employability of local residents to pursue higher-paying jobs after closure.






COMMUNITY INFRASTRUCTURE AND SERVICES

SCOPE OF ASSESSMENT

Community Infrastructure and Services was selected as a VC based on discussions with the public, First Nations, local communities, and government stakeholders. The potential effects of the Project on the VC are related to an increased demand on existing infrastructure and services as employees and their families move into the region. Six key indicators were used to focus the assessment on the VC: Municipal Infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities); Housing; Transportation; Educational Services; Health and Social Services; and Protective Services.



ASSESSMENT AREA

The LSA includes communities in proximity to the mine site and the access route, since the communities represent potential sources of labour, goods, and services needed for the Project. The communities within the LSA include the Settlement of Pelly Crossing (Selkirk First Nation), the Village of Carmacks, the community of Little Salmon/Carmacks First Nation and the City of Whitehorse. Employment and economic activities associated with the Project could extend to the territory as a whole, therefore the RSA encompasses the Yukon.

BASELINE CONDITIONS

Baseline conditions were compiled using primary and secondary data sources. Primary data sources were one-on-one interviews conducted primarily in 2012 and 2013 with representatives from the Yukon government, City of Whitehorse, Whitehorse and Yukon Chambers of Commerce, Yukon Mine Training Association, the Yukon Housing Corporation, Wildland Fire Management, Energy Mines and Resources, Whitehorse International Airport, Selkirk First Nation (SFN), Little Salmon/ Carmacks First Nation (LSCFN), the Village of Carmacks, Carmacks Renewable Resource Council, and Tantalus School. Primary information was also gained from community meetings. Data were also collected from secondary sources such as Statistics Canada, Yukon Bureau of Statistics, Canada Mortgage and Housing Corporation (CMHC), Yukon Health Care Review Committee, Official Community Plans, and civic and municipal websites.

Potential Residual Effects	Proposed Mitigation Measures
Population change (influx of up to 645 people) will alter demand for municipal infrastructure.	• Provide a fly in/fly out camp to offset the demand on municipal infrastructure • Employ a community liaison staff member to work with community staff on infrastructure and services/planning issues related to mine staff
Population change (influx of up to 645 people) will create additional demand on housing and temporary accommodation, health and social services, protective services, air transportation infrastructure	• Implement priority hiring for qualified local residents • Camp will partially offset demands on regional health services • On-site security services • Require employee compliance with company policy on drug and alcohol use and safe and secure workplace procedures • Stagger work rotation schedule to minimize airport and passenger congestion
Project hiring requirements will increase incentive for educational attainment, which in turn will increase demand for education training services	• Provide support programs and initiatives at local schools and Yukon College • Implement a Recruitment, Training, and Employment Plan
Transport of equipment, services, and materials will increase road traffic and the risk for motor vehicle collisions, increased demand on first responders, increase the risk of spills	• Implement Environmental Management Plans, including Road Use Plan • Control speed limits • Perform regular vehicle maintenance and regular road maintenance to reduce risk to motor vehicle safety
Accidents at worksite could increase demand for regional health services and emergency services	• Compliance with Environmental Health and Safety Management System • Health and medical equipment and personnel will be on site • Trained personnel and firefighting equipment will meet all on-site fire and rescue needs
Road extension and upgrades will improve transportation infrastructure for other users	• Beneficial effect – no mitigation required • A 24/7 staffed security gate at the start of the Freegold Road Extension will control access to permitted users

CUMULATIVE EFFECTS

The effects assessment of the Project on Community Infrastructure and Services takes into consideration past and existing actions and is based on forecasts for population growth incorporating those actions. Consequently, the assessment is already cumulative in nature.



KEY FINDINGS

The effects of an incremental increase in demand on Community Infrastructure and Services associated with in-migration of Project employees are considered to be Not Significant.

The housing market will be able to react to new housing demand given the large number of serviced lots either already purchased by developers or available to the public. The key residual effects of the Project are anticipated to be slightly increased demand for protective services (ambulance services, first responders, and police) and health care services, since any ill or injured mine workers will be transferred to the nearest health care centre capable of providing the required treatment. These effects are considered Not Significant because of their relatively low magnitude and proposed mitigation. Finally, there will be an enhancement of workforce experience and skills base resulting from additional training provided.

EMPLOYMENT AND INCOME

SCOPE OF ASSESSMENT

Employment and Income was selected as a VC based on discussions with the public, Aboriginal groups, local communities, and government stakeholders. The potential effects of the Project on the VC are related to labour availability in the study communities and their ability to meet Project labour demands and the direct, indirect and induced local employment and employment income derived from the Project.



ASSESSMENT AREA

The LSA includes communities in proximity to the mine site and the access route, since the communities represent potential sources of labour, goods, and services needed for the Project. The communities within the LSA include the Settlement of Pelly Crossing (Selkirk First Nation), the Village of Carmacks, the community of Little Salmon/Carmacks First Nation and the City of Whitehorse. Since potential effects associated with the Economic Development and Business Sector VC, such as changes to economic growth, business opportunities, government revenues, and employment and income, will be experienced throughout the Yukon, the RSA encompasses the territory.

BASELINE CONDITIONS

Statistics Canada information was compiled to characterize the Employment and Income levels in the communities within the LSA. Rural communities are characterized by low participation rates (the portion of the population 15 years of age and over either employed or seeking work), high unemployment rates, and low incomes compared to the City of Whitehorse. In addition to direct employment opportunities, Project operations are expected to impact Yukon's economy through expenditures on goods and services. The employment effects would depend on whether Project-related jobs are filled by residents or by non-residents; and whether non-residents relocate to the RSA or commute to work. Increased employment opportunities will positively affect labour incomes of local and regional residents. Rising incomes in one sector can shift workers into higher-paying sectors, affecting the overall industry composition of the labour market.

Casino Mining Corporation intends to employ as many people from Yukon as possible, including from First Nations communities; additional personnel from outside Yukon may be necessary to fully staff the Project during the operation phase, but CMC plans to develop a rising share of Yukon-based employees as construction moves to peak production. The assessment of economic effects in terms of quantitative estimates of employment and income were derived from Statistics Canada's 2008 Input/Output ("I-O") Model using estimates of future operational and capital spending.

Potential Residual Effects	Proposed Mitigation Measures
Project purchases would generate employment opportunities for residents	• Procurement process that gives preferences to suppliers from the RSA and in particular rural communities within the LSA
Project workforce demands would increase local and regional employment	• Providing on-the-job training to assist local and regional workers to develop mining-specific skills • Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA • Partnering with First Nation communities to access additional funding for training • Implementing career training and development opportunities for employees once hired; and providing continuous, on the job safety training
Project-related competition for local labour may result in shortages in other sectors and industries	• Work with closing mines to transfer workers; • Target unemployed for trainable positions

CUMULATIVE EFFECTS

The assessment of potential Project effects on employment and income was conducted in the context of all past and existing economic activity, as well as forecasts industry employment that take into consideration other proposed and anticipated development projects and activities. Consequently, the effects assessment of the Casino Project is inherently cumulative.



KEY FINDINGS

Employment and income effects from the Project would be beneficial, amounting to 5.6% of Yukon's workforce and raising incomes by an average of 6.9%. These effects would be expected to reduce the unemployment rate in the RSA, increase participation, and increase the rate of migration into Yukon.

Local effects in rural LSA communities would be Beneficially Significant, given the very high baseline rates of unemployment, low overall populations, and the commitment of CMC to work with First Nation leaders to maximize local recruitment, training, and advancement within the Project workforce.

EMPLOYABILITY

SCOPE OF ASSESSMENT

The Project will require substantial amounts of labour with different skill levels during the construction and operation phases, and meeting labour demand is expected to require substantial investments in training and capacity-development. Employability was selected as a VC because changes in an individual's ability to obtain employment affect the well-being of the individual, families and communities. The key indicators used to assess Employability are Experience and Educational Level. These indicators can extend past Project closure and decommissioning and can be transferred to other activities or areas.



ASSESSMENT AREA

The LSA includes communities in proximity to the mine site and the access route, since the communities represent potential sources of labour, goods, and services needed for the Project. The communities within the LSA include the Settlement of Pelly Crossing (Selkirk First Nation), the Village of Carmacks, the community of Little Salmon/Carmacks First Nation and the City of Whitehorse. The RSA encompasses the Yukon.

BASELINE CONDITIONS

Employment figures and education levels were obtained from secondary sources and used to characterize the communities in the LSA. Considerable differences were noted in educational attainment between rural and urban areas: fewer adults had any educational certificate, diploma, or degree in the communities of Pelly Crossing and Carmacks compared to Whitehorse. In addition, census data for the rural communities indicates that few residents have any resource industry experience. However a small proportion of the workforce is employed in trades, transport, and equipment operation as well as in primary industries which indicates that a sizable share of the labour force may be gaining experience in areas relevant to the needs of the mining sector. Whitehorse was found to have a diversified industrial workforce with experience in resource-based industries, trades, transport, heavy equipment operation and related maintenance.

Potential Residual Effects	Proposed Mitigation Measures
Improved capacity and industry experience of contractors	• Procurement process that gives preference to suppliers from the RSA and LSA • Contractors would be encouraged to hire local/regional/territorial residents to the extent practical
Employment opportunities will increase incentive for educational attainment and training of local residents; training programs during operations would enhance the local and regional skills profile and employment levels, and project employment will improve capacity and industry experience of workers	• Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical

CUMULATIVE EFFECTS

The effects assessment of the Project on employability takes into consideration past and existing projects and activities and is based on cumulative labour market forecast for Yukon's mining industry. Consequently, the assessment is inherently cumulative in nature.



KEY FINDINGS

Existing mines in Yukon depend on a high percentage of non-resident workers, amounting to roughly half of the workers. Casino Mining Corporation has set a target of obtaining 80% of their production workforce from regional workers by 2024. In order to achieve this objective, the company plans to work cooperatively with the Yukon College Centre for Northern Innovation in Mining in developing and delivering training programs that would serve the needs of the Project, as well as other mining operations in Yukon. Work will also be required with other government departments and the communities towards ensuring appropriate services are in place to attract and retain Yukon-based employees. Skill attainment and upgrading in the RSA would represent a sustained and substantial benefit for the employability of the region's workers. The effects would be particularly important for low-skilled workers in rural communities within the LSA that face high levels of unemployment. In general, the residual effects of the Project on Employability is anticipated to be Beneficially Significant.

ECONOMIC DEVELOPMENT AND BUSINESS SECTOR

SCOPE OF ASSESSMENT

The Project will require substantial amounts of staff, contracted employment, and procured goods and services in order to meet the demands of construction, operations, and closure and decommissioning. Economic Development represents a means to raise the livelihood of residents and has the capacity to fund public services associated with human development and social progress. Project effects on the Business Sector represent a direct and tangible form of regional participation in the long-term benefits arising from the Project. The Economic Development and Business Sector VC is assessed using the key indicators of Economic Growth, Business Opportunities, and Government Revenues



ASSESSMENT AREA

The LSA includes communities in proximity to the mine site and the access route, since the communities represent potential sources of labour, goods, and services needed for the Project. The communities within the LSA include the Settlement of Pelly Crossing (Selkirk First Nation), the Village of Carmacks, the community of Little Salmon/Carmacks First Nation and the City of Whitehorse. The RSA encompasses the territory.

BASELINE CONDITIONS

Secondary information sources (Whitehorse Chamber of Commerce, Yukon Chamber of Mines) were reviewed to characterize the regional economy and business climate. Yukon's economy has consistently grown over the past nine years to varying degrees, with a peak growth of 8.7% in 2008. The growth rate was less than 1% for 2013; however, the forecast for 2014 is for a return to rapid expansion due to increased mineral production, mining development expenditures, and large capital projects planned for the year.

Whitehorse-based businesses and services related to the mining industry include communications, catering, and camp services; drilling and heavy equipment operations; engineering, environmental, and geological consulting; expediting, logistics, and transportation; and Aboriginal and community engagement consulting.

The assessment of economic effects, in terms of quantitative estimates of economic growth and some elements of government revenue were derived from Statistics Canada's 2008 Input/Output Model using estimates of future operational and capital spending.

Potential Residual Effects	Proposed Mitigation Measures
Project purchases of goods and services and workforce demands would increase Yukon GDP and employment	• Contractors would be encouraged to hire local/regional residents to the extent practical. • CMC would seek to recruit local/regional/territorial residents to the extent practical
Increased use of the public portion of the Freegold Road may occur	• None
Re-spending by households of additional income derived directly or indirectly from the mine employment will increase economic activity and businesses	• CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.
Project purchases will create contract and business opportunities across the Yukon	• CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.
Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues	• CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes. • CMC would seek to recruit local/regional/territorial residents to the extent practical.
During operations Project will pay royalties / Yukon Mining Tax to Yukon	• None
Additional direct and indirect taxes paid by Project employees will increase government revenues	• CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes • CMC would seek to recruit local/regional/territorial residents to the extent practical

CUMULATIVE EFFECTS

The assessment of potential Project effects on the Economic Development and Business Sector VC was conducted in the context of all past and existing economic activity, as well as forecasts of economic growth that take into consideration other proposed and anticipated development projects and activities. Consequently, the effects assessment of the Project is inherently cumulative and therefore no further assessment of cumulative effects is required.



KEY FINDINGS

The assessment of potential effects on the Project in terms of economic growth, business opportunities, and government revenues found effects of construction and operations to be beneficial .

The construction of the Project is expected to occur over four years and cost a total of $2.5 billion in capital expenditures, increasing Yukon's GDP over that period by $363 million. During the operation phase, the Project is expected to increase GDP by $274 million, equivalent to 11.4% of Yukon's 2011 GDP of $2.4 billion. Government revenue from the Project is forecasted to amount to $219 million annually over the operation phase, of which $61.1 million annually is expected to be raised through the Yukon Mining Tax. Revenues for the Government of Yukon are estimated to amount to 7.4% of Yukon's 2012 overall revenue. The magnitude of this increase in resource revenue would be sufficient to change the nature of the funding arrangement between the federal and territorial governments, allowing a greater share of resource revenues to be retained by the Government of Yukon. Residual effects on the economy post-operations would be limited to closure expenditures, which are of a relatively low magnitude and not expected to be noticeable, as well as ongoing economic returns from infrastructure investments made by CMC (notably the Freegold Road), human capital investments retained by workers (training and education), and returns from public investments funded by increased government revenue.

CULTURAL CONTINUITY

SCOPE OF ASSESSMENT

Cultural identity is based on shared behaviours, practices, beliefs, and values of a community that are gained over time. Practicing culture may include participating in local community events, speaking a local language or participating in traditional land uses such as hunting and fishing. From an Aboriginal perspective, maintaining cultural identity requires the use of land for harvesting traditional resources, opportunities to transfer traditional knowledge and skills, and speaking the local language. From a Yukon or northern lifestyle perspective, recreational hunting, fishing, and gathering are culturally important. The Cultural Continuity VC assesses the potential effects of the Project on the ability of a community or individual to sustain their cultural identity through access to resources that support cultural retention and opportunities to participate in cultural activities. The key indicators used to assess this VC were Language (specifically local First Nations languages); places of historical, cultural, and archaeological value; social, community, and cultural events; subsistence and recreational harvesting; and Traditional knowledge.



ASSESSMENT AREA

The LSA boundaries for the Cultural Continuity VC vary by indicator. For the VC indicators of language, and social, community and cultural events, the spatial scale includes the Community of Pelly Crossing and Selkirk First Nation, the Village of Carmacks and Little Salmon/Carmacks First Nation, and the City of Whitehorse, the communities closest to the Project site and its proposed access route. The LSA used to describe effects on VC indicators that are related to land uses is comprised of a 500 m buffer around the entire Project.

The RSA also varied with VC indicator. For the language and social, community and cultural events, the RSA comprises Yukon to provide a broader geographic context for understanding how the Project and other future foreseeable projects in the region could affect these cultural continuity indicators. For places of historical, cultural, and archaeological value, traditional knowledge, and subsistence and recreational harvesting the RSA is based on defined Game Management Areas (GMAs) and provides a representative buffer around the Land Use.

BASELINE CONDITIONS

Secondary sources such as census data were primarily used to compile the baseline information on the VC indicators; the sources were supplemented with some first-hand information. There is a potential for a direct loss or disturbance of areas that are used for cultural purposes such as subsistence hunting, as well as a change in local ambience that could detract from the area from being used for cultural activities.

Potential Residual Effects	Proposed Mitigation Measures
Some sites of historical, cultural and archaeological value may be displaced or destroyed by the Project	• Avoidance of sites • Adherance toHeritage Management Plan • Adherance to Access Management Strategy
Loss of or decreased area for recreational or subsistence hunting and plant harvesting	• Reclamation and Closure Plan • Compact Project footprint
Improved access for recreational and subsistence harvesting	• Project employees and contractors will be restricted from hunting and fishing while on the job at any time
Temporary loss of road access during construction	• Traffic Management Plan (in conjunction with Government of Yukon, SFN, and LSCFN) • Communications Plan (ensuring ongoing communications with First Nations)
Increased noise, emissions and traffic may affect the wilderness experience	• Implement Environmental Management Plans and a Communications Plan • Maintain equipment; install sound buffering on equipment and in buildings
Increased local employment may result in reduced participation in cultural activities (language, community events, harvesting activities)	• Support efforts to revitalize Northern Tutchone language and incorporate Northern Tutchone language into mine signage as appropriate • Allow shift flexibility to accommodate Aboriginal community and cultural events, deaths, illnesses • Incorporate Aboriginal ceremonies at the mine site in consultation with the SFN and LSCFN • Support community cultural events based on input from SFN and LSCFN and other local communities • Conduct cultural awareness training for all employees and contractors working at the mine site.
Abundance and availability of plant/animal resources available for cultural activities and harvesting	• Project employees and contractors will be restricted from harvesting within the mine footprint while on the job at any time; • Implement an Access Management Plan.

CUMULATIVE EFFECTS

Cumulative effects on the VC could accrue through increased placer and quartz staking and exploration activities due to the improved access associated with the upgrade and extension of Freegold Road. Additional mitigation measures recommended to manage cumulative effects include collaborative (First Nation and Government of Yukon) decisions about permitting access to new placer and quartz claims, and monitoring traffic along Freegold Road. With these mitigation measures in place, the significance of the residual cumulative effect was considered Not Significant.

KEY FINDINGS

The Cultural Continuity VC assesses the potential effects of the Project on the ability of a community or individual to sustain their cultural identity through having access to resources that support cultural retention and opportunities to participate in cultural activities. From an Aboriginal perspective, this includes the use of land for harvesting traditional resources and engaging in related traditional practices such as opportunities to transfer traditional knowledge and skills, and speak Aboriginal languages. From a Yukon or northern lifestyle perspective, recreational hunting, fishing, and gathering are culturally important. This is evident by the high proportion of residents participating in subsistence and recreational hunting.

No residual effects on language; places of historical, cultural, and archaeological value; and social, community, and cultural events are anticipated. Some residual effects were identified for recreational and subsistence harvesting (hunting, trapping, fishing, and plant harvesting) as a result of loss of the land base and increased pressure resulting from changes to access to the region. Additional residual effects to recreational and subsistence harvesting are expected to result from increased noise and air emissions from mining activities at the mine site and traffic along Freegold Road. The loss of area directly for harvesting associated with the Project footprint is determined to be relatively minor when compared to the total available area in the region for this activity. Access for First Nations recreational or subsistence harvesters will be not adversely affected for the majority of the LSA and to most areas of their traditional territories. The exception will be at the mine site itself where no hunting, trapping, fishing or plant harvesting will be permitted and road access will be restricted to permitted users beyond the security gate on the Freegold Road Extension. The ability of a community to continue to convey or acquire Traditional knowledge is tied to the ability of that community to speak their own language, to visit and use sites of historic/cultural importance and to the participate in community, social and cultural events. Overall, the residual effects of the Project on Cultural Continuity VC is Not Significant.



LAND USE AND TENURE

SCOPE OF ASSESSMENT

The Land Use and Tenure VC examines the potential interactions of the Project on other land users in the area. Key indicators used to assess the Land Use and Tenure VC are: First Nation Settlement Lands; traditional and domestic use; hunting / guide outfitting / trapping; recreation and tourism; mining, prospects, exploration and mineral tenures; and transportation and access.



ASSESSMENT AREA

A 500 m buffer around the entire Project footprint was selected as the Local Study Area to ensure potential direct effects of the Project on land use are addressed. The Land Use Regional Study Area is based on defined Game Management Areas and encompasses land uses potentially indirectly affected by the Project.

BASELINE CONDITIONS

The Land Use RSA is primarily situated in the Selkirk First Nation and Little Salmon/ Carmacks First Nation Traditional Territories. In addition to hunting, trapping and fishing activities, the Selkirk First Nation and Little Salmon/Carmacks First Nation in the area participate in a variety of traditional land uses. Recreational hunting, guide outfitting and trapping take place within the Land Use LSA and RSA. Recreation opportunities in the Yukon are abundant and include boating (rafting, kayaking, canoeing), dog sledding, hiking/backpacking, recreational hunting, cross-country skiing and snowshoeing, horseback riding and mountain bike riding. Mining activities that occur in the Yukon and are present within the Project area include placer (gold), quartz (hard rock), coal, and quarries for borrow source material. The existing Freegold Road serves as a corridor for a number of placer mines and exploration in the area, and is also used for accessing hunting, fishing and gathering. Access west of the existing Freegold Road is by the Casino Trail.

Potential Residual Effects	Proposed Mitigation Measures
Loss of available area for First Nation traditional land use activities Loss of available area for quartz and placer mining Loss of available area for trapping and outfitting	• Limit mine footprint • Implement appropriate best management practices and reclamation and closure measures • Ensure ongoing communication with First Nation and local stakeholders.
Freegold Road Upgrade - Easier access to area for others whose activities may conflict with First Nation traditional land use activities; Reduced access to Traditional Territory due to Project traffic but easier access at other times for traditional land use activities; Easier access to existing tenure areas and new permitted exploration activities; Reduced access to recreational areas due to Project traffic Freegold Road Extension: No road access to area for recreational activities; Negotiated road access to area for existing trappers and guide outfitters;	• Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. • Implement access management measures and associated monitoring and communication plans. Ensure ongoing communication with First Nation and local stakeholders.
Reduced wilderness experience for First Nation traditional land use activities Reduced wilderness experience for recreational land use activities Reduced wilderness experience for trappers and outfitters utilizing the area	• Limit mine footprint • Implement appropriate EMPs (i.e. Air Quality Management Plan) and reclamation and closure measures • Ensure ongoing communication with local stakeholders

CUMULATIVE EFFECTS

Potential residual cumulative effects associated with new future exploration and mining activities along both the Freegold Road Upgrade and Freegold Road Extension could include an increase in noise levels, emissions and traffic and change in disturbed and reclaimed areas. Any residual cumulative effects would have low magnitude and be localized and reversible, and therefore would be considered Not Significant.



KEY FINDINGS

The Project has the potential to have both beneficial and negligible adverse effects on land use and tenure activities within the Land Use study area. A direct loss or disturbance of area available for other land uses is expected within the Project footprint. Following closure and decommissioning the area occupied by the Freegold Road Extension and within the mine site that will not be permanently disturbed will be available for a variety of land uses. In general, improved accessibility to the area due to the Freegold Road Upgrade will benefit existing permitted land user groups (e.g. mining exploration); however, it may also attract additional third party interest and use in the area. Traffic along the Freegold Road Extension will be strictly through individual access arrangements with tenure holders. Any change in ambiance and wilderness experience for land use activities occurring proximate to the LSA is considered Not Significant due to the remoteness of the area. Casino Mining Corporation is committed to monitoring potential effects of the Project and ensuring emerging issues are addressed in consultation with the Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nation.

EFFECTS OF THE ENVIRONMENT ON THE PROJECT

A range of environmental events have a potential to affect the Casino Project components and activities during all phases of the Project. These include:

- Seismic Activity
- Terrain Instability
- Extreme Weather Events
- Wildfires
- Climate Change

SEISMIC ACTIVITY

Seismic activity could damage Project infrastructure directly through ground shaking or indirectly through landslides. A review of the regional tectonics and historical seismicity of the Project area was carried out to determine mitigation measures that were subsequently integrated into the design for key Project components. The consequence of seismic activity on the Casino Project is anticipated to be minimal and restricted to the minor deformation of surface facilities. There would be a negligible effect on the integrity of the Project components and little, if any, effect on critical activities and timing of operations. The tailings dam and facilities will be designed to withstand extreme earthquake events and will adhere to Canadian Dam Association guidelines.

TERRAIN INSTABILITY

Terrain instability can take the form of landslides, avalanches, or permafrost degradation. Of these three forms, permafrost degradation is the dominant potential terrain instability hazard for the Project. A terrain hazards assessment was conducted at the Casino mine site and included terrain mapping, terrain stability mapping, and a permafrost hazard assessment. The Casino mine site, Casino airstrip, and Freegold Road Extension are located within a zone of widespread but discontinuous permafrost, and there is regional evidence of permafrost degradation in the Project area. CMC has used design-based mitigation measures for all potentially sensitive structures and will establish monitoring and response measures prior to construction of the Casino Project. The overall potential effects of terrain instability, in particular permafrost degradation, on the Casino Project is not considered significant.

EXTREME WEATHER EVENTS

Extreme weather events are considered to be unusual, severe or unseasonal weather at the extremes of the historical distribution. In general, the climate of the Casino Project area is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect. During the life of the Casino Project, the Emergency Response Plan and other associated environmental management and monitoring plans will define actions and procedures to ensure that human and environmental health and safety is considered in relation to potential effects on the Casino Project from extreme weather events. Although extreme weather events have the potential to occur during the life of the Project, the Casino Project has incorporated design-based measures to mitigate any potential effects.

WILDFIRES

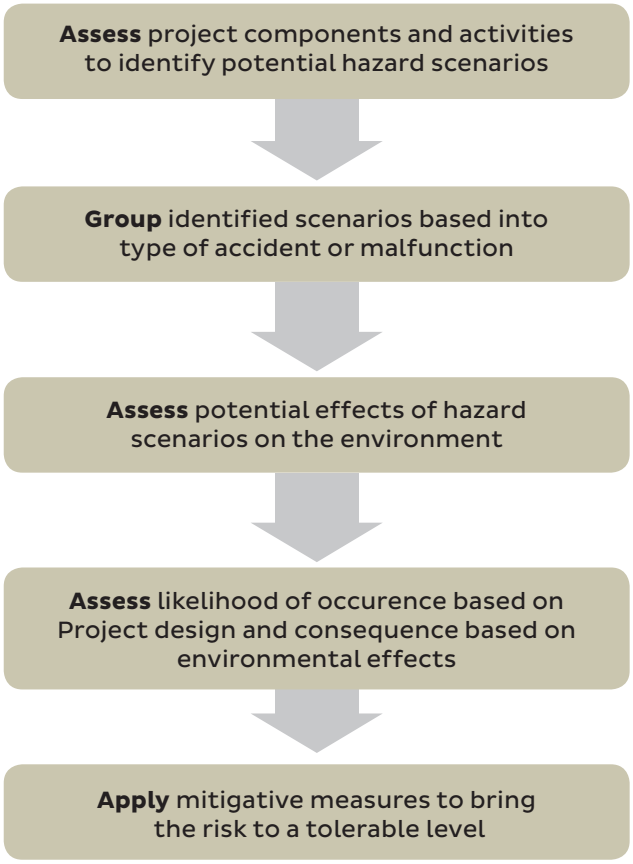
Wildfires have the potential to cause widespread damage to ecosystems and property if not contained. The potential effects of wildfires on the Casino Project include damage to onsite buildings and structures within the Casino mine site, the Casino Airstrip, Yukon River water pipeline and the access road. Based on various categories of likelihood, and taking into consideration the wildfire data provided by the Yukon Government, the overall likelihood of a wildfire event occurring that has the potential to affect the Casino Project during the life of the Project is moderate. Given the likelihood of occurrence, CMC has incorporated design based measures to avoid wildfires and minimize the potential severity and consequence to the Project. The overall potential effect of wildfires on the Project components and activities is not considered to be significant.

CLIMATE CHANGE

Climate change reflects abnormal variations to the expected climate, and is most commonly associated with increasing temperatures. A preliminary assessment of potential climate change effects was conducted for the Casino Project. Historical trends were compared to global climate models developed for the Intergovernmental Panel for Climate Change in order to assess a full range of possible climate change scenarios for the Project. It is believed that current climatic and hydrologic records provide an appropriate basis for assessing the general conditions in the Project area over the expected life of the mine.

ACCIDENTS AND MALFUNCTIONS

Accidents and malfunctions are unplanned events that may be caused by design failure, equipment malfunction, or human error. Potential accidents or malfunctions associated with the Project components were assessed for all Project phases. Typical risks associated with mining developments include transportation accidents resulting in fuel or chemical spills, tailings line rupture or release, and tailings impoundment or spillway failure. The method used to assess the significance of potential accidents and malfunctions follows the general approach and framework of a Failure Modes and Effects Analysis (FMEA). The purpose of a FMEA is to assess the risk of failure in a process and identify the most important areas for improvement. A qualitative risk assessment was conducted for the Casino Project in order to identify all components or activities and potential hazard scenarios that could pose a risk to the Project VCs.



Professional judgment and experience was used to identify potential accidents and malfunctions associated with each of the major Project components and activities and resulting hazards that were determined to be credible. A Risk Register, which is a tool used to record details of all risks identified for a component or activity, was developed for the Casino Project and includes 61 potential accident or malfunction hazard scenarios.

Credible Hazard Scenarios

- Embankment failures
- Slope failures
- Spills or leaks
- Transportation accidents
- Water conveyance and storage systems failure
- Fires and explosions
- Failure of erosion and sediment control measures
- Reclamation measures failure

The Casino Project considered site-specific geotechnical, hydrogeological and hydrometeorological characteristics in developing the feasibility level design to minimize the likelihood of any potential accidents or malfunctions. All construction, operation, closure and reclamation activities will be closely governed by environmental management and monitoring plans, including an Emergency Response Plan, to ensure that the consequences of any accidents or malfunctions, should they occur, are minimized and remediated. Based on the likelihood and consequence ratings, none of the accidents or malfunctions were considered to have a significant impact on any of the Project VCs.

ENVIRONMENTAL MANAGEMENT PLANS

Casino Mining Corporation is committed to conducting its operations and activities in a manner that protects the natural and social environments, protects the environmental health and welfare of its employees and contractors, meets or exceeds requirements of all applicable environmental acts, regulations and permitting requirements, and keeps employees and the public informed about its environmental plans through its internal and external communication programs.

The following conceptual Environmental Management Plans (EMPs) have been developed for the Casino Project:

- Waste Management Plan;
- Hazardous Materials Management Plan;
- Wildlife Management Plan;
- Spill Contingency Management Plan;
- Erosion and Sediment Control Management Plan;
- Occupational Health and Safety Management Plan;
- Heritage Resource Protection Plan;
- Air Quality Management Plan;
- Road Use Management Plan; and
- Metal Leaching / Acid Rock Drainage Management Plan.

The overarching goal of the EMPs is to demonstrate operational procedures and Best Management Practices to minimize adverse effects to the environment and employee and public health and safety, and ensure the stability of Project facilities and infrastructure.

CONCLUSIONS

The development of the Casino Project Proposal has relied upon many years of study, analysis, interpretation, and consultation in order to present findings with a high degree of understanding. The content and format of the Proposal was guided by input from YESAB, as well as from First Nations and other stakeholders.

Fourteen Valued Components were identified and assessed with due consideration of the temporal and geographic boundaries. Wherever possible, impacts to each VC were eliminated or reduced through Project design. Where this proved unfeasible, mitigation was proposed such that none of the identified residual adverse effects were assessed as Significant. An analysis of potential Accidents and Malfunctions likewise revealed no areas of High Risk to any of the identified Valued Components.

Several positive effects were identified, including employment opportunities with an expected $43 million in annual wages during operations. It is anticipated that during operations, approximately $274 million of the Yukon GDP will be generated by the Casino Project.

Casino Mining Corporation believes that the Project will be developed and operated in an environmental and socially acceptable manner. As the Project progresses, CMC will uphold its commitments to undertake comprehensive monitoring and management to ensure avoidance of unacceptable Project effects.



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1 – INTRODUCTION

1.1 PROJECT OVERVIEW

Casino Mining Corporation (CMC) proposes to develop the Casino Project (the Project) 150 km northwest of Carmacks and 300 km from Whitehorse. The Project is designed to process approximately 120,000 t/d or 43.8 million t/y of copper and gold ore over a 22 year mine life. During the life-of-mine operations, the Casino Project will produce an anticipated 5.72 million ounces of gold, 30.26 million ounces of silver, 3.58 billion pounds of copper, and 325 million pounds of molybdenum.

Access to the project area is gained from Whitehorse via a network of existing paved highways linking Northern British Columbia and the Port of Skagway in Alaska. From Whitehorse, the paved Klondike Highway (Yukon Highway 2) affords access to the Village of Carmacks. From Carmacks, the access will follow for approximately 83 km on the existing gravel Freegold Road, which will be upgraded to accommodate Project requirements, referenced herein as the Freegold Upgrade. At the terminus of the Freegold Road, an extension (referenced as the Freegold Road Extension) will be constructed to provide all-weather gravel access over the approximate 120 km to the Project, generally following the existing and historic Casino Trail alignment.

Ore will be removed from the Open Pit and will then be hauled by truck and delivered to one of two ore processing facilities at the Casino mine site, one for sulphide ore and one for oxide ore. The sulphide ore processing facility will produce mineral concentrates of copper (which also contains gold) and molybdenum using conventional flotation technology. The oxide ore processing facility will produce gold and silver doré bars via heap leaching and carbon adsorption technology.

Located southeast of the Open Pit within the valley formed by the headwaters of Casino Creek, the Tailings Management Facility (TMF) will act as storage for all waste rock, process tailings, and process water from the operations. Storage for a volume of 947 Mt of tailings and 658 Mt of potentially reactive waste rock and overburden materials is considered in the design of the TMF.

1.1.1 Project Location

The Project is situated at latitude 62°44'N and longitude 138°50'W in western central Yukon and sits in the northwest trending Dawson Range mountains 300 km northwest of Whitehorse. The Project is located on crown land administered by the Yukon government. It is within the Selkirk First Nation's traditional territory. The Freegold Road Extension crosses into the Little Salmon/Carmacks First Nation traditional territory to the south of the Project. The Property is in the Yukon Environmental and Socio-economic Assessment Board (YESAB) Central Yukon Assessment District, with the designated office located in Mayo.

The Casino Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern BC, and within the Klondike Plateau ecoregion. There are no parks or protected areas in the vicinity of the mine site or access roads.

1.1.2 Project Key Components

1.1.2.1 Principal Project

The main components of the Project are the Open Pit, the TMF, the processing facilities, the heap leach pad, temporary stockpiles, and associated mine infrastructure components.

The final (end of mine) Open Pit footprint will cover approximately 300 ha between the headwaters of Casino Creek and Canadian Creek and is comprised of the Main Pit and the West Pit. Each of these pits will be developed largely concurrently during the operations phase.

In order to facilitate reclamation at closure, the TMF is designed to protect the regional groundwater and surface waters throughout the Project area. The final (end of mine) TMF footprint will cover approximately 1,120 ha. The embankment forming the TMF will be developed in stages using a combination of suitable non-reactive overburden, cyclone sand, and waste rock materials.

The two processing plants (one for sulphide ore and one for oxide ore) along with the Heap Leach Facility (HLF) will cover approximately 101 ha at the end of mine. The HLF will be formed approximately 1 km south of the Open Pit and is anticipated to store approximately 157.5 million tonnes of oxide ore.

Oxide “gold” ore, low grade ore, supergene oxide ore, sulphide coarse ore, topsoil, and overburden will be stored in temporary stockpiles.

Ancillary support facilities including power generation and distribution, fuel storage and distribution, an accommodation camp, offices, laboratory, warehouse, truck shop, service roads, water supply and distribution, wastewater treatment and disposal, and communications infrastructure will also be included in the Project footprint.

1.1.2.2 Freegold Road Upgrade

The existing Freegold Road is the property of the Yukon Government and begins at the Village of Carmacks and extends approximately 83 km northwest towards the Casino mine site. The existing Freegold Road requires upgrades to make it suitable for mine traffic. In order to keep mine traffic out of the Village of Carmacks, a bypass formed by a new bridge over the Nordenskiold River and a new section of road will be required connecting the start of the Freegold Road with the Klondike Highway. Casino Mining Corporation and the Yukon Government are in discussions regarding the proposed upgrade of the existing Freegold Road segment.

1.1.2.3 Freegold Road Extension

Casino Mining Corporation proposes to construct an all-weather road from the end of the Freegold Upgrade to the Casino mine site called the Freegold Road Extension. The Freegold Road Extension will be a 120 km, two-lane, gravel resource road designed to accommodate double-trailer and tridem trucks. The completion of the Freegold Road Extension will occur prior to the operations phase of the Project, and together with the Freegold Road Upgrade will offer an all-weather access route between the Project and the Klondike Highway at the Village of Carmacks, which allows for transportation to and from Whitehorse, the Port of Skagway, and Fort Nelson.

1.1.2.4 Airstrip and Airstrip Access Road

The Project includes a new 1,600 m airstrip with a pre-engineered terminal building and an access road to facilitate employee transport to and from the Casino mine site. The airstrip is located approximately 15 km southwest of the Casino mine site. The airstrip access road consists of approximately 16 km of single lane gravel road starting from the Casino airstrip and connects with the tailings dam access road at the Casino mine site.

1.1.3 Project Economics

The proven and probable mineral reserve is estimated to be 965.2 Mt with a grade of 0.204% Copper, 0.240 g/t gold, 0.0227% molybdenum, and 1.74 g/t silver. In addition, the heap leach reserve provides 157.5 Mt at 0.292 g/t

gold and 0.036% copper. Based on these reserves, the Project is forecasted to produce the following over the 21.5 year commercial life of the mine;

- Gold – 5.72 million oz;
- Silver – 30.26 million oz;
- Copper – 3.58 billion pounds; and
- Molybdenum – 325 million pounds.

The initial capital investment for the complete development of the Project is estimated to be $2.456 billion, which includes direct and indirect costs. In addition, the total life of mine sustaining capital is estimated to be $361.7 million, which will be expended over 22 years.

The life of mine average operating cost is $8.52 per tonne for sulphide ore, which includes mining, concentrator plant and general and administrative costs. The life of mine average operating cost is $4.04 per tonne for oxide ore, which includes processing only (mining costs are included in the sulphide ore costs).

The undiscounted net income for the life of the mine after taxes equates to $6.7 billion.

1.1.4 Labour Force

Approximately 1,000 personnel will be required during the construction phase of the Project, although this number will vary both seasonally and from year to year. The workforce will be a combination of CMC employees and contracted skilled and unskilled workers. Casino Mining Corporation is expected to employ approximately 600 to 700 permanent mining personnel at the mine site during the remaining phases of the Project. An additional 100 to 200 contractor support personnel will be on site throughout all phases of the mine life.

Casino Mining Corporation intends to employ as many people from the Yukon (including First Nations communities) as possible. However, additional personnel from outside the Yukon will be necessary to fully staff the Project.

1.1.5 Project Benefits and Rationale

The Project has the ability to boost the economy in several ways, including employment, revenues, and royalties. The benefits of the Project will extend beyond CMC to stakeholders including local communities, First Nations groups, and Yukon as a whole by stimulating economic growth and creating local direct and indirect employment.

The Project will add value to many industries while minimizing effects to the environment. A key objective of the Project is to minimize environmental impact and to leave the mine site in conditions as close to baseline as possible. This key consideration has guided the design of mine components such as the heap leach facility, which has been optimized to minimize environmental impacts.

During construction and operation, the Casino Project will generate a Gross Domestic Product (GDP) of $9.678 billion (6.4 billion in the Yukon - the equivalent of 13.6% of the Territory's $2.7 billion nominal GDP in 2011). The mine is expected to create total employment of 23,893 full-time equivalents FTEs () and to generate $1.131 billion in wages and salaries. Federal taxes should total $936 million, Yukon Territorial Taxes and Royalties will total $2.169 billion.

Casino Project operations are expected to benefit the economy of Yukon through expenditures on goods and services, the creation of employment opportunities and the generation of tax revenues for local, territorial and federal governments. Casino Mining Corporation anticipates that roughly 69% of operational spending will occur

in Yukon; based on projected annual operational spending data, the annual GDP generated in Yukon by the operation of the Casino project is estimated at $274 million, equivalent to 10.3% of the Territory's 2011 nominal GDP of $2.7 billion (MNP LLP 2013). Operation of the mine is also anticipated to create annual employment of 855 FTEs and to generate $43 million in annual wages and salaries. Direct taxes and economic activity generated by the Project are estimated to raise $20 million annually in Federal Taxes and $81 million annually in Yukon Territorial and Provincial Tax.

1.2 THE PROPONENT

The Proponent of the Casino Project is Casino Mining Corporation (CMC), a wholly-owned subsidiary of the Western Copper and Gold Corporation, which is a Vancouver-based exploration and development company. More information is provided in Table 1.2-1.

Table 1.2-1 Proponent Information

Proponent Name	Casino Mining Corporation (a subsidiary of Western Copper and Gold Corporation)
Head Office Address	1800 – 570 Granville Street Vancouver, BC V6C 3P1
Telephone	1-604-684-9497 / 1-888-966-9995
Fax	1-604-669-2926
Email	info@casinomining.com
Website	http://www.casinomining.com
Stock Exchange	TSX; NYSE
Stock Symbol	WRN-T; WRN-Z

1.2.1 Management Structure and Experience

Casino Mining Corporation requires high standards of professional and ethical conduct from its employees. Casino Mining Corporation's reputation with its shareholders, business partners, prospective investors and other stakeholders for honesty and integrity is key to the success of its business. No employee will be permitted to achieve results through violations of laws or regulations, or through unscrupulous dealings.

Casino Mining Corporation is committed to a culture of honesty, integrity and accountability and outlines the basic principles and policies with which all employees are expected to comply. Casino Mining Corporation is also committed to operating in a responsible manner that complies with applicable laws, rules and regulations; providing a safe and healthy workplace; operating free from favouritism, fear, coercion, discrimination or harassment; and providing full, fair, accurate, timely and understandable disclosure in reports and documents filed with any governing body or publicly disclosed. Casino Mining Corporation requires its directors and officers to provide leadership and direction with respect to these principles and standards.

Casino Mining Corporation has many qualified individuals involved including:

- **Paul West-Sells – President and Chief Operating Officer:** Dr. West-Sells has 20 years' experience in the mining industry. After obtaining his Ph.D. from the University of British Columbia in Metallurgical Engineering, he worked with several companies in increasingly senior roles in Research and

Development and Project Development. Dr. West-Sells oversees the day to day operations of the company.

- **Cameron Brown – Vice President, Engineering:** Mr. Brown has over 40 years' experience in mineral processing. He is responsible for plant maintenance, project management and engineering of major base and precious metal projects.
- **Jesse Duke – Vice President, Environmental Affairs:** Mr. Duke has been actively involved in leading, managing and supporting a range of projects in the Yukon, Nunavut, Northwest Territories, British Columbia and Alaska. Mr. Duke is a long-time Yukon resident with over 25 years' experience working throughout the north in the mineral industry. He has held senior positions within Yukon Government and within the consulting industry prior to this appointment. His expertise includes managing complex multidisciplinary projects, government and First Nations relations, mineral policy, and major mine project permitting and licensing. He has extensive experience dealing the public communications, stakeholder consultations and community relations for major mining projects.

Casino Mining Corporation has been supported by a team of qualified professionals in the development of this Proposal. Details on these qualified professionals involved in preparing the Proposal are shown in Table 1.2-2. Associated environmental consulting firms include Knight Piésold Ltd., Palmer Environmental Consulting Group Inc., Lorax Environmental, Brodie Consulting, Source Environmental Associates, Marsland Environmental Associates, AMEC, Altamira, EcoFor, Environmental Dynamics Inc., and others.

Table 1.2-2 Qualified Professionals

Qualified Professionals	Areas of Expertise
Knight Piésold Ltd.	Proposal Coordination, Climate, Air Quality, Noise, Surface Hydrology, Instream Flow, Hydrogeology, Groundwater Quality, Water Quality, Terrain Hazards, Geomorphology, Engineering Support, Project Description
Palmer Environmental Consulting Group	Water Quality Baseline, Fish and Aquatic Resources, Fish Habitat Compensation
AMEC	Socio-economics, First Nations Engagement, Community Engagement, Land Use
Environmental Dynamics Inc.	Wildlife, Vegetation, Rare Plants, Soils, Terrain
Lorax Environmental	Geochemistry
Brodie Consulting	Closure and Reclamation
Source Environmental Associates	Water Quality Model
Altamira	Archaeology, Cultural Heritage
EcoFor	Archaeology, Cultural Heritage

1.2.2 Contact Information

The primary contact for the Project is Dr. Paul West-Sells, the President and Chief Operating Officer of Western Copper and Gold. Dr. West-Sells has the following contact information:

Casino Mining Corporation
1800 – 570 Granville Street
Vancouver, BC V6C 3P1
(604) 684-9497 / (888) 966-9995
info@casinomining.com

1.2.3 Sustainability

Casino Mining Corporation is committed to advancing the Project while operating in an environmentally responsible manner to conserve natural resources. The Project will be developed in a manner that respects and protects the environment while enhancing benefits to nearby communities using sound and proven technologies and industry best practices. In this respect, CMC will strive to meet or exceed the Towards Sustainable Mining Guiding Principles advocated by the Mining Association of Canada (Mining Association of Canada 2004). The principles include;

- Protecting the health and safety of our employees, contractors and communities;
- Practicing continuous improvement through the application of new technology, innovation and best practices in all facets of our operations; and
- Be responsive to community priorities, needs and interests through all stages of mining exploration, development, operations and closure.

These principles are considered vital to CMC's progress and continued development.

Casino Mining Corporation believes that establishing strong collaborative relationships with nearby communities will create long lasting benefits. Casino Mining Corporation aims to achieve this through open and transparent communication with all interested and affected parties.

Additionally, CMC will ensure that all YESAB requirements are met in the current Proposal.

1.3 BACKGROUND

In 1992, Pacific Sentinel Gold Corp. acquired the property and commenced a major drilling program as well as a significant amount of metallurgical, geotechnical, and environmental work from 1992 to 1995. In addition, a scoping study was completed in 1995. First Trimark Resources and CRS Copper Resources acquired the property in 2003 and published a Qualifying Report. The two firms then merged to form the Lumina Copper Corporation, which updated the Qualifying report in 2004. Western Copper Corporation obtained Lumina Copper Corporation along with the Casino Deposit in November 2006. By 2011, all assets other than the Casino Deposit were spun out and Western Copper Corporation became the Western Copper and Gold Corporation. The Casino Deposit was then transferred to Casino Mining Corporation, a wholly owned subsidiary of Western Copper and Gold.

Environmental baseline studies were initiated in 2007 and a new exploration camp was constructed in 2008. M3 Engineering produced a pre-feasibility study in 2008, and geotechnical drilling continued from 2009-2011. The feasibility study was published in January 2013.

Casino Mining Corporation has been actively engaging First Nations, Yukon Environmental and Socio-economic Assessment Board (YESAB), other Yukon and federal agencies, renewable resource councils, city and village leadership, and other public stakeholders since 2008. The frequency and depth of these discussions varied depending on the scale and scope of First Nations and stakeholder interest in learning more about the proposed

Project, providing input into the Project Proposal and as the status of the project changed over time. The focus of CMC's efforts has been on those First Nations and other groups which are directly affected by the project.

Casino Mining Corporation identified potentially affected First Nations and stakeholders during the early stages of the proposed Project. As consultations progressed and CMC gathered information, other First Nations and stakeholders were identified. These additional stakeholders either contacted CMC directly, were identified by CMC as the Project evolved, or were identified by others as likely to have an interest in the proposed Project.

The First Nations, governments and other stakeholders have consulted with CMC through a range of events and activities, including: Open Houses, community meetings, workshops, letters, e-mails, interviews, surveys and questionnaires, face-to-face one-on-one and group meetings, as well as through many phone calls. Discussions were carefully documented and retained for reference and consideration in the Project Proposal development.

Section 2 describes the consultations CMC has completed and includes information about the groups consulted, the activities and events completed, and description of the topics discussed. Sections 2.3, 2.4 and 2.5 describe the issues and concerns raised by First Nations, government and public, as well as how they were considered and the degree to which they have been addressed in the development of the Project Proposal and in project design and planning. Commitments are also described in these sections.

Casino Mining Corporation has met with nine First Nations and First Nations organizations and 32 stakeholder groups, including YESAB and Yukon Executive Council Office. Numerous individual Yukoners attended Open Houses but are not specifically listed as they did not mention any affiliation.

The First Nations and their Renewable Resources Councils that CMC consulted are:

- Selkirk First Nation;
- Selkirk Renewable Resources Council;
- Little Salmon/Carmacks First Nation;
- Carmacks Renewable Resources Council;
- Tr'ondëk Hwëch'in First Nation;
- Champagne and Aishihik First Nations;
- Kluane First Nation
- Nacho Nyak Dun First Nation; and
- White River First Nation.

The Yukon and federal government agencies that CMC consulted include:

- Yukon Community Services;
- Yukon Development Assessment Branch;
- Yukon Economic Development;
- Yukon Energy, Mines and Resources;
- Yukon Environmental and Socio-Economic Assessment Board;
- Yukon Executive Council Office;

- Yukon Fish and Wildlife Management Board;
- Yukon Health and Social Services;
- Yukon Highways and Public Works;
- Yukon Tourism and Culture; and
- Yukon Water Board.

The federal agencies CMC consulted include:

- Canadian Environmental Assessment Agency;
- Canadian Northern Economic Development Agency;
- Environment Canada;
- Fisheries and Oceans Canada;
- Natural Resources Canada; and
- Transport Canada.

The Yukon public stakeholders that CMC consulted include:

- Village of Carmacks;
- Carmacks School;
- Carmacks Health Centre;
- City of Whitehorse;
- Whitehorse Chamber of Commerce;
- Whitehorse Hospital;
- Yukon Tourism Industry Association;
- Yukon Conservation Society;
- Yukon Fish and Game Association;
- Yukon River Panel;
- Yukon Mine Training Association;
- Yukon College;
- Royal Canadian Mounted Police;
- Trapline holders and guide outfitters (potentially affected); and
- Local businesses.

1.4 REQUIRED AUTHORIZATIONS AND REGULATORY APPROVALS

The *Yukon Environmental and Socio-economic Assessment Act* (YESAA) is the legislation which creates the basis for assessment in all Yukon, federal, territorial, and First Nation lands in the territory. Outlining

responsibilities, requirements, and procedures for environmental and socio-economic assessment, YESAA provides guidance to the assessment process. YESAA is regulated and administered by the Yukon Environmental and Socio-economic Assessment Board with periodic revisions.

Assessment of the Project is subject to section 47(2)(c) of YESAA in accordance to the following:

> "47 (2) An activity listed under paragraph (1)(a) – and not excepted under paragraph (1)(b)—is subject to assessment if proposed to be undertaken in Yukon and if (c) an authorization or the grant of an interest in land by a government agency, an independent regulatory agency, municipal government or first nation is required for the activity to be undertaken"

Additionally, the project is subject to assessment under Schedule 3 item 3(b) of the Project Regulations, requiring an Executive Committee Screening for the construction, decommissioning, and closure of a gold mine with production capacity exceeding 300 t/day.

YESAA requirements include the following:

- Section 47(2) of YESAA requires the proponent to gain approval through authorization or a grant of an interest in land by a government agency, independent regulatory agency, municipal government, or first nations group for any activity undertaken in the Yukon Territories.
- Section 50(2) of YESAA requires a proponent to consider alternatives to the project or alternative ways of undertaking the project during the proposal stages. Consideration of alternatives and relative impacts facilitates the minimization of significant adverse environmental or socio-economic impacts. Section 42(1)(e) of YESAA directs the Executive Committee to make similar considerations in assessment.
- Section 50(3) outlines the proponent's responsibility to consult stakeholders such as First Nations and residents whose location will cause them to incur environmental or socio-economic impacts. Consultation shall be conducted by providing: notice of the matter in sufficient form and detail to allow the party to prepare its views on the matter, a time period reasonable for the preparation and organization of views, as well as an opportunity to present the views of the affected party. Following the presentation of views they must all be considered fully and fairly by the proponent.

This project will also be under the legislation of federal and territorial boundaries thus requiring many permits and approvals. A Quartz Mining Licence will be required and must adhere to the regulations of the *Quartz Mining Act* particularly as per section 135. Additionally CMC will be required to obtain a Type A Water Licence under the *Waters Act* for mine operations with use of water and deposit of waste, as well as considerations of tailings creation and storage according to the project design. The Yukon Water Board would administer this licence.

Other legislation must also be considered; federal legislation that may apply includes:

- Section 35(2) Authorization under the *Fisheries Act* (harmful alteration, disruption or destruction (HADD) of fish habitat).
- Section 36(4) Regulation or Order in Council under the *Fisheries Act (*deposit of deleterious substances).
- Section 5(2) Approval under the *Navigable Waters Protection Act.*
- Blasting Permit under the *Explosives Act and Regulations* and the *Occupational Health and Safety Act.*

Potentially applicable territorial legislation includes:

- Energy and Operating Certificates under the *Public Utilities Act.*

- Work in Highway Right-of-Way Permit, Access Permit, and Highways Hauling Permit under the *Highways Act.*
- Land Use, Quarry, and Timber Permits under the *Lands Act.*
- Air Emissions, Special Waste, and Storage Tank Systems Permits under the *Environment Act.*
- Burning Permit under the *Forest Protection Act.*
- Archaeological Sites Permit under the *Historic Resources Act.*
- Sewage Disposal System Permit under the *Public Health and Safety Act.*
- Certificate for Transport of Dangerous Goods under the *Dangerous Goods Transportation Act.*
- Building and Plumbing Permits under the *Building Standards Act / Electrical Protection Act.*
- Gas Installation Permit under the *Gas Burning Devices Act.*
- Pressure Vessel Boiler Permit under the *Boiler and Pressure Vessel Act.*
- Compliance with the *Public Health and Safety Act.*

1.5 ORGANIZATION AND LAYOUT OF THE PROJECT PROPOSAL

The Project Proposal consists of five volumes of information with numerous detailed technical appendices. The Proposal responds to the information and assessment requirements identified in the "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" (YESAB 2006a) and follows the format of this guide wherever possible.

In addition, a number of other federal and territorial documents provide guidance regarding the content of the Proposal. During preparation of the Proposal, careful attention was given to these guidance documents. For ease of reference, Table 1.5-1 contains a list of documents that were consulted during the preparation of the Proposal.

For additional clarity, Figure 1.5-1 provides a Document Map of the Proposal, which offers an "at a glance" directory of the material found in each section, within each volume, with their appurtenant appendices.

Table 1.5-1 Federal and Territorial Guidance Documents

Document	Date	Author
"Permit and Authorization Guide for Yukon Activities"	April 2013	Yukon Energy, Mines and Resources
"Rules for Screenings Conducted by the Executive Committee"	November 23, 2005	YESAB
"Filing Requirements for Project Proposals Submitted to the Executive Committee" (English)	August 27, 2013	YESAB
"Guidebook of Mitigation Measures for Place Mining in the Yukon"	April 11, 2008	Yukon Placer Secretariat
"Proponent's Guide – Water Information Requirements for Quartz Mining Project Proposals"	December 13, 2011	YESAB
"Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions"	November 2005	YESAB
"Yukon Environmental and Socio-economic Assessment Act"	May 13, 2003	Government of Canada
"Assessable Activities, Exceptions and Executive Committee Projects Regulations"	November 28, 2005	YESAB
"Decision Body Time Periods and Consultation Regulations"	November 28, 2005	YESAB
"Assessor's Guide to the Assessment of Cumulative Effects"	January 2006	YESAB
"Guide to Socio-economic Effects Assessments"	June 2006	YESAB
"First Nation Participation in Assessments"	July 2005	YESAB
"Plan Requirement Guidance for Quartz Mining Projects"	March 2013	Yukon Energy, Mines and Resources

FIGURE 1.5-1 DOCUMENT MAP

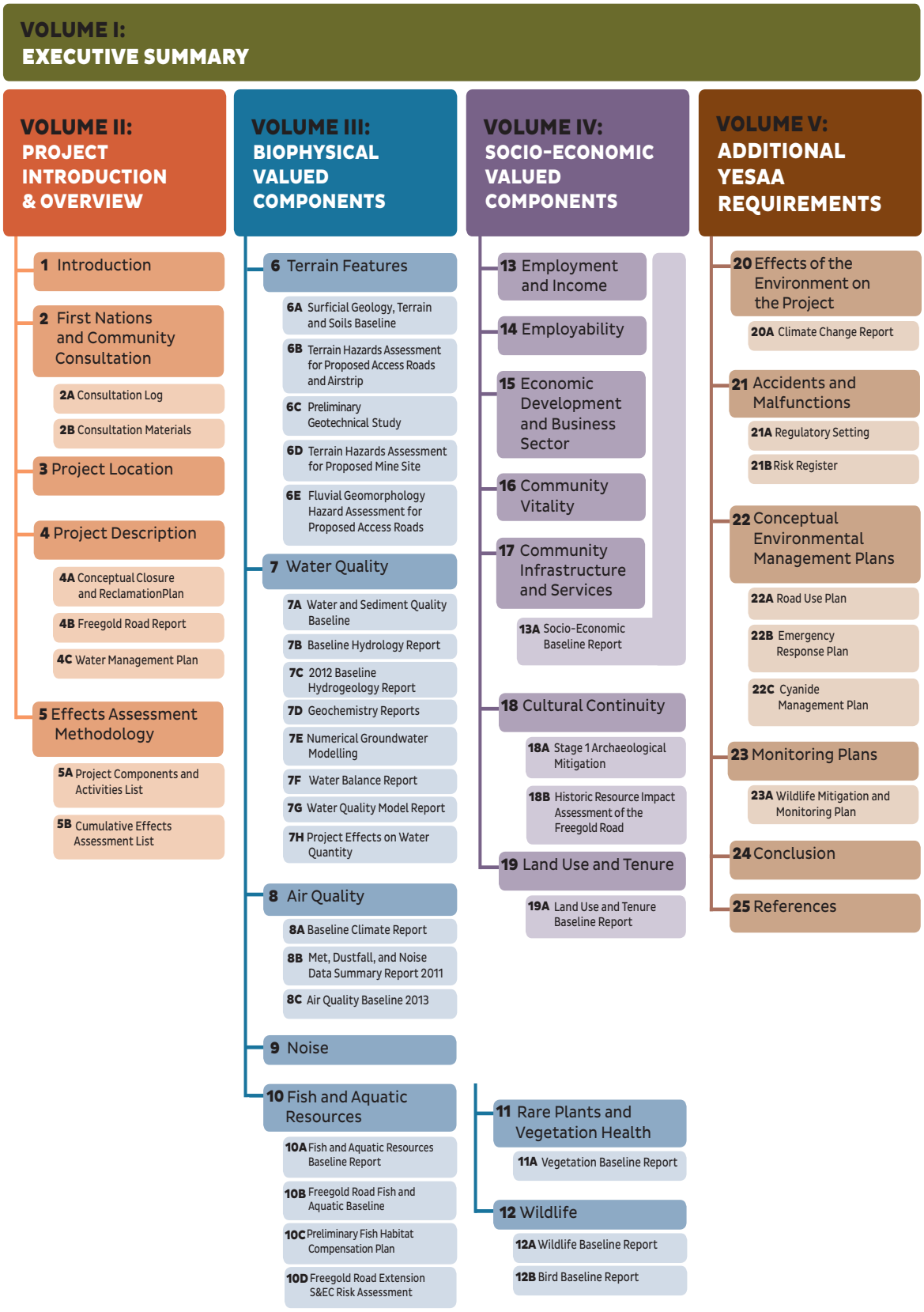


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2 – FIRST NATIONS/GOVERNMENT/PUBLIC CONSULTATION

2.1 INTRODUCTION

Casino Mining Corporation (CMC) is committed to developing and operating the Casino Project (the Project) in a safe, ethical and socially-responsible manner. Consistent with this, CMC recognizes that First Nation and stakeholder engagement are important to the success of the Project. The principles, objectives, and methods for consultation followed by CMC, the concerns raised during the course of consultations, and the measures taken by CMC to address those concerns are discussed herein.

CMC developed an approach to consultation in accordance with the Yukon Environmental and Socio-economic Assessment Board (YESAB) Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions ("Information Requirements Guide") and began to implement that approach in 2008 (YESAB 2005). Consultation activities and the provision of information about the Project have been undertaken with First Nations, the Yukon Government and Agencies, the Federal Government, and Municipal Governments. Consultation tracking was employed to compile and track consultation activities that have occurred to date and will continue to be employed into the future. A detailed log of the consultation activities that have taken place can be found in Appendix 2A.

2.1.1 Consultation Requirements

The *Yukon Environmental and Socio-economic Assessment Act* (YESAA) requires a proponent to consult with those who might be affected by its proposed activities. While First Nation and stakeholder engagement is required under YESAA, consultation also informs project design, operations, mitigation, decommissioning and closure to strengthen and improve a project.

The Project will require a proposal submitted to the YESAB Executive Committee for review. Section 50(3) of the YESAA states that "Before submitting a proposal to the Executive Committee, the proponent of a project shall consult any first nation in whose territory, or the residents of any community in which, the project will be located or might have significant environmental or socio-economic effects". The definition of consultation under YESAA requires that the parties to be consulted (First Nations, stakeholders) be provided with:

- Notice of the project and related activities in sufficient form and detail to allow the Party to prepare its views on the matter;
- A reasonable period (of time) for the Party to prepare its views; and
- An opportunity to present such views to the Party having the duty to consult (CMC).

The Party having the duty to consult (CMC) must also fully and fairly consider the views presented by the First Nation or stakeholder.

The Information Requirements Guide indicates that a Project Proposal must, with respect to consultation under YESAA, include the following:

- A list of the parties who have been provided notice of the Project;
- A detailed description of the consultation methods used to identify and inform potentially affected First Nations and community residents, including describing the form and detail of information provided;
- A description of the format of the events and information provided to those consulted;

- Allotted reasonable amount of time for those consulted to allow them to prepare their views on the proposal;
- Identification of any interests/issues that were raised, and the individual or group that raised them. Outline similarities or differences in presented views; and,
- A detailed description of how the views and information (issues and concerns) presented to the proponent, including traditional knowledge if provided, were considered in preparation of the project proposal.

2.1.2 Consultation Overview

CMC has been sharing information and consulting with First Nations, local communities, Yukon government and federal agencies, non-government organizations (NGOs), and individuals since 2008. CMC's consultation program included a range of techniques to identify concerns and methods to address those concerns. Techniques used by CMC to consult included: one-on-one, group and community meetings, Open Houses, presentations, field trips, general and Project Proposal meetings, interviews and questionnaires, as well as phone calls, e-mails, and letters. Full descriptions of the consultation techniques used are included in Section 2.2.2.

Since the initiation of the consultation program in 2008, CMC engaged the following First Nations and stakeholders.

First Nations and Renewable Resource Councils:

- Selkirk First Nation;
- Selkirk Renewable Resource Council;
- Little Salmon-Carmacks First Nation;
- Carmacks Renewable Resource Council;
- Tr'ondëk Hwëch'in First Nation;
- Champagne and Aishihik First Nation;
- Kluane First Nation; and
- White River First Nation.

Yukon Based Government and Agencies:

- Yukon Community Services;
- Yukon Development Assessment Branch
- Yukon Development Corporation;
- Yukon Energy Corporation;
- Yukon Energy, Mines and Resources;
- Yukon Environment;
- Yukon Environmental and Socio-Economic Assessment Board (YESAB);
- Yukon Executive Council;

- Yukon Fish and Wildlife Management Board;
- Yukon Health and Social Services;
- Yukon Highways and Public Works;
- Yukon Housing Corporation;
- Yukon Tourism and Culture; and
- Yukon Water Board;

Federal Government:

- Canadian Northern Economic Development Agency;
- Environment Canada;
- Fisheries and Oceans Canada;
- Natural Resources Canada; and
- Transport Canada.

Yukon Public:

- Village of Carmacks;
- Carmacks (Tantalus) School;
- Carmacks Health Centre;
- City of Whitehorse;
- Whitehorse Chamber of Commerce;
- Whitehorse Hospital;
- Royal Canadian Mounted Police;
- Yukon College;
- Yukon Tourism Industry Association;
- Yukon Mine Training Association;
- Yukon Conservation Society;
- Yukon Fish and Game Association;
- Yukon River Panel;
- Trapping Concession #121;
- Trapping Concession #148;
- Trapping Concession #116;
- Trapping Concession #122;
- Trapping Concession #130 and Land Owner;

- Trapping Concession #131;
- Trapping Concession #145;
- Trapping Concession #146;
- Other Trapline Tenure holders;
- Prophet Muskwa Guide Outfitters;
- Mervyn's Yukon Outfitting; and
- Local businesses.

Additionally, CMC shared and received information from various NGOs, special interest groups and individuals.

2.2 CONSULTATION PRINCIPLES, OBJECTIVES APPROACH AND METHODS

The approach employed by CMC was based on establishment of respectful, mutually-beneficial relationships and maintaining open and transparent communications.

Feedback from First Nations and stakeholders has informed CMC's consultation approach and methods, as well as Project design (e.g. road location, fuel used for power generation, road access management). It has also helped CMC to develop measures to address potential Project effects both at the development stage and throughout operations.

2.2.1 Principles

The consultation principles align with CMC's objective to develop and operate the Project in a safe, ethical and socially responsible manner. They were developed to guide CMC's First Nations and stakeholder consultations. The consultation principles employed by CMC include:

- Communication
  - Communicate regularly on the Project's progress;
  - Wherever practical, maximize opportunities to provide feedback; and
  - Clearly communicate feedback mechanisms to foster two-way communication.
- Transparency
  - Clearly explain the decision making process and define the intended outcomes of any consultation;
  - Communicate to stakeholders what they can and cannot influence in the consultation process;
  - Inform stakeholders about how their input will be used; and
  - Where issues or concerns were raised, document decisions or outcomes of meetings with stakeholders.
- Inclusiveness
  - Identify First Nations and stakeholders and, where possible, involve them in consultation at an early stage;
  - Seek to understand issues or concerns; and
  - Facilitate engagement as appropriate.

2.2.2 Objectives

The overarching objective of consultation for CMC is to develop and operate the Project in a safe, ethical and socially responsible manner. CMC recognized the role that effective consultation can play in informing the design and approach to the Project and the Environmental Assessment. Specifically, the objectives of the consultation programs were to:

- Ensure timely, open, effective and ongoing communication and information sharing;
- Develop and support ongoing relationships with First Nations and stakeholders;
- Create and maintain awareness and understanding of the Project, including benefits and consultation processes;
- Learn about First Nation and stakeholder values, issues and concerns;
- Consider values when designing the Project, conducting the assessment, and when developing mitigation, monitoring programs, and management plans; and
- Identify and discuss the challenges and opportunities the First Nations, stakeholders and the Project face.

2.2.3 Approach and Methods

It is understood that consultation preferences may vary amongst First Nations and stakeholders. As well, communication styles, information needs, types of forums or location of venues for communication may differ based on demographic, cultural and other factors. Consequently, CMC's consultation program included a wide variety of consultation techniques and approaches. This section has been informed by and addresses YESAA's requirements for consultation.

During consultations with each of the First Nations, CMC was made aware of their specific consultation policies or protocols. Those First Nations who wished further or more in depth consultation advised CMC of the appropriate persons with whom or through whom communications should take place.

Consultations with First Nations was undertaken by CMC in a manner that is respectful of their preferences, including considering and responding to specific requests regarding consultation processes. For example, during engagement with the Selkirk and Little Salmon/Carmacks First Nations, CMC engaged with Chief and Council and designated representatives to receive direction and guidance with respect to format, timing, information to be shared or collected, and how meetings should be communicated to individual community members or the community overall. CMC took direction from these First Nations with respect to which representatives should be included in meetings or provided certain information. CMC was also flexible in selecting mutually agreeable meeting dates and venues, changing these as needed, and responding to requests for specific types of material and information.

Extensive effort was undertaken by CMC to fulfill YESAA's consultation requirements and to meet CMC's consultation objectives. Specifically, CMC, through various actions ensured the following:

- Provided notice of the Project and related activities;
- Provided opportunities to review, and reasonable timeframes to review, Project-related materials and to provide feedback;
- Provided opportunities to present views and provide feedback to CMC about the Project; and
- Fairly and fully considered comments and information received.

Potentially affected First Nations and stakeholders were identified by CMC and, where possible, CMC involved them in consultation at an early stage. Information was communicated both broadly to First Nations and stakeholders and on a topic-specific basis to match the requests and stated preferences of First Nations and stakeholders. When possible and appropriate, First Nations and stakeholders were provided information in advance of meetings and events as well as opportunities to review information, before and during such events. Responses to requests for information were provided promptly, recognizing that in some cases information had to be located, assembled or otherwise prepared. Timelines for providing responses varied accordingly. CMC endeavored to provide meeting agendas at least 2 to 3 days before meetings. Information for meetings and information corresponding to questions and/or requests was provided to First Nations, governments and stakeholders on an ongoing basis. Timelines for feedback from meetings were discussed at those meetings and follow-up on topics/questions identified was provided. CMC tracked and documented decisions or outcomes of meetings and other consultations, and where appropriate, conveyed these to the parties involved.

A detailed list of communications and consultation are included in Appendix 2A.

2.2.3.1 Consultation Materials

A range of corporate materials was developed and used to provide information about the Project and to build understanding, raise awareness, support consultation and engage participants in the consultation process. These included:

- A series of PowerPoint Presentations that covered a variety of topics including:
  - Project overview;
  - Project schedule;
  - Environmental studies and status;
  - Mine design; and
  - Opportunities and benefits for communities.
- A Project booklet providing descriptions of:
  - Casino Mining Corporation;
  - Project and history;
  - Project description;
  - Project timeline;
  - Socio-economic effects assessment information;
  - Project benefits for Yukon and communities;
  - Business, training opportunities;
  - Consultation and community involvement;
  - Consultation groups; and
  - Contact information.
- Open House Flyers
  - Brief project description;
  - Brief description of event; and
  - Dates, contact information.
- Open House Posters
  - Introduction to the company;
  - Introduction to the consulting team;
  - Introduction and overview of the project;

- Details on Engineering, geological and related studies;
- Details on Biophysical (Terrestrial and Aquatic) Studies;
- Details on Socio-economic Studies; and
- Details on Heritage and Archaeology Studies.

Copies of these consultation materials are provided in Appendix 2B.

A Project website is available (www.casinomining.com) from which interested parties can access a newsletter and other material.

In addition to the materials developed and used to support consultation, a range of events and activities were designed and convened including those discussed below.

2.2.3.2 Open Houses

Nine Open Houses were arranged and facilitated by CMC that took place in Pelly Crossing, Village of Carmacks, Little Salmon/Carmacks Community, City of Whitehorse, and Beaver Creek. These events served to: share information with First Nations, the government and stakeholders; provide an update on the project progress; and to gather feedback on the Project, including issues and concerns.

First Nations and stakeholders were notified of Open Houses through a variety of methods, including:

- Discussion at meetings or during phone calls prior to events;
- Notices delivered by mail or dropped off to community members (in Pelly Crossing and Village of Carmacks);
- Flyers about the event posted around the community;
- Letters to First Nations and key stakeholders; and
- Advertisements in the Whitehorse Star and Yukon News.

Refreshments and food were provided at all Open Houses. Babysitting was provided at the Open House in the Village of Carmacks allowing participants to review the posters and materials and to talk with CMC and its consultants at a leisurely pace and in a focused manner.

Open Houses were arranged in a casual, informal setting. Approximately 15 to 23 poster boards, maps and photos describing the Project were arranged around the periphery of the room. CMC and its consultants were available to discuss the poster board content, maps and photos as well as the Project in general, and to answer questions posed by event participants.

Upon entering the Open House venues, attendees were greeted, invited to sign in, and provided information on how to access future Project updates and other communication. Participants were offered a comment form, and/or a Project booklet that provided a high level overview of the Project.

Open House display materials including poster boards and maps. Information included descriptions of:

- Casino Mining Corporation;
- Project;
- Project status and timeline;
- Project benefits;

- Regulatory review and permitting process;
- Freegold Road extension and upgrades;
- Key issues and studies undertaken;
- Community involvement;
- Consultation and community engagement and objectives;
- Consultation groups and activities; and
- Contact information.

An overview presentation of the Project and the various studies being conducted was provided by CMC. Specific technical aspects of the Project and the studies being undertaken were provided by various CMC consultants. There were opportunities for those at the Open House to watch the presentation and to ask questions. After the presentation was complete, CMC representatives and consultants were available for further questions and discussion regarding the Project. The open houses included the following:

- Selkirk First Nation on October 20, 2008;
- Pelly Crossing on December 1, 2009, at Selkirk First Nation offices meeting room from approximately 4 pm to 6 pm;
- Selkirk First Nation on January 13, 2010;
- Carmacks on May 28, 2012 at the Recreation Centre from 5 pm to 8 pm
- Whitehorse on May 30, 2012, at the Yukon Inn in two sessions, the first from 2:30 pm to 5:00 pm and the second from 6:00pm to 8:30 pm;
- Whitehorse on May 14, 2013,
- Whitehorse on May 15 over a lunch session from 12 to 1:30 pm;
- Carmacks on May 14, 2013 at the Arena from 4 pm to 7 pm; and
- Beaver Creek on September 24, 2013, at the recreation hall from 4 pm to 6 pm.

Comment forms were collected from participants. Information from the comment forms was added to CMC's records and considered by CMC during development of the Project Proposal, mitigation measures and proposed operational procedures.

2.2.3.3 Site Visits

As of the date of submission of the Project Proposal, CMC has arranged and facilitated eight site visits to the proposed mine site. During site visits CMC and its consultants took the participants on a tour of the existing facilities and the proposed mine area. Participants viewed the various existing components and were shown proposed locations for future components.

The site visits included the following:

- September 18, 2009 with Selkirk First Nation;
- June 8, 2011 with Fisheries and Oceans Canada;

- July 12, 2011 with Fisheries and Oceans Canada and Environment Canada;
- September 20, 2013 with Selkirk First Nation consultants;
- June 12, 2013 with Yukon Energy, Mines and Resources and Yukon Government representatives;
- June 13, 2013 with Yukon Energy, Mines and Resources, Yukon Government representatives, and YESAB;
- June 26, 2013 with Selkirk First Nation; and
- August 30, 2013 with Selkirk First Nation.

Transportation around the site was by helicopter or vehicle. CMC and its consultants explained current and Project components, and responded to questions or requests for information. Comments made at site visits were considered by CMC during the development of the Project Proposal and mitigation measures, and potential future operating procedures and plans.

2.2.3.4 Face to Face Meetings

There were many one-on-one and small group meetings to share project information and gain valuable feedback from First Nations and stakeholders that occurred between 2008 and late 2013. These included meetings with First Nation's Chief and Council, City Councils, territorial and federal regulators, community-based organizations, local businesses, and others.

2.2.3.5 Interviews and Questionnaires

Interviews were held with First Nations, government and members of the public. CMC's socio-economic consultant prepared questionnaires to facilitate these interviews. The questionnaires were designed to gather socio-economic information and were specifically designed for the group to be interviewed. Information from more than 30 interviews that were completed was considered and incorporated into the socio-economic assessment. Where concerns or issues were raised, they were considered by CMC in developing the Project Proposal, mitigation measures and Project planning.

2.2.3.6 General Communications and Correspondence

In addition to the techniques described above, CMC shared information through commonly available methods such as phone calls, faxes, e-mails, memos and letters.

2.3 FIRST NATIONS CONSULTATION

This section describes the consultation activities CMC has undertaken with potentially affected First Nations and the associated Renewable Resource Councils. This section includes:

- A brief description of the potentially affected First Nations;
- A description of the consultation undertaken; and
- A detailed summary of issues raised during consultation along with an indication of how they were considered and the degree to which issues have been resolved or addressed by CMC and other parties.

2.3.1 Consultations

CMC consultations included all First Nations that identified an interest, or that were identified by government agencies as having potential interests in the Project or most likely to be potentially affected. The entire list of First Nations with whom CMC consulted is set out in Section 2.3.2 and a more detailed description of these First Nations and their responses during consultation is set out in Sections 2.3.5 through 2.3.8. As a result of its consultations, Selkirk First Nation and Little Salmon/Carmacks First Nation were the First Nations evaluated most likely to be potentially affected by the Project for the purposes of YESAA.

CMC consulted each of the Selkirk and Little Salmon/Carmacks First Nations and their respective Renewable Resources Councils through open houses, meetings, letters, e-mails, and phone calls. Through the consultation activities described in this section, CMC identified and addressed a range of issues, concerns and information requests. The issues raised during these consultations, along with an indication of how they were considered and the degree to which issues have been resolved or addressed by CMC, is described in Section 2.3.3. Finally, a description of the consultation that CMC plans to undertake during the Project Proposal review is set out in Section 2.8.

The description of consultations that took place, as set out below, is in chronological order by quarter and include, as applicable, headings for each type of consultation. These headings are:

- Communications and General Meetings;
- Project Proposal Meetings;
  - Meetings, or efforts to meet, to specifically discuss the approach, content and requirements of the YESAB Project Proposal.
- Open Houses; and
- Site Visits.

Consultation with First Nations began with meetings to introduce the Project in late 2008, early 2009 and in some cases, at later dates. Introductory meetings provided:

- An overview of the project components;
- Description of proposed environmental studies; and
- Opportunities to discuss CMC's understanding of the regulatory process and approvals needed to support the Project.

When appropriate and prior to each meeting, CMC sent the First Nation a letter and information package that included an agenda and information, such as slide presentations and other information to support the proposed discussion. In many cases, the letters and contents of the information packages were also sent by e-mail or dropped off in hard copy, in accordance with the preference requested by the First Nation.

2.3.1.1 General Meetings

Following introductory meetings between CMC and the First Nations, general meetings took place. These meetings included meetings to discuss various topics including:

- Project Proposal;
- Baseline aquatics program;

- Geochemical characterization;
- Air and water programs;
- Biophysical (terrestrial);
- Socio-economics;
- Heritage and archaeology;
- Fish and fish compensation;
- Road design, construction and management;
- Traditional knowledge information collection;
- Traditional knowledge information integration into the Project Proposal; and
- Baseline study status.

At key intervals, CMC also arranged project update meetings. These meetings were to discuss specific issues that may have arisen, to outline work planned for upcoming seasons, and to discuss work completed in previous seasons.

Where appropriate, First Nations were invited to group meetings with Yukon Government and federal agencies and regulators. A series of meetings took place in 2011 to specifically discuss a compensation agreement for potential adverse effects on fish habitat associated with the Project. Meetings with Fisheries and Oceans included topics such as:

- Water quality,
- Habitat assessment and compensation,
- Water balance,
- Fish sampling,
- Baseline data collection,
- Effects of climate change on water balance,
- Monitoring; and
- Winter low-flow period data.

A number of meetings with Yukon Environment and Yukon Tourism and Culture also took place and included a range of topics such as:

- Review of work completed and sites documented;
- Presentation and review of plans for future fieldwork;
- Discussion of potential mitigation options for potentially affected sites;
- Clarifying expectations for evaluating potential paleontological resources;
- Clarifying expectations for inventorying and impact assessment of paleontological resources;

- Clarifying expectations for inventorying and evaluating 20th century mining equipment and other industrial remains;
- Clarifying criteria for evaluating significance of historic period cabins; and
- Clarifying reporting process.

2.3.2 Potentially Affected First Nations

The 1993 *Yukon Land Claims Umbrella Final Agreement* among the Governments of Yukon and Canada and the Yukon First Nations (UFA) identifies the traditional territories of the Yukon First Nations as they were considered for land claim settlement purposes at the time. The Project has components that are located within the Traditional Territories of three of the Yukon First Nations that entered into Final Agreements under the UFA: the Selkirk First Nation, the Little Salmon/Carmacks First Nation, and the Tr'ondëk Hwëch'in First Nation. The term 'Traditional Territory' refers to those lands that were historically used by the First Nation for traditional pursuits and were recognized and accepted as such by the Governments of Canada and Yukon in the UFA.

CMC consulted or engaged with a number of First Nations, including the ones noted above, and where applicable, their respective Renewable Resources Councils and initially determined that those First Nations most likely to be potentially affected by the Project would be the Selkirk First Nation and the Little Salmon/Carmacks First Nation. The mine site, airstrip, and most of the proposed Freegold Road Extension falls within the Traditional Territory of the Selkirk First Nation. The existing Freegold Road, a portion of that road that CMC proposes to upgrade, and some of the proposed Freegold Extension falls within the Traditional Territory of the Little Salmon/Carmacks First Nation. Because the Project components clearly fall within their Traditional Territories, these two First Nations were consulted to a greater extent as were their corresponding Renewable Resource Councils. Descriptions of these First Nations are provided below.

CMC also engaged with four other First Nations to inform them of the Project and to respond to questions that they may have. Tr'ondëk Hwëch'in First Nation, whose Traditional Territory includes a very small part of the Project Area where the proposed fisheries compensation would occur, was contacted early in the Project development and kept informed of Project progress. CMC was advised by Tr'ondëk Hwëch'in First Nation that the Project was seen to fall within Selkirk First Nation Territory and that CMC should consult with Selkirk First Nation and keep Tr'ondëk Hwëch'in First Nation informed of the Project.

CMC has also engaged with First Nations whose territory or interests are adjacent to the Traditional Territories of the Selkirk, Little Salmon/Carmacks, and Tr'ondëk Hwëch'in First Nation. CMC engaged with:

- Champagne and Aishihik First Nation,
- Kluane First Nation, and
- White River First Nation.

CMC provided these First Nations with general information about the Project, met with representatives when invited, and answered questions as they arose. Details of these communications and consultations are set out in Sections 2.3.5 through 2.3.8 below.

2.3.3 Selkirk First Nation

The Selkirk First Nation maintains administration and government offices in the vicinity of the village of Pelly Crossing on the Klondike Highway in central Yukon, about 280 km northwest of Whitehorse. Pelly Crossing is approximately 110 km east of the Project.

The Selkirk First Nation is comprised of approximately 614 registered members. About half of the members live around Pelly Crossing. The Selkirk First Nation People are associated with the Na-Cho Nyak Dun and the Little Salmon Carmacks First Nations, all of whom are Northern Tutchone.

The Selkirk First Nation Final Agreement and Selkirk First Nation Self-Government Agreement were signed in July 1997 and the Selkirk First Nation Self-Government Agreement Implementation Plan was signed in September 1997. Currently the Selkirk First Nation Chief and Council are:

- Chief Kevin McGinty;
- Crow Councilor Roger Alfred;
- Crow Councilor Milly Johnson;
- Wolf Councilor Deputy Chief Lori Sims; and
- Wolf Councilor Jeremy Harper.

The Selkirk First Nation's Traditional Territory includes the Project's footprint and most of the proposed Casino road extension. See Figure 2 in Appendix 19A for First Nations Settlement Lands and Traditional Territories.

The company continues to engage with Selkirk First Nation on a range of matters related to Selkirk's direct involvement. CMC and the Selkirk First Nation are proceeding with these discussions. The elements of these discussions are confidential at Selkirk's request.

The Selkirk First Nation has discussed a number of approaches to gathering traditional knowledge with CMC. Dialogue on the approach is ongoing and agreement on an approach for the appropriate application of traditional knowledge to this project is an outstanding issue to be resolved.

2.3.3.1 Selkirk First Nation Consultation

CMC or their consultants regularly contacted the Selkirk First Nation seeking their participation in field programs taking place in the Traditional Territory or Settlement Lands. Where Selkirk First Nation members were available they participated in field programs. In 2011, CMC's heritage and archaeology consultants provided on-the-job heritage assessment fieldwork training to a Selkirk First Nation member. In 2013 CMC's heritage and archaeology consultant provided on-the-job training to three Selkirk First Nation members.

Table 2.3-1 provides an overview of the consultation CMC completed with the Selkirk First Nation. Additional meeting details can be found in Appendix 2A.

Table 2.3-1 Selkirk First Nation Consultation Overview

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
95	Meeting	May 3, 2008	Community Vitality	Potential project effects on Yukon River and local communities, and consideration of traditional knowledge.	CMC has had numerous discussions with the Selkirk First Nation regarding traditional use studies and traditional use of the area surrounding the proposed Project. CMC intends to continue discussions with the First Nations regarding traditional use of the Project area. CMC gathered detailed information and completed effects assessments, to identify potential adverse effects of the Project. Effects assessments included employment and income, employability, economic development and business sector, community vitality, infrastructure and services, cultural continuity, land use and tenure, as well as wildlife, aquatics, vegetation, noise and air quality. CMC will implement a variety of plans to minimize potential adverse effects on traditional uses, Yukon River and communities. Plans include a Wildlife Mitigation and Monitoring Plan (Appendix 23A), Wildlife Management Plan (Section 22.3) Waste Management Plan (Section 22.3), Air Quality Management Plan (Section 22.3), Air Quality and Fugitive Dust Deposition Monitoring Program (Section 23.3), Aquatics Monitoring Plan (Section 23.3), and a Progressive Reclamation Effectiveness Monitoring Program (Section 23.3). CMC will implement a Fish Habitat Compensation Plan (Appendix 10C) and will monitor socio-economic effects and adapt management measures where required (Sections 13-19). Resolved, monitor in future, adapt as required.
95	Meeting	May 3, 2008	Cultural Continuity	Baseline information collection needs to be complemented by significant traditional knowledge of the area.	CMC has had discussions with the Selkirk First Nation regarding traditional use studies, and protection and confidentiality of traditional knowledge. Through consultations a number of traditional uses have been identified and considered in the effects assessments and the development of mitigation. CMC intends to continue to discuss collection and consideration of traditional knowledge. Resolved, on-going.
21	Drop-in Visit/Casual Meeting	May 4, 2008	Employability	Possibility of Selkirk First Nation workers providing field support to the project.	CMC and their consultants have invited Selkirk First Nation members or other representatives to join field teams since 2008. Selkirk First Nation has joined field teams when they have been available. CMC intends to continue to consult the Selkirk First Nation (Sections 2.3.2 and 2.3.4). Resolved, on-going.
22	Open House	October 20, 2008	Land Use and Tenure	Consultation with Selkirk First Nation regarding access points for the project.	CMC has consulted with the Selkirk First Nation since 2008. The Selkirk First Nation was invited to and participated in most meetings with Yukon regulators and other government agencies to review the development of the Project Proposal and to discuss topics of mutual interest, including access options, and specifically the Freegold Road, and the proposed extension and upgrades. Land Use and Cultural Continuity sections (18 and 19) assess effects. CMC intends to continue consultation with the Selkirk First Nation. Resolved, on-going.
26	Meeting	October 20, 2008	Cultural Continuity	Proper delineation of First Nation territorial boundaries on project maps.	First Nations territory map (Figure 2 First Nations Settlement Lands and Traditional Territories, Appendix 19A) is based on Yukon Government mapping. Some First Nation's land claims are still under negotiation. Boundaries of some First Nations may change. Resolved for those First Nation with settled land claims agreements.
26	Meeting	October 20, 2008	Cultural Continuity	First Nations need capacity to participate in the assessment process.	CMC intends to continue discussions with First Nations regarding agreements and funding to participate in the review of the Project Proposal. Resolved, on-going.
26	Meeting	October 20, 2008	Cultural Continuity	Clarification of the appropriate level and type of consultation required by the Selkirk First Nation.	CMC, its consultants and the Selkirk First Nation met and corresponded numerous times since 2008. A number of discussions and correspondence have been exchanged to define how the Selkirk First Nation would like to be consulted. CMC intends to continue to consult with the Selkirk First Nation. Resolved, on-going.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
26	Meeting	October 20, 2008	Cultural Continuity	Engagement of the whole Selkirk First Nation community in the preparation of the environmental assessment, including the socio-economic effects assessment.	CMC and its socio-economic consultant met a number of times with the Selkirk First Nation and conducted Open Houses in Pelly Crossing, Carmacks and Whitehorse. CMC and its consultants and the Selkirk First Nation and Yukon and other regulators met seven times in 2013 to discuss approach to and development of the Project Proposal. CMC's socio-economics consultant shared the draft Socio-economic Baseline Report with the Selkirk First Nation and received and responded to their feedback. CMC intends to continue to consult the Selkirk First Nation during the review of the Project Proposal. Resolved, on-going.
26	Meeting	October 20, 2008	Wildlife	SFN identified they completed a number of wildlife and fisheries studies. Request these studies to include data in the proposed Project baseline studies.	Selkirk First Nations' fisheries and wildlife reports were not provided, however there was discussion about key findings from these reports which was used to inform CMC's work. Resolved.
26	Meeting	October 20, 2008	Project Activities	Guidelines for use of the Minto Landing barge site need to be developed and communicated.	CMC plans do not include reliance on the barge site during operations. (The concern appears to relate to extensive use of the barge site to support other mining activities, with CMC contributing some additional activity. Resolved
22	Open House	October 20, 2008	Fisheries and Aquatic Resources	CMC is perceived as a primary contributor to land-based damage at the Minto Landing barge site. Notwithstanding that many were likely contributors it was agreed that guidelines for use of the site need to be developed and communicated. There are issues outstanding at the Barge Landing. The area is becoming quite torn up.Fish utilization in lower Canadian and Britannia and salmon spawning was raised as something of interest and concern to SFN.	CMC does not plan the use of the barge landing during operations. CMC has only received feedback from SFN regarding the 1 Chinook adult that was found spent (spawned and dead) on the banks in the lower reach of Britannia Creek. CMC has conducted spawning surveys for Chinook by foot and by helicopter during the fall for multiple years. CMC has never identified Chinook spawning in Britannia, Canadian, Casino and Dip Creeks. However, CMC has captured Chinook juveniles within the lower 300-400m of Britannia Creek at its confluence with the Yukon River. Resolved, ongoing.
26	Meeting	October 20, 2008	Fisheries and Aquatic Resources	SFN identified they completed a number of wildlife and fisheries studies. Request these studies to include data in the proposed Project baseline studies.	CMC has never received any written information from SFN. We have also never obtained any TK on fisheries or water quality, where SFN fish on the Yukon, fishing camps. Resolved. We anticipate Selkirk's internal review of the project may be informed by their own baseline data and other internal reports.
26	Meeting	October 20, 2008	Fisheries and Aquatic Resources	Fish utilization in lower Canadian and Britannia, including potential for salmon spawning.	To our knowledge, Chinook salmon do not spawn in Britannia Creek. However, as we have discussed in our fish compensation plan, lower Britannia Creek has changed course since the 1970's and currently follows an old road alignment. The majority of Chinook spawn in the main stem of the Yukon river in areas called clear water channels, where groundwater upwelling is located. Most tributaries to the Yukon, such as Britannia Creek freeze to the bottom during winter, which would be detrimental to Chinook eggs, as egg development needs oxygenated water during the winter months
2	Meeting	Dec. 3, 2008	Cultural Continuity	Need to consult with Kluane and Champagne and Aishihik First Nations regarding transportation options.	CMC met with Kluane First Nation and the Champagne and Aishihik First Nations. , identified issues and interests and responded to those. These First Nations' Traditional Territories are west and south-west of Carmacks and the proposed Project. Access will be via the upgraded and extended Freegold Road Resolved, on-going.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
12	Meeting	June 10, 2009	Cultural Continuity	Use First Nations staff in field work to allow better retention of field learnings and improved opportunities to share traditional knowledge.	CMC has invited the Selkirk and Little Salmon/Carmacks First Nations to join field crews and included First Nations in fieldwork when they were available. CMC intends to continue discussions with First Nations regarding collection and sharing of traditional knowledge. Resolved, on-going.
12	Meeting	June 10, 2009	Cultural Continuity	Access road route needs to consider known heritage resources.	CMC has completed a heritage resources impact assessment on the proposed road extension and upgrades. Heritage sites have been identified and marked in the field. CMC to develop and implement a Heritage Resources Protection Plan including a chance find procedure (Section 22.3). Additional approaches identified to minimize or avoid potential adverse effects on heritage resources are contemplated in the Proposal. Resolved, monitor in future, adapt as required.
12	Meeting	June 10, 2009	Cultural Continuity	TK integration into EA work.	CMC and the Selkirk and Little Salmon Carmacks First Nations have discussed approaches to gathering and protecting traditional knowledge. CMC, the Selkirk First Nation and Yukon regulators specifically discussed how traditional knowledge would be integrated into the Project Proposal. A number of Little Salmon/Carmacks and Selkirk First Nations' traditional uses have been identified in the vicinity of the proposed Project. These uses were considered in the effects assessments as well as during the development of mitigation measures and the Project Proposal. Efforts to sequester additional traditional knowledge continue. Resolved, on-going.
17	Meeting	October 14, 2009	Community Vitality	Benefits agreements should consider social and health impacts.	CMC intends to continue to discuss potential agreement elements, including social and health aspects as the proposed Project moves forward. Resolved, on-going.
17	Meeting	October 14, 2009	Cultural Continuity	Effects on ability to practice traditional activities.	CMC has had numerous discussions with the Selkirk First Nation regarding traditional use studies and traditional use of the area surrounding the proposed Project. CMC intends to continue discussions with the First Nations regarding traditional use of the Project area. CMC gathered detailed information and completed effects assessments, to identify potential adverse effects of the Project. Effects assessments included employment and income, employability, economic development and business sector, community vitality, infrastructure and services, cultural continuity, land use and tenure, as well as wildlife, aquatics, vegetation, noise and air quality. CMC will implement a variety of plans to minimize potential adverse effects on traditional uses, Yukon River and communities. Plans include a Wildlife Mitigation and Monitoring Plan (Appendix 23A), Wildlife Management Plan (Section 22.3) Waste Management Plan (Section 22.3), Air Quality Management Plan (Section 22.3), Air Quality and Fugitive Dust Deposition Monitoring Program (Section 23.3), Aquatics Monitoring Plan (Section 23.3), and a Progressive Reclamation Effectiveness Monitoring Program (Section 23.3). CMC will implement a Fish Habitat Compensation Plan (Appendix 10C) and will monitor socio-economic effects and adapt management measures where required (Sections 13-19). Resolved, monitor in future, adapt as required.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
17	Meeting	October 14, 2009	Cultural Continuity	Effects on increased access on subsistence hunting, fishing and harvesting.	CMC has had numerous discussions with the Selkirk First Nation regarding traditional use studies and traditional use of the area surrounding the proposed Project. CMC intends to continue discussions with the First Nations regarding traditional use of the Project area. CMC gathered detailed information and completed effects assessments, to identify potential adverse effects of the Project. Effects assessments included employment and income, employability, economic development and business sector, community vitality, infrastructure and services, cultural continuity, land use and tenure, as well as wildlife, aquatics, vegetation, noise and air quality. CMC will implement a variety of plans to minimize potential adverse effects on traditional uses, Yukon River and communities. Plans include a Wildlife Mitigation and Monitoring Plan (Appendix 23A), Wildlife Management Plan (Section 22.3) Waste Management Plan (Section 22.3), Air Quality Management Plan (Section 22.3), Air Quality and Fugitive Dust Deposition Monitoring Program (Section 23.3), Aquatics Monitoring Plan (Section 23.3), and a Progressive Reclamation Effectiveness Monitoring Program (Section 23.3).CMC will implement a Fish Habitat Compensation Plan (Appendix 10C) and will monitor socio-economic effects and adapt management measures where required (Sections 13-19). Resolved, monitor in future, adapt as required.
17	Meeting	October 14, 2009	Cultural Continuity	Request for artifacts to go back to the Pelly community and to have all artifact finds reviewed by Selkirk First Nation Elders. Also need a process for dealing with unexpected heritage finds.	CMC has been consulting with the Selkirk First Nation since 2008. Many discussions, meetings and presentations have taken place regarding planned heritage programs as well as outcomes. Selkirk First Nations have been invited, and when available joined heritage field crews during field programs. Results of heritage assessments have been regularly shared with the Selkirk First Nation. Detailed discussions with elders, Selkirk First Nation's land representatives, and others took place when artifacts were discovered. CMC intends to continue to consult the Selkirk First Nation as the project proceeds. CMC will implement a Heritage Resources Protection Plan, including a chance find procedure (Section 22.3). Mitigation described in impact assessment will be followed. Resolved, on-going
17	Meeting	October 14, 2009	Cultural Continuity	Establishment of a TK policy/protocol to ensure protection for Selkirk First Nation Elders' knowledge.	CMC has had numerous discussions with the Little Salmon/Carmacks and Selkirk First Nations regarding traditional use studies, including protection and confidentiality of traditional knowledge. CMC intends to continue to discuss protocols or agreements for protection of traditional knowledge. Resolved, on-going.
39	Meeting	December 1, 2009	Cultural Continuity	Involvement of Selkirk First Nation in the socio-economic work.	CMC and its socio-economic consultant have suggested and discussed approaches to involving the Selkirk First Nation in the collection of socio-economic information. Discussions have included joint socio-economic monitoring with the Minto mine; discussions continue. CMC and its socio-economic consultant also shared the draft Socio-economic Baseline Report with the Selkirk First Nation and received and responded to their feedback. CMC intends to continue to consult the Selkirk First Nation during the review of the Project Proposal. Resolved, on-going.
39	Meeting	December 1, 2009	Wildlife	Identified concern regarding how wildlife surveys are being conducted.	A combination of published data and field assessments were undertaken to address key indicator species information requirements. A management prescription has been recommended for each species where effects are likely. The methodology for the assessments is described in Section 12. CMC is committed to ongoing monitoring and management of wildlife through the project development, operation and closure and will incorporate new studies with responsible management agencies as required under the project permit. Resolved. Ongoing monitoring and adaptive management required.
39	Meeting	December 1, 2009	Fisheries and Aquatic Resources	Protection of fish resources in the project area.	Avoidance and mitigation of fish resources are considered in the Project approach, as assessed in Section 10.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
31	Meeting	March 16, 2010	Cultural Continuity	Socio-economic and traditional study work be undertaken on an all-encompassing traditional land basis rather than in a piecemeal way for various individual land users.	CMC has had numerous discussions with the Selkirk First Nation regarding traditional use studies and traditional use of the Project area. CMC and its socio-economic consultant have suggested and discussed approaches to gathering traditional knowledge and socio-economic information with the Selkirk First Nation. Discussions have included joint socio-economic monitoring with the Minto mine; discussions continue. CMC and its socio-economic consultant shared the draft Socio-economic Baseline Report with the Selkirk First Nation and received and responded to their feedback. CMC intends to continue to consult the Selkirk First Nation during the review of the Project Proposal. Resolved, on-going.
31	Meeting	March 16, 2010	Cultural Continuity	Need to consult with Tr'ondek Hwetch'in and Little Salmon/Carmacks First Nations in addition to consultations with the Selkirk First Nation.	CMC has consulted the Little Salmon Carmacks and Tr'ondek Hwetch'in First Nations. Open Houses have been conducted in the Village of Carmacks and with the Little Salmon Carmacks First Nation. CMC intends to continue to consult these and other First Nations during the review of the Project Proposal. Resolved, on-going.
31	Meeting	March 16, 2010	Operations	Road access problems at stream crossings and side cuts.	The road will be engineered to incorporate consideration of the landscape, including slope hazards and permafrost issues in order to minimize issues.
35	Meeting	April 13, 2010	Cultural Continuity	Concerned about encumbering rights that allow mining companies to proceed with activities that may damage heritage sites without doing impact assessment studies.	CMC completed heritage resource impact assessments on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. A Heritage Management Plan and chance find procedure have been developed. CMC to continue to engage with the Selkirk First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3). Resolved, monitor in future, adapt as required.
35	Meeting	April 13, 2010	Cultural Continuity	Clarification of buffer distance requirements for heritage sites.	CMC has an interim Heritage Management Plan and chance find procedure. Sites identified have been flagged. CMC intends to continue to engage with First Nation and Yukon Heritage to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan, including a chance find procedure (Section 22.3). Mitigation described in the impact assessment will be followed. Resolved, monitor in future, adapt as required.
43	Meeting	April 22, 2010	Wildlife	Identified concern regarding the importance of wildlife in the area.	Wildlife effects potentially resulting from the project were dealt with using a key indicators approach. A management prescription has been recommended for each species where effects are likely. CMC will address and mitigate effects on specific key indicator wildlife species and populations as required through the development and operation of the project. CMC aims to minimize effects to wildlife, monitor the results of mitigation, and adaptively manage for any unanticipated effects given the final Project footprint. See Appendix 23A). Resolved.
43	Meeting	April 22, 2010	Closure	Contingency monitoring programs in the event the mine has a temporary or pre-mature closure.	Closure planning will include consideration of premature closure. This will be defined and implemented in detail at the permitting phase of project development.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
97	Meeting	May 3, 2010	Land Use and Tenure	Increased traffic and spur roads.	CMC completed land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Potential traffic effects are discussed in Sections 17, 18 and 19. Socio-economic monitoring and adaptive management are proposed. CMC will implement a Road Use Plan (Appendix 22A) and CMC will monitor project socio-economic effects and adapt management measures where required (Section 17). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means as defined in a management plan, but CMC will work with First Nations to arrange for access as appropriate. Resolved, monitor in future, adapt as required.
97	Meeting	May 3, 2010	Wildlife	Identified concern about the low wildlife numbers in parts of SFN Traditional Territory and the lack of good regional information about wildlife. SFN requested a regional environmental protection plan be developed.	Wildlife effects potentially resulting from the project were dealt with using a key indicators approach. A management prescription has been recommended for each species where effects are likely. CMC cannot develop or implement a regional environmental protection plan independently, but it can participate as a stakeholder member of the working group if such a planning process is established by the Yukon Government. CMC will address and mitigate effects on specific key indicator wildlife species and populations as required through the development and operation of the project. CMC aims to minimize effects to wildlife, monitor the results of mitigation, and adaptively manage for any unanticipated effects given the final Project footprint. (See Appendix 23C). Resolved.
97	Meeting	May 3, 2010	Design	Development and use of spur roads off of the primary Casino project access road.	CMC completed land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Potential traffic effects are discussed in Sections 17, 18 and 19. Socio-economic monitoring and adaptive management are proposed. CMC will implement a Road Use Plan (Appendix 22A) and CMC will monitor project socio-economic effects and adapt management measures where required (Section 17). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access as appropriate. Resolved, monitor in future, adapt as required.
118	Meeting	Dec. 15, 2011	Fisheries and Aquatic Resources	Identified issue of residency time for Chinook salmon in Britannia and Dip Creek due to the potential effects on their olfactory system because of water quality changes.	Fish and Aquatic Resources Effects Assessment discusses these questions in more detail. There has been no official request for information from SFN.
118	Meeting	Dec. 15, 2011	Fisheries and Aquatic Resources	Scope of fish habitat compensation plan	A fish habitat compensation plan has been developed for consideration as provided in Appendix 10C.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
188	Meeting	October 15, 2012	Cultural Continuity	Effects on traditional activities.	CMC has had numerous discussions with the Selkirk First Nation regarding traditional use studies and traditional use of the area surrounding the proposed Project. CMC intends to continue discussions with the First Nations regarding traditional use of the Project area. CMC gathered detailed information and completed effects assessments, to identify potential adverse effects of the Project. Effects assessments included employment and income, employability, economic development and business sector, community vitality, infrastructure and services, cultural continuity, land use and tenure, as well as wildlife, aquatics, vegetation, noise and air quality. CMC will implement a variety of plans to minimize potential adverse effects on traditional uses, Yukon River and communities. Plans include a Wildlife Mitigation and Monitoring Plan (Appendix 23A), Wildlife Management Plan (Section 22.3) Waste Management Plan (Section 22.3), Air Quality Management Plan (Section 22.3), Air Quality and Fugitive Dust Deposition Monitoring Program (Section 23.3), Aquatics Monitoring Plan (Section 23.3), and a Progressive Reclamation Effectiveness Monitoring Program (Section 23.3). CMC will implement a Fish Habitat Compensation Plan (Appendix 10C) and will monitor socio-economic effects and adapt management measures where required (Sections 13-19). Resolved, monitor in future, adapt as required.
191	Meeting	October 15, 2012	Land Use and Tenure	Potential effects on traditional harvesting.	CMC has had numerous discussions with the Little Salmon Carmacks and Selkirk First Nations regarding traditional use studies and traditional use of the Project area and area surrounding the Freegold Road. CMC intends to continue discussions with the First Nations regarding traditional knowledge protocol, and traditional activities and uses of the Project area (Sections 2.3.2 and 2.3.4). CMC gathered detailed information and completed effects assessments, which considered traditional uses to identify potential adverse effects, including on communities and the Yukon River. Effects assessments included community vitality, cultural continuity, as well as land use, wildlife, aquatics, vegetation, noise and dust. Effects assessment results and mitigation and monitoring plans to address potential adverse effects are described in Sections 11, 12, 16, 17, 18, and 19. CMC will implement a variety of plans to minimize potential adverse effects on traditional uses, Yukon River and communities. Resolved, monitor in future, adapt as required.
188	Meeting	October 15, 2012	Wildlife	Are there options for the road access?	CMC took three years to study options before the Freegold Road extension was selected. The preferred option is the Freegold Road Extension. . An assessment of the alternative route options is included in the project description (Section 4) and as part of the impact assessment (Section 12).
188	Meeting	October 15, 2012	Wildlife	Identified concern related to potential effects to traditional way of life, caribou migration, hunting and safety associated with proposed Freegold Road extension. Identified concern on how potential effects on caribou will be mitigated.	Potential effects on caribou habitat, migration, mortality, and seasonal use were thoroughly assessed. Mitigation measures to address these effects have been established. See Section 12 Potential Effects and Mitigation Measures for Caribou. Resolved. Ongoing monitoring and adaptive management required.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
188	Meeting	October 15, 2012	Wildlife	Access management to prevent negative effects on caribou populations.	CMC has considered a range of issue related to effects on Caribou and will develop a management plan that proposes to mitigate the risk of increased mortality from harvest by managing the Freegold Road extension as a private resource road. CMC will work with government agencies and First Nations to monitor and adapt the access management plan as necessary through the life of the project to ensure that effects on wildlife are minimized. CMC will: • Restrict access to the road during operation by installing a continuously manned gate at Big Creek, and • Decommission the road during the reclamation and closure phase. • Develop a wildlife management planning group including regulators, First Nations, and stakeholders, to advise on mitigation, monitoring and adaptive management strategies. See Appendix 23C). Resolved. Ongoing monitoring and adaptive management required.
188	Meeting	October 15, 2012	Design	Defining final road route and related concerns expressed by SFN.	The road alternatives have been carefully considered in light of all environmental, physical, and cost data available. Alternatives are discussed in Section 4. Resolved.
301	Meeting	Feb. 12, 2013	Climate/Climate Change	Concern about transport of large LNG rigs over streams and rivers to supply power plant at the mine.	Road design will incorporate safety considerations to minimize risk of accidents. A discussion of the potential Accidents and Malfunctions is provided in Section 21, and an Emergency Response Plan is provided in Appendix 22B. Resolved.
301	Meeting	Feb. 12, 2013	Tailings Pond/ Impoundment	Concern about water quality downstream of the tailings facility.	Water quality modeling includes for predictions during operations and post closure at locations downstream of the TMF for consideration. Resolved and ongoing.
301	Meeting	Feb.12, 2013	Malfunctions	Concern about the contingency plans and mitigation for accidents, spills, etc.	A discussion of the potential Accidents and Malfunctions is provided in Section 21, and an Emergency Response Plan is provided in Appendix 22B. Resolved.
288	Meeting	Feb. 13, 2013	Project Activities	Concern about fuel hauling on the current access road.	A discussion of the potential Accidents and Malfunctions is provided in Section 21, and an Emergency Response Plan is provided in Appendix 22B. Resolved.
292	Meeting	Feb. 20, 2013	Community Vitality	Increased safety risks with trucks driving through local communities. Increased dust and noise from trucks. Effects of increased numbers of large trucks on tourism in the area.	CMC completed land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Potential effects from noise and dust were considered in a number of effects assessments. Mitigation to address potential adverse effects was developed. Potential traffic effects are discussed in Sections 17, 18 and 19. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. Socio-economic monitoring and adaptive management are proposed. Effects of noise and dust will be monitored.
257	Meeting	March 11, 2013	Tailings Pond/Impoundment	Issues identified include the depth of wetland on top of the tailings, winter operation of the wetland downstream of the TMF, and potential effects on the wetland if more than 5% of low grade ore is not processed.	Closure activities, including the development of wetlands are considered in the Project approach as discussed in Section 4A. Post closure water quality and aquatics effects are discussed in Sections 7 and 10.
257	Meeting	March 11, 2013	Water Quality	Issues identified include potential effects to water quality by exposed open pit walls above flood level and the hydro geological effects to Canadian and Casino Creeks	The potential loading of metals and other parameters from exposed pit walls has been considered in the geochemical assessment of the project, which in turn was modeled and assessed as part of the water quality impact assessment. Details can be found in Section 7. Resolved and ongoing.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
431	Meeting	May 16, 2013	Cultural Continuity	Need for a heritage monitor ahead of road construction to identify potential heritage sites.	CMC has completed a heritage resources impact assessment on the proposed road extension and upgrades. Heritage sites have been identified and marked in the field. A Heritage Management Plan and chance find procedure have been developed. CMC intends to continue to engage with First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan, including a chance find procedure (Section 22.3.7). Mitigation described in impact assessment will be followed. Environmental monitoring, including heritage resources, will be completed during road construction (Section 22). Resolved, monitor in future, adapt as required.
340	Phone Call	June 14, 2013	Cultural Continuity	Need a process to deal with historical finds during project activity.	CMC completed heritage resource impact assessments on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. A Heritage Management Plan and chance find procedure have been developed. CMC to continue to engage with the Selkirk First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3.7). Resolved, monitor in future, adapt as required.
391	Meeting	June 19, 2013	Water Quality	Have you yet performed a Failure Modes Effects Analysis (FMEA)?	Consideration of Accidents and Malfunctions is provided in Section 21, where an FMEA framework was applied. CMC intends to continue dialogue with the Selkirk First Nation on this issue. Resolved and ongoing.
406	Meeting	July 9, 2013	Land Use and Tenure	Will traffic thresholds be applied as part of the management and mitigation strategy for the access road?	As a strictly controlled Resource Road, traffic volumes will be known and specified. The road design will be specified to support the Project traffic. Additional traffic will be added through controlled management planning only. Potential traffic effects are discussed in Sections 17, 18 and 19. Resolved ongoing.
406	Meeting	July 9, 2013	Design	Concern about road corridor and road design as it relates to wildlife interactions.	The reduction of vehicle-wildlife interactions is discussed in Appendix 23A, with specific controls proposed. Resolved ongoing.
406	Meeting	July 9, 2013	Design	Concern about the source and location of borrow for the road construction and maintenance.	Borrow sources will be confirmed at the permitting phase, but in any case will be selected with consideration of sensitive areas for flora and fauna. Resolved ongoing.
406	Meeting	July 9, 2013	Natural Hazards	Concern about inclusion of fire hazard in the project assessment.	The risk of fire induced by Project activities is considered in Sections 20 and 21. Resolved ongoing.
405	Meeting	August 20, 2013	Process (leaching, etc.)	Concern about the location and slope topography at the heap leach facility.	The Heap Leach Facility has been designed with consideration of the local topography. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Post-closure	Concern about precipitation events post closure and the ability of the tailings facility to handle high rainfall events.	Water management is a critical aspect of post closure infrastructure stability. The TMF water balance has incorporated high rainfall events to the post-closure design. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Closure	Concern about the rinsing process for the heap leach closure.	CMC intends to continue dialogue with the Selkirk First Nation regarding the approach to closure of the Heap Leach Facility. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
405	Meeting	August 20, 2013	Post-closure	Concern about heap leach cover and stabilization with re-vegetation.	CMC intends to continue dialogue with the Selkirk First Nation regarding the approach to closure of the Heap Leach Facility. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Malfunctions	Concern about the stability of the heap leach facility.	The Heap Leach Facility has been designed with consideration of the local topography. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Natural Hazards	Concerns about potential for earthquake effects to compromise the closure plans.	Seismic analysis was undertaken in order to properly design post-closure infrastructure. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Waste Management	Concern about the cyanide treatment process and the duration of this part of the closure process.	CMC intends to continue dialogue with the Selkirk First Nation regarding the approach to closure of the Heap Leach Facility. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.
405	Meeting	August 20, 2013	Reclamation	Concern about how to stabilize slopes for reclamation.	Proper design post-closure infrastructure has been considered. Information about Project design can be found in the Proposal (Section 3), and also in the Feasibility Study. Resolved ongoing.

2.3.4 Little Salmon/Carmacks First Nation

The Little Salmon/Carmacks First Nation maintains administration and government offices in the vicinity of Carmacks on the Klondike Highway in central Yukon, about 170 km north-east of Whitehorse. Carmacks is approximately 150 km south-west of the Project.

As of September 2013, Little Salmon/Carmacks First Nation had approximately 640 registered members. (Aboriginal Affairs and Northern Development Canada internet site). Little Salmon/Carmacks First Nation members have strong ties with the Na-Cho Nyak Dun and the Selkirk First Nations, all of whom are part of the Northern Tutchone cultural group. The Northern Tutchone Tribal Council delivers some programs and services for the Little Salmon/Carmacks First Nation.

In July 1997, the Little Salmon/Carmacks First Nation signed both its Final Agreement and its Self-Government Agreement with federal government. As do other First Nations who have entered Self-Government Agreements, the Little Salmon/Carmacks First Nation has jurisdiction to make its own laws and deliver programs and services to its citizens. The Little Salmon Carmacks First Nation now holds elections for Chief only, consistent with a more traditional form of government. Council members are selected by representatives of the Crow and Wolf moieties. The current Chief and Council are:

- Chief Eric Fairclough;
- Deputy Chief Lita Blackjack;
- Crow Councilor Russell Blackjack;
- Crow Councilor Lenny Charlie;
- Wolf Councilor Darlene Johnson;
- Wolf Councilor Shwanda Wheeler;
- Elder Councilor Shirley Bellmore; and
- Youth Councilor Rodrica Blackjack.

The Little Salmon-Carmacks First Nation's Traditional Territory includes the area around Carmacks, the existing Freegold Road and a small portion of the proposed Casino Freegold Road Extension. See Figure 2 in Appendix 19A for First Nations Settlement Lands and Traditional Territories.

CMC continues to engage with Little Salmon/Carmacks First Nation on a range of matters related to Little Salmon/Carmacks direct involvement.

CMC and the Little Salmon/Carmacks First Nation have discussed gathering traditional knowledge. Little Salmon/Carmacks First Nation advised CMC that they would like to revisit the need for, and collection and use of traditional knowledge following their opportunity to review the Project Proposal.

2.3.4.1 Little Salmon/Carmacks First Nation Consultation

Table 2.3-2 provides an overview of the consultation CMC completed with the Little Salmon/Carmacks First Nation. Additional meeting details can be found in Appendix 2A.

Table 2.3-2 Little Salmon/Carmacks First Nation Consultation Overview

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
301	Meeting	February 12, 2013	Cultural Continuity	Effect of increased access on traditional medicine and berry areas, as well as hunting habitat.	CMC has had numerous discussions with the Little Salmon/Carmacks First Nation regarding traditional use studies and traditional use of the Project area and area surrounding the Freegold Road. CMC intends to continue discussions with the First Nations regarding traditional activities and uses of the Project area. Traditional use, including hunting, fishing, and gathering of resources such as berries, has been considered in the aquatics, wildlife and vegetation effects assessments and the land use (Section 19) and Cultural Continuity assessments. Mitigations to avoid or minimize adverse effects have been developed. CMC will develop and implement a Road Use Plan (Section 22.3). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access as appropriate. CMC will monitor project socio-economic effects and adapt management measures where required (Section 18.4.2). Resolved, monitor in future, adapt as required.
301	Meeting	February 12, 2013	Economic Development and Business Sector	Ensure accuracy of First Nations profiles from a socio-economic perspective.	CMC's socio-economic consultant met with Little Salmon/Carmacks First Nation and gathered socio-economic information. Little Salmon/Carmacks First Nation will have the opportunity to review and provide feedback to CMC on the Project Proposal. Resolved, on-going.
301	Meeting	February 12, 2013	Land Use and Tenure	Accurate assessment of increased level of traffic in Carmacks and construction of a by-pass at Carmacks.	CMC completed land use and socio-economic effects assessments that considered potential traffic levels and effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Potential traffic effects are discussed in Sections 17, 18 and 19. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3) and CMC will monitor project socio-economic effects and adapt management measures where required (Section 17.4.2). Resolved, monitor in future, adapt as required.
301	Meeting	12-Feb-13	Fisheries and Aquatic Resources	Need for enhancement of salmon spawning habitat.	The fish habitat compensation plan is focused on Chinook salmon habitat
288	Meeting	13-Feb-13	Wildlife	Identified concern related to the proposed Freegold Road extension and its potential effect on wolverine and caribou migration.	Potential effects on caribou habitat, migration, mortality, and seasonal use were assessed. Mitigation measures to address these effects have been established. See 12.3.3.4 Potential Effects and Mitigation Measures for Caribou. Wolverine are found only in very low densities in the project area and effects will be addressed by a species that is a key indicator species. Wolverine will be largely covered by the assessment on grizzly bears. CMC's goal is to prevent the Caribou from becoming threatened or endangered by engaging responsible agencies to carefully manage caribou and their habitat within the project footprint and access corridor. See Appendix 23C). Resolved. Ongoing monitoring and adaptive management required.

2.3.5 Tr'ondëk Hwëch'in First Nation

The Tr'ondëk Hwëch'in First Nation's Traditional Territory is north of the Project. Their traditional Territory includes the lower reaches of Britannia Creek, where the freshwater pipeline to supply make-up water to the mine will terminate. It also covers an area that CMC is proposing for fish habitat compensation work.

2.3.5.1 Tr'ondëk Hwëch'in First Nation Consultation

On May 27, 2009, CMC met with the Tr'ondëk Hwëch'in First Nation Chief and other representatives. At the meeting, CMC presented the Project to the Tr'ondëk Hwëch'in First Nation. CMC also presented a proposed consultation plan and discussed how the Tr'ondëk Hwëch'in First Nation may wish to be consulted about the Project.

In May 2010, CMC and their consultant met the Tr'ondëk Hwëch'in First Nation Chief and other representatives and provided them with a second overview of the proposed Project. In addition, CMC and its consultant outlined the field work program proposed for 2010, short and longer-term employment, contracting and training opportunities as well as CMC's proposed approach to consultation and engagement. Following the presentation to the Tr'ondëk Hwëch'in First Nation Chief, the information was also presented to the Tr'ondëk Hwëch'in First Nation Lands Department. CMC provided Tr'ondëk Hwëch'in First Nation Chief a memo that outlined the project as well as a summary of the various programs underway.

In February 2012 the Tr'ondëk Hwëch'in First Nation Chief contacted CMC by letter and provided CMC with a copy of the Tr'ondëk Hwëch'in Mining Mandate, which had been issued in November 2011. The mandate indicates that the Tr'ondëk Hwëch'in First Nation intends to enter into impact benefit agreements with significant mining projects in the Tr'ondëk Hwëch'in First Nation Traditional Territory. The Tr'ondëk Hwëch'in First Nation provided CMC a contact for future consultations.

In April and May 2013, CMC contacted Tr'ondëk Hwëch'in First Nation by e-mail and phone seeking a meeting to provide an update on the proposed Project. Following this, CMC contacted Tr'ondëk Hwëch'in First Nation by e-mail and letter offering an information session on the proposed Project.

In September 2013, CMC contacted Tr'ondëk Hwëch'in First Nation by e-mail and letter and provided Tr'ondëk Hwëch'in First Nation with an application package describing the Class 4 Mining Land Use Approval CMC submitted to the Yukon Government. CMC travelled to the Tr'ondëk Hwëch'in First Nation community, Dawson City, and presented an update on project activities and to further discuss activities taking place on the Casino property.

Newspaper ads for the Open houses were placed in local newspapers with circulation that included Dawson City where the Tr'ondëk Hwëch'in First Nation's offices are located. The Tr'ondëk Hwëch'in First Nation representatives were not present at any of the project Open Houses.

2.3.6 White River First Nation

In 2013, the White River First Nation informed CMC that the Project is located within territory its members had traditionally used and occupied. The White River First Nation is an *Indian Act* band whose members reside primarily in Beaver Creek, Yukon. The White River First Nation, which has not entered into a land claim or a self-government agreement with the Crown, asserts that the boundary for its traditional territory should be extended further to the north and east than the traditional territory boundary that was set out for the White River First Nation in the UFA. The White River First Nation asserts that the Project falls within this territory and has the potential to affect its Aboriginal rights and culture. To the extent that the Project overlaps with traditional subsistence activities or heritage resources connected to the White River First Nation, and interferes with the White River First Nation's traditional and cultural use of the land, CMC will apply the mitigations developed for these Valued Components in consultation with First Nations. Studies related to traditional land use by the members of the White River First Nation and the First Nation's strength of claim are ongoing. CMC intends to continue its dialogue with the White River First Nation to ascertain whether and how the Project might affect the rights and interests of its members and will work with the First Nation to mitigate and, where appropriate, accommodate its concerns. CMC will also continue to provide Project-related information to the White River First Nation and the people of Beaver Creek.

2.3.6.1 White River First Nation Consultation

In June 2013, the White River First Nation sent a letter to CMC stating their desire to consult and secure mutual benefits from the Project. In response, CMC sent the White River First Nation a letter offering to provide the White

River First Nation with a public information session and a session specifically for the Chief and Council of the White River First Nation, explaining the Project.

In July 2013, the White River First Nation e-mailed CMC advising that they would like to meet CMC to discuss the White River First Nation's traditional activities in the Project area. Following this e-mail, CMC spoke with a White River First Nation representative and discussed CMC providing information about their Project and regulatory applications.

CMC provided the White River First Nation a package describing the Class 4 Mining Land Use Approval CMC had recently submitted to the Yukon Government. CMC offered to meet the White River First Nation to discuss the application and the Project further. The White River First Nation contacted CMC in late 3rd quarter seeking the information CMC had shared with Yukon regulators and First Nations regarding the planned Project Proposal (information packages for the Project Proposal meetings). Following this, CMC sent the White River First Nation an e-mail linking them to information provided to YESAB and other regulators and First Nations during the Project Proposal meetings. Hard copies of the information were also provided to the White River First Nation. CMC offered to meet and discuss the Project and information with the White River First Nation further, noting CMC would be in Beaver Creek in near future. The White River First Nation followed up on this correspondence and provided CMC with a report asserting the northern boundary of the White River First Nation's Traditional Territory. This claim is made in connection to WRFN's asserted traditional territory as described in the document "WRFN Consideration of the Northern Boundary" (Easton et al. 2013).

In addition and in response to becoming aware of the interests and concerns of the White River First Nation in the Project, CMC and its consultants reviewed the report provided by White River and existing literature in relation to the White River First Nations: the Casino Trail Local Resource Group Workshop and Report (Casino Trail Local Resource Group, 1989) and the Agreement on the Casino Trail Project (Yukon Government, 1988). These two documents contained comments from the Selkirk and Little Salmon/Carmacks First Nations regarding issues and concerns associated with the proposed development of the Freegold Road, referred to at that time as the Casino Trail, and surrounding areas. Issues and concerns identified through reviewing these reports often reflected traditional practices and land use.

On October 23 and November 8 of 2013, CMC met the White River First Nation, provided a brief overview of the Project and its status, and explained the approach that CMC was taking regarding First Nations consultation. White River also shared information with respect to their interest in the Project. CMC advised the White River First Nation that they would keep them informed as the Project moved forward.

On September 24, 2013, CMC convened an Open house in Beaver Creek. A number of White River First Nation members and Beaver Creek residents attended. More detail on this open house is set out in Section 2.5.2.2.

2.3.7 Champagne and Aishihik First Nations

The Champagne and Aishihik First Nations' Traditional Territory is south of Carmacks and the Project.

2.3.7.1 Champagne and Aishihik First Nations Consultation

In September 2013, CMC contacted the Champagne and Aishihik First Nations by letter and introduced the Project. The Champagne and Aishihik First Nations have not indicated interests in the area of the Project as it is not located within their Traditional Territory. There were questions and interest in participating in business opportunities that may arise.

Newspaper ads for the Project Open houses were placed in local newspapers with circulation that included Haines Junction where the Champagne and Aishihik First Nations offices are located. Champagne and Aishihik First Nations representatives were not present at any of the project Open Houses.

2.3.8 Kluane First Nation

The Kluane First Nation's Traditional Territory is south-west of Carmacks and the Project.

2.3.8.1 Kluane First Nation Consultation

In June 2013, CMC contacted the Kluane First Nation by letter and e-mail and introduced the Project. The Kluane First Nations followed-up with CMC and advised that they believe the Project may affect Kluane First Nation Traditional Territory and requested that they have an opportunity to participate in Project information sessions and the Project Proposal application process prior to the Project Proposal being submitted to YESAB. CMC advised the Kluane First Nation of a YESAB meeting planned in the 3rd quarter of 2013 regarding the access road and wildlife. CMC welcomed the Kluane First Nation to attend the meeting in Whitehorse. However, the Kluane First Nation did not attend the meeting.

Subsequently, CMC and consultants met Kluane First Nation Counsellor, Executive Director and staff at a meeting in Beaver Creek. An overview of the project was provided and a discussion about road access took place. It was confirmed that the proposed access route is from Carmacks and not the Burwash Landing option earlier proposed.

In October 2013, CMC sent the Kluane First Nation a letter confirming that the Burwash Landing access route option is no longer being considered due to environmental sensitivities and that the Freegold Road is the proposed access route.

2.4 YUKON AND FEDERAL GOVERNMENT CONSULTATION

This section presents a description of consultation activities undertaken with government representatives, including:

- Identification of the parties consulted;
- Description of the consultation undertaken; and
- Detailed summary of issues raised during consultation along with an indication of how they were considered and the degree to which issues have been resolved or addressed by CMC and other parties.

2.4.1 Rationale for Consulting Yukon and Federal Government Agencies

The YESAA requires that project Proponents consult First Nations and residents of communities where a proposed project will be located, or where the project might have significant environmental or socio-economic effects. In addition, numerous Yukon and Federal government departments, agencies and regulatory authorities have a mandate to make decisions regarding a proposed project. Consistent with CMC's commitment to corporate social responsibility and to implementing a thorough and on-going consultation process in relation to the Project, CMC conducted two significant rounds of formal consultation with government agencies that will have assessment and regulatory authority over the Project.

The first round, in 2009, focused on presenting and securing feedback on the baseline data collection. The objective was to ensure the data collection was appropriate and addressed the expectations of technical review agencies when the project proposal was submitted. The approach was to meet individually with agencies to

present the program specific to their mandate, then bring these agencies together in a formal session with YESAB to present the methodology and approach for the project. Feedback was received from a number of different agencies and allowed CMC to make a number of important changes and improvements to the baseline program.

The second round of formal consultation was in 2013. This was to present the initial results from the baseline program, and the methodology and approach planned for the project proposal submission to YESAB. A similar approach was used as before with initial discussions with the agencies, culminating in a formal presentation to YESAB. Numerous side meetings with various technical agencies occurred through this period as required.

To date, CMC's consultation activities have involved the following departments of the Yukon Government:

- Yukon Community Services;
- Yukon Economic Development;
- Yukon Energy, Mines and Resources;
- Yukon Environment; Yukon Executive Council Office, including the Development Assessment Branch;
- Yukon Health and Social Services;
- Yukon Highways and Public Works;
- Yukon Housing Corporation; and
- Yukon Tourism and Culture;

CMC has consulted with the following boards and agencies in Yukon:

- Yukon Environmental and Socio-Economic Assessment Board;
- Yukon Water Board; and
- Yukon Energy Corporation.

CMC has consulted the following Federal government departments and agencies to date:

- Canadian Northern Economic Development Agency;
- Environment Canada;
- Fisheries and Oceans Canada;
- Natural Resources Canada; and
- Transport Canada.

In addition to consultations with Yukon and Federal governments, three communities were identified as being most likely to be affected by the Project; these include Pelly Crossing, Village of Carmacks and City of Whitehorse.

The community of Pelly Crossing was selected because it is the centre of government for Selkirk First Nation and the Project is located in their traditional territory. As Pelly Crossing community members are primarily from the Selkirk First Nation, consultation activities with Pelly Crossing are described in Section 2.3.4. The proposed footprint for the mine, as well as the majority of the proposed access road, falls within Selkirk First Nation Traditional Territory.

The community of Carmacks was selected due to its proximity to the Project access road. The majority of the residents of the Village of Carmacks are members of Little Salmon/Carmacks First Nation (their main community is located across the Yukon River from Carmacks). A portion of the proposed access road falls within Little Salmon/Carmacks First Nation Traditional Territory and the road intersection is within the Village of Carmacks.

The City of Whitehorse was selected because it is the largest Yukon community and plays a significant role in the provision of services, goods and labour.

Dawson City is home to the Tr'ondëk Hwëch'in First Nation offices; Burwash Landing is home to the Kluane First Nation offices; and Beaver Creek is home to the White River First Nation offices. CMC has provided Project-related information to and engaged with the Tr'ondëk Hwëch'in, Kluane and White River First Nations (see Section 2.3).

2.4.2 Consultations to Date

CMC consultations with government and regulatory bodies included all those Yukon and Federal government agencies and regulators that had a legislative or policy mandate in relation to the Project and Project-related activities, those that either self-identified as having an interest or were identified by other stakeholders as having an interest in the Project. Comprehensive consultations took place with the Yukon Environmental and Socio-economic Assessment Board, Yukon Executive Council and other Yukon and Federal regulatory decision-makers. The scope, nature and level of detail associated with information provided during consultations was tailored to the particular agency and varied depending on the nature of the decision they would have to make in relation to the Project. While highly technical information was provided to some agencies (e.g. fisheries and aquatics data provided to Fisheries and Oceans Canada) that same information was not necessarily provided to another agency (e.g. Yukon Community Services or Yukon Housing Corporation).

In 2008, CMC began providing information to and engaging with government agencies and regulators and did so through written correspondence (digital and hard copy), phone calls, in-person meetings, site visits, and interviews. Detailed descriptions of the consultation activities undertaken to date are provided in this section as follows:

- Introductory meetings;
- General meetings;
- Project Proposal meetings;
- Project update meetings;
- Socio-economic interviews;
- Site visits; and
- Community open houses.

The following sections describe consultation activities undertaken with government agencies.

A summary of the consultation activities is provided in Appendix 2A. Issues raised during the consultation activities described in this section, their consideration and status are discussed in Section 2.4.3.

Copies of consultation materials, such as presentations, booklets, and other related documents are located in Appendix 2B.

2.4.2.1 Introductory Meetings

Consultation with government agencies and regulators began with a number of meetings in late 2008 and early 2009 for the purpose of introducing the Project, providing an overview of Project components and proposed environmental studies, and affirming CMC's understanding of the regulatory process and approvals needed to support the Project. The Selkirk and Little Salmon/Carmacks First Nations were invited to and participated in many of these meetings.

Prior to each meeting, CMC distributed to each participant an information package in support of the proposed discussion. The package included a letter, agenda and materials, such as slide presentations, draft and final reports and studies. These packages were distributed by e-mail or hard copy depending on the participant's preference.

Introductory meeting topics included: brief Project overview, Project scope and schedule, YESAB information requirements (Project Proposal Table of Contents), proposed approach for baseline data collection, baseline data collection overview, anticipated YESAB key issues, and proposed approach to regulatory review of the Project Proposal (technical advisory committee; external and internal consultation/communications).

A listing of all meetings with government agencies is located in Appendix 2B.

2.4.2.2 General Meetings

Following introductory meetings, general meetings took place in late 2009 and 2010, covering the topics:

- Project Proposal;
- Aquatics program;
- Geochemical characterization;
- Air and water programs;
- Socio-economic;
- Heritage and archaeology;
- Traditional knowledge/land use information collection and integration; and
- Baseline study status.

At key intervals, CMC also arranged Project update meetings to provide an overview of current and proposed Project-related activities, as well as information on activities completed to date, and to discuss specific issues that may have arisen.

In addition to the group meetings with Yukon and Federal government agencies and regulators, CMC also met with specific agencies such as Fisheries and Oceans Canada, Yukon Tourism and Culture, and Yukon Environment, for topic-specific discussions. Meetings with Fisheries and Oceans Canada included topics such as water quality, habitat assessment and compensation, water balance, fish sampling, baseline data collection, effects of climate change on water balance, monitoring and lack of winter low-flow period data. In 2010 and 2011, specific meetings took place with Fisheries and Oceans Canada to discuss a compensation agreement for potential adverse effects on fish habitat associated with the Project.

From 2010 to 2012, a number of meetings occurred with Yukon Environment and Yukon Tourism and Culture, covering topics such as:

- Review of work completed and sites documented;
- Review of future fieldwork work plans;
- Discussion of potential mitigation options for potentially affected sites;
- Clarification of expectations for evaluating potential paleontological resources;
- Clarification of expectations for inventorying and impact assessment of paleontological resources;
- Clarification of expectations for inventorying and evaluating 20th century mining equipment and other industrial remains;
- Clarification of criteria for evaluating significance of historic period cabins; and
- Clarification of the reporting process.

A listing of all meetings with government agencies is located in Appendix 2A.

2.4.2.3 Project Proposal Meetings

In early 2010, CMC arranged two meetings to discuss the specifics of CMC's approach to developing the Project Proposal. The objectives of these meetings were to:

- Provide YESAB, the Selkirk First Nation and other government regulatory agencies with information on the studies, baseline data collection and other Project work conducted to date;
- Outline the studies and work proposed for 2010; and
- Identify key issues that may potentially arise in the Project proposal review.

In addition, during the Project Proposal meetings, CMC sought to confirm with YESAB and other governments whether:

- Work conducted to date would provide an acceptable level of information to support a comprehensive Project Proposal;
- Studies proposed for 2010 would provide an acceptable level of information to support a comprehensive Project Proposal; and
- Methodology used by or proposed for use by CMC's consultants for various components of the work was acceptable.

During the Project Proposal meetings, a number of aspects of the discussions were identified that warranted further discussion. These included:

- Socio-economic program;
- Air quality modelling;
- Cumulative effects assessment;
- Project scope (mine facilities and access road);
- Project proposal table of contents; and
- EA methodology.

In follow-up to the additional discussions suggested at the Project Proposal meetings, CMC met with YESAB in April 2010 to discuss the socio-economic program proposed for the Project. The topics the parties discussed included:

- Rationale for undertaking the socio-economic effects assessment;
- Review of proposed methodology for the socio-economic effects assessment;
- Review 2010 socio-economic fieldwork work plan;
- Review of top-level findings from situational analysis and data;
- Consultation requirements for socio-economic work; and
- Identification of potential issues and solutions.

Following this meeting there was an approximately 18-month period during 2010 and 2011 where CMC continued to gather baseline biophysical data in support of the Project at the same time as undergoing corporate reorganization and structuring.

In late 2011, CMC renewed its engagement with government agencies and regulators through Project update meetings, becoming more focused on the specific requirements and content of the Project Proposal. Additional topics were discussed at the meetings, including:

- Air quality
- Closure bonds;
- Mine and processing operations;
- Noise;
- Water quality; and
- Tailings Management Facility design and tailings in general.

In 2011, there were also one-on-one or small group meetings with specific regulators such as the Fisheries and Oceans Canada, Environment Canada and Yukon Tourism and Culture.

A meeting was held on May 24, 2011 with various government agency stakeholders including Environment Canada, YESAB, and various Yukon Government departments and agencies. Discussion focused on aspects of the Project Proposal including operations, water, air quality, noise, tailings and closure bonds.

CMC and its consultants met with representatives from Fisheries and Oceans Canada and Yukon Environment on May 25, 2011 to discuss a planned site visit to review fish habitat compensation. CMC also met with Environment Canada on the same day to discuss water quality and provide an update on the Project's aquatic program. Discussions also focused on potential groundwater issues, long-term monitoring and a site tour planned for July 2011.

CMC's archaeological heritage consultant met Yukon Tourism and Culture in April 2012 to discuss planning related to the summer 2012 archaeological fieldwork and to discuss the previous fieldwork completed in 2009 during which time the entire mine property underwent an archaeological survey. It was noted that the summer 2012 fieldwork would focus on determining the significance of existing sites, which may result in requirements for further work. Yukon Tourism and Culture provided recommendations and a plan was made for moving forward for regulatory approval.

In 2013, CMC arranged and facilitated seven Project Proposal meetings with YESAB and other participants to discuss the specifics of CMC's approach to developing the comprehensive Project Proposal. The objectives of these meetings were to:

- Provide YESAB, the Selkirk First Nation and/or Little Salmon/Carmacks First Nation and other regulatory agencies with information on the studies, baseline data collection to date and other work that had been conducted;
- Outline the studies and work completed and proposed to support the Project Proposal; and
- Identify key issues that may potentially arise in the Project Proposal review.

Topics discussed during the series of Project Proposal meetings included:

- Project overview;
- Project schedule;
- YESAB information requirements;
- Annotated Table of Contents;
- Project scope;
- Proposed approach for baseline data collection;
- Baseline data collection overview;
- Proposed approach to regulatory review;
  - Technical advisory committee; and
  - External and internal consultation/communications.
- Project Update and Closure Plan;
- Freegold Road;
- VC and YESAA scoping reviews;
- Socio-economics;
- Fisheries and water management;
- Wildlife and mitigation and management plans; and
- Heap leaching;

As previously noted, in addition to the above, during the Project Proposal meetings, CMC sought to confirm with YESAB and other governments that:

- Work conducted to date would provide an acceptable level of information to support a comprehensive Project Proposal;
- Studies proposed would provide an acceptable level of information to support a comprehensive Project Proposal; and
- Methodology used by or proposed for use by CMC's consultants for various components of the work is acceptable.

Selkirk First Nation was invited to meetings when topics included Freegold Road Extension, mine site and related facilities, or other matters that may potentially affect the First Nation. The Little Salmon/Carmacks First Nation was invited to meetings when topics included Freegold Road or other matters that may potentially affect the First Nation. CMC followed up with the First Nation to encourage discussions about the information shared or other topics of interest.

Following each Project Proposal meeting, CMC sent the participants copies of draft meeting notes for review, and asked for acknowledgement that the notes accurately reflected discussions.

A Project Proposal meeting was held on March 11, 2013 that included: CMC and its consultants, Fisheries and Oceans Canada, Environment Canada, various Yukon Government departments, YESAB, and the Selkirk First Nation. The purpose of the meeting was to provide a Project update and to discuss Closure Plan Concepts. Other items discussed at the meeting included baseline environmental findings, geochemistry, and tailings and waste rock management.

On April 17, 2013, a meeting was held with YESAB, the Selkirk First Nation, Yukon Executive Council Office, and Yukon Energy, Mines and Resources to provide a Project overview, discuss the proposed Freegold Road extension, review the annotated Table of Contents for the Project Proposal and discuss the Valued Components which would be included in the Project Proposal.

A meeting was held on May 14, 2013 to present and discuss the proposed approach to the socio-economic assessment being conducted for the Project. Topics discussed during the meeting included the study methodology, VCs, potential data limitations and gaps as well as effects assessment. The meeting was attended by YESAB, Yukon Economic Development, Yukon Health and Social Services as well as CMC and its consultants.

CMC and its consultants met with various government agencies and regulators on June 11, 2013 to review and discuss fisheries and water management aspects of the Project. Meeting participants included YESAB, Selkirk First Nation, Yukon Energy, Mines and Resources, Yukon Environment, Yukon Executive Council Office, Fisheries and Oceans Canada, and Environment Canada. The objective of the meeting was to bring together YESAB and other government agencies for an opportunity to review and discuss the methodology and concepts that would form the design for submission to YESAB, Yukon Government and other regulators.

A technical meeting was held on July 9, 2013 to discuss the approach and methodology to the road and air access components of the Project. Meeting participants included YESAB, various Yukon Government departments, Selkirk First Nation and Little Salmon/Carmacks First Nation. During the meeting, CMC, CMC consultants and government participants reviewed the engineering, baseline studies and proposed management plans to ensure the continued protection of wildlife during the construction, operation and decommissioning of the proposed access road and airstrip.

The Project's proposed heap leach facility was the focus of a technical meeting held on August 20, 2013. The meeting was attended by representatives from YESAB, various Yukon Government departments, Environment Canada, CMC and its consultants. CMC and its consultants provided an overview of the Project, a review of the work completed to date regarding heap leach facility planning, and responses to various questions about the proposed heap leach facility.

The seventh Project Proposal meeting, held with the Selkirk First Nation and its technical specialists, the Little Salmon/Carmacks First Nation, YESAB, Carmacks Renewable Resources Council, Yukon Highways, Yukon Executive Council, and Yukon Environment on September 10, 2013, was to review the key focus areas and key issues discussed to date. Topics discussed, and issues raised related to the Freegold Road and upgrades,

access construction (including air and Freegold Road traffic), mitigation and management plans to address potential effects on wildlife (including wildlife monitoring), and cumulative effects. The meeting agenda topics included:

- Project overview;
- Access overview, including:
  - Engineering (Freegold upgrade and extension, airstrip);
  - Traffic volumes and types; and
  - Closure.
- Terrestrial Environment, including:
  - Project interactions; and
  - Baseline information and studies.
- Issues; and
- Mitigation and management plans.

In addition to the seven Project Proposal meetings held with government agencies in 2013, several meetings were held to discuss various technical aspects of the Project and to provide updates on Project activities to date and planned activities.

A meeting was held with Environment Canada on March 25, 2013 to discuss the Project's water quality program. Following this meeting, CMC's aquatics consultant provided Environment Canada a memo describing proposed site-specific water quality objectives.

CMC and its consultants met with YESAB, Yukon Environment and Yukon Executive Council Office on May 2, 2013 to discuss baseline data and potential Project effects with respect to caribou. Meeting participants engaged in discussions on the status and potential effects of development on caribou populations. A concern was noted regarding the proposed Freegold Road extension through a caribou winter range near Hayes Creek/Selwyn River.

Environment Canada met with CMC on May 22, 2013 to review the planned field program and baseline report. Environment Canada advised attention to the proposed tailings management facility and development of the wetland during closure/post-closure, possible interactions with migrating and/or breeding waterfowl using the pit and/or tailings management facility, and interaction with species of conservation concern.

A listing of meetings with government agencies is located in Appendix 2A. Many more informal communications took place over the last six years by phone and email with numerous agency personnel that are not documented here.

2.4.2.4 Socio-Economic Interviews

Interviews were conducted with several government agencies to inform the socio-economic baseline report and the effects assessment studies that were being prepared for the Project. These interviews were conducted in-person or by phone with specific individuals to gather pertinent information related to the study area. Fourteen interviews were conducted with Yukon government agencies for the purpose of informing socio-economic studies. Interviews were conducted as follows:

- Yukon Community Services, Emergency Planning (October 3, 2012);
- Yukon Community Services, Municipal Infrastructure (October 3, 2012);

- Yukon Community Services, Wildland Fire Management (February 13, 2013);
- Yukon Energy Corporation (October 22, 2013);
- Yukon Energy, Mines and Resources (October 1, 2012, February 13, 2013, October 22, 2013);
- Yukon Energy, Mines and Resources, Land Department (October 3, 2012)
- Yukon Health and Social Services (October 2, 2012);
- Yukon Highways and Public Works (October 2, 2012);
- Yukon Housing Corporation (October 1, 2012, October 22, 2013 and October 24, 2013) ; and
- Yukon Tourism and Culture (October 2, 2012).

CMC also made attempts to schedule interviews with other government agencies including Yukon Department of Education.

Information from the interviews was considered and incorporated into the socio-economic baseline report and effects assessments and, where concerns or issues were raised, they were considered by CMC in Project planning and developing mitigation measures.

2.4.2.5 Site Visits

In 2011, three site visits were conducted for government agencies. Fisheries and Oceans Canada took part in a site visit on June 8, 2011 for the purpose of reviewing environmental stations, potential compensation sites, the in-stream flow program, water supply options and tailings management options. A second site visit involving Fisheries and Oceans Canada took place on July 12, 2011 for the purpose of reviewing habitat compensation areas. Environment Canada participated in a site visit on July 12, 2011 to discuss the mine layout and its potential effects on the aquatic environment.

In 2013, government and regulatory representatives participated in two site visits. The first, on June 12, 2013 involved the Yukon Government Premier, Darrell Pasloski and Senator for Yukon, Dan Lang. YESAB Executive members participated in a site visit on June 13, 2013.

2.4.2.6 Community Open Houses

CMC conducted community open houses to provide information to the public, to introduce the Company and the Project, and to discuss any interests or concerns. From 2008 through 2013, CMC conducted nine community open houses that were in addition to the open houses conducted specifically for First Nation communities. CMC extended invitations to attend the community open houses to representatives of the Village of Carmacks, the City of Whitehorse, the Renewable Resource Councils, and First Nations of each of the Carmacks and Selkirk First Nations, and a wide array of Yukon and federal government representatives. The Yukon government was represented at the May 28, 2012 Carmacks community open house and the May 30, 2012 Whitehorse community open house. Detailed information on the community open houses is provided in Section 2.5.2.2.

2.4.3 Issues Raised, Their Consideration and Status

CMC consulted with Yukon and federal government agencies and regulators to proactively gain their input on the Project and its related studies. CMC documented these interests and issues, which are presented in Table 2.4-1.

Table 2.4-1 Government Consultation Overview

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
2	Meeting	December 3, 2008	Operations	What are the power options for the site? How will the fuel source be sourced?	A variety of power generation and fuel and power supply options were considered. CMC has determined that LNG is the preferred power generation option. See Commitments for additional information. LNG will be used to fuel on-site power generation.
2	Meeting	December 3, 2008	Tailings Pond/Impoundment	Potential permafrost effects on the project development and operations.	CMC has considered permafrost during the design of Project infrastructure, including the access road and the mine requirements. Additional consideration was given to permafrost effects during the assessment of Terrain in Section 6
2	Meeting	December 3, 2008	Tailings Pond/Impoundment	How is the project assessing geochemistry and waste run off from the mine?	CMC has completed a number of studies to characterize geochemistry and potential water quality issues. Specific geochemical studies and water quality modeling is included in Section 7.
6	Meeting	March 31, 2009	Community Infrastructure and Services	Use of coal for power generation is an issue.	A variety of power generation and supply options were considered. Proponent has determined that LNG is the preferred power generation option (Section 4). LNG will be used to fuel on-site power generation (Section 1.1). Resolved.
5	Meeting	March 31, 2009	Air Quality	What are the climate change effects resulting from the project.	Climate change effects have been considered and are discussed in Appendix 20A
5	Meeting	March 31, 2009	Baseline Studies	Baseline data for Dip creek. Was this completed?	Studies regarding the physical and biological components of Dip Creek have been completed.
5	Meeting	March 31, 2009	Baseline Studies	Potential toxicity in fish in downstream of the tailing facility and testing stations on Dip Creek.	CMC has completed studies to characterize geochemistry and potential adverse effects on water quality. The impacts of predicted operational and post-closure water quality parameters on fish have been assessed in Section 10
5	Meeting	31-Mar-09	Fisheries and Aquatic Resources	Need a quantitative assessment of habitat quality for fish.	CMC consultants have written a Fish and Aquatic Resources Baseline Report, based on detailed field data collected since 2008.
5	Meeting	31-Mar-09	Fisheries and Aquatic Resources	Development of a fish habitat compensation plan.	CMC consultants have developed a Fish Habitat Compensation Plan
5	Meeting	31-Mar-09	Water Quality	Winter flow data for water quality baseline	CMC consultants have written baseline reports for both Fish and Aquatic Resources and Water Quality - they include sampling from all potentially effected watercourses and water quality has been collected in all seasons and on a monthly basis for a min. 1 year period
5	Meeting	31-Mar-09	Water Quality	Fish habitat assessment	CMC consultants conducted extensive sampling for Fish and WQ.
9	Meeting	May 13, 2009	Cultural Continuity	Need to ensure confidentiality of traditional knowledge information provided by First Nations.	CMC intends to continue discussions with Selkirk and Little Salmon/Carmacks First Nations regarding protocols or agreements for protection of traditional knowledge. Resolved, monitor in future, adapt as required.
24	Meeting	January 7, 2010	Cultural Continuity	Need to ensure confidentiality of TK information provided by First Nations.	CMC intends to continue discussions with Selkirk and Little Salmon/Carmacks First Nations regarding protocols or agreements for protection of traditional knowledge. Resolved, monitor in future, adapt as required.
24	Meeting	January 7, 2010	Cultural Continuity	Collection, authorization and integration of TK into the project proposal and impact assessment.	CMC has had numerous discussions with the Little Salmon/Carmacks and Selkirk First Nations regarding traditional use studies, and protection and confidentiality of traditional knowledge. Through consultations a number of traditional uses have been identified and considered in the effects assessments and the development of mitigation. Resolved, on-going.
24	Meeting	January 7, 2010	Cultural Continuity	The implementation of the Heritage Mitigation Plan and oversight by the Yukon Historic Resources Board; data collected on heritage and	CMC completed a heritage resource impact assessment on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. Heritage sites have been identified and marked in the field. A Heritage Management Plan and chance find procedure have been

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
				archaeological sites and TK are sensitive and confidential to Selkirk First Nation.	developed. CMC and its consultants are respectful of the sensitivity of heritage information. CMC intends to continue discussions with Selkirk and Little Salmon/Carmacks First Nations regarding protocols or agreements for protection of traditional knowledge. CMC to continue to consult with the Selkirk First Nation and Yukon Heritage to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Protection Plan, including a chance find procedure (Section 22.3.7). Mitigation described in impact assessment will be followed. Resolved, monitor in future, adapt as required.
24	Meeting	January 7, 2010	Economic Development and Business Sector	Need to see the full range of positive project effects presented in the Project Proposal.	CMC met seven times in 2013 with Yukon and other regulators to discuss the approach to and elements of the Project Proposal. CMC designed the Project Proposal based on these meetings. Potential adverse and positive effects have been identified as appropriate. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond. CMC will monitor project socio-economic and other potential effects and adapt management measures where required (Sections 6 through 19). Resolved, monitor in future, adapt as required.
25	Meeting	January 8, 2010	Air Quality	Air Quality and Noise Discipline Lead needs to follow up with the air quality expert within the Yukon Government regarding the proposed 2010 Air Quality, Noise and Climate programs.	CMC's consultants had numerous meetings with Yukon and other regulators to confirm their baseline programs would match regulatory requirements. In addition, CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Specific topics discussed included air quality. CMC designed the Project Proposal and cumulative effects assessment based on input from First Nations and Yukon and other regulators. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond (Section 2.4.2).
25	Meeting	January 8, 2010	Baseline Studies	The Hydrology Discipline Lead to follow up with Richard Janowicz (Yukon Government) to discuss the hydrology program and to obtain any regional hydrometric data if available in the near future.	CMC's consultants had numerous meetings with Yukon and other regulators to confirm their baseline programs would match regulatory requirements. In addition, CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Specific topics discussed included hydrology. CMC designed the Project Proposal based on input from First Nations and Yukon and other regulators. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond.
25	Meeting	January 8, 2010	Baseline Studies	Importance of the water balance model as it will be scrutinized a lot due the situation at the Minto Mine.	CMC's consultants had numerous meetings with Yukon and other regulators to confirm their baseline programs would match regulatory requirements. In addition, CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Specific topics discussed included water balance. CMC designed the Project Proposal based on input from First Nations and Yukon and other regulators. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond.
25	Meeting	January 8, 2010	Baseline Studies	Question of groundwater flowing towards north towards the Yukon River. This is a major concern and may require addition surface water quality stations to be established in the Canadian/Britannia watershed.	CMC's consultants had numerous meetings with Yukon and other regulators to confirm their baseline programs would match regulatory requirements. In addition, CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Specific topics discussed included hydrology. CMC designed the Project Proposal based on input from First Nations and Yukon and other regulators. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond.
25	Meeting	January 8, 2010	Environmental Management	Need to define critical parameters for the environmental management system.	CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Mitigation and management of potential adverse effects on VCs were discussed. Section 22 describes the conceptual management plans proposed to address potential adverse effects. CMC designed the Project Proposal based on input from First Nations and Yukon and other regulators. CMC intends to

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					continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond.
25	Meeting	January 8, 2010	Closure	Establishment of a detailed closure plan that satisfies the needs of YSAB policy and the Quartz Mine License issued by Yukon Government.	CMC met YESAB and other Yukon and federal regulators seven times in 2013, and a number of times in prior years to discuss elements of the Project Proposal. Closure plans and planning were specific topics discussed. Management of potential adverse effects on VCs were discussed. Section 22 describes the conceptual management plans proposed to address potential adverse effects. CMC designed the Project Proposal based on input from First Nations and Yukon and other regulators. CMC intends to continue to consult First Nations and Yukon and other regulators during the Project Proposal review and beyond. See Commitments for more information. CMC Mine closure and site reclamation 23.3.12 This section will address the actions to be taken following mine closure to protect the natural and social environments. And monitoring for closure 23.4.4
34	Meeting	April 12, 2010	Cultural Continuity	Need a process to deal with historical finds during project activity (Heritage Resources Management Plan).	CMC completed heritage resource impact assessments on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. A Heritage Management Plan and chance find procedure have been developed. CMC to continue to engage with the Selkirk First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3.7). Resolved, monitor in future, adapt as required.
36	Meeting	April 13, 2010	Community Vitality	Need to consider community's resilience to withstand (or ability to benefit from) potential Project effects.	CMC completed a socio-economic effects assessment that considered community resilience when assessing potential effects. Mitigation to address potential adverse effects were developed. Socio-economic monitoring and adaptive management are proposed. CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2, 16.4.2, 17.4.2, 18.4.2). Resolved, monitor in future, adapt as required.
36	Meeting	April 13, 2010	Land Use and Tenure	Need to have the same project team members working on the access road as the mine site (in terms of socio-economic issues).	The mine site and the access road are components of the Project (Section 4). The same project team members worked on the access road and mine site socio-economic effects assessment. Resolved.
36	Meeting	April 13, 2010	Community Vitality	Community fatigue and capacity because of multiple major projects occurring at the same time.	CMC will implement a socio-economic management plan and monitor project socio-economic effects; adapt management measures where required. CMC has discussed this topic with the Selkirk First Nation and is exploring the option of completing socio-economic monitoring jointly with the Minto mine. CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2, 16.4.2, 17.4.2, 18.4.2). Resolved, monitor in future, adapt as required.
36	Meeting	April 13, 2010	Effects Assessment	Consideration of the differences in effect between the various power options i.e. coal vs. natural gas. - Capturing different levels of road access impacts for different communities.	Effects assessments include consideration of the proposed alternative (LNG). Alternative assessment is presented in Section 3.
36	Meeting	April 13, 2010	Effects Assessment	Clarification of responsibility for addressing effects. i.e. company vs. government.	Where mitigation is suggested by CMC to reduce or eliminate adverse residual effects, these have been captured as company commitments, in the Table of Commitments (Section 24)
101	Letter	June 22, 2010	Fisheries and Aquatic Resources	Information from DFO needs to be incorporated into fish habitat	Ongoing. This information was obtained and has been used in the development of the fish compensation plan.

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				compensation plan	
44	E-mail	April 11, 2011	Design	Ensuring that the proper Fisheries Act authorizations are in place for culverts on the access road.	The access road does not contemplate culverts. Rather, bridges are proposed for each stream crossing. Regardless, Fisheries Act authorizations will be acquired where necessary.
103	Meeting	April 20, 2011	Fisheries and Aquatic Resources	Need for DFO Schedule 2 amendment in regards to fish in upper Casino Creek	Ongoing. The schedule 2 amendment was deemed unnecessary by DFO in 2012, so there will be no discussion between DFO and EC on this issue. However, the addendum to the letter, based on finding fish in upper Casino Creek in 2013 might trigger some follow-up between DFO and EC on this issue.
104	Meeting	May 24, 2011	Design	Incorporating the onsite gold smelting processes into the air quality program.	All Project components have been included to the air model.
104	Meeting	May 24, 2011	Closure	A need to develop plans for closure bonds for different phases of the life of mine.	Closure bonding will be addressed in detail during the review of the Quartz Mine License
104	Meeting	May 24, 2011	Tailings Pond/Impoundment	Consideration of climate change and discontinuous permafrost in the TIA design.	Permafrost and probable maximum flood / precipitation were considered in the TMF (TIA) design.
104	Meeting	May 24, 2011	Noise	A need to factor in the location of the mill – high elevation, to the Noise Assessment.	All Project components have been included to the noise model.
104	Meeting	May 24, 2011	Operations	Potential need to replace the current snow-course monitoring station next to current airstrip at Casino site when infrastructure is constructed.	Monitoring during Project operations will adapt to changing infrastructure.
104	Meeting	24-May-11	Water Quality	Identified need to a water quality model to identify where it approaches background (i.e., at what point do water quality impacts cease to be detected?). Identified need to consider the effects of the open pit and groundwater flow on Canadian Creek. Identified need to evaluate the potential downstream effects from diversion of flow from Casino Creek (i.e., develop water balance; determine what percentage of Casino Creek will be within the footprint of the tailings impoundment area). Identified need to establish site-specific water quality objectives (SSWQO) without loadings from non-natural sources.	This information will be captured in the baseline and effects assessment reports for water quality and sediment.

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106	Meeting	May 25, 2011	Baseline Studies	Groundwater flows and baseline information needs to be well documented in the proposal.	Groundwater flows have been characterized.
105	Meeting	25-May-11	Fisheries and Aquatic Resources	Identified the need to consider impacts from equipment mobilization and access to compensation site. Identified that Transport Canada will need to review the compensation plans; therefore, engage them after draft proposal but consider engaging them early to determine level of involvement.	All parties have been engaged with the exception of Transport Canada
106	Meeting	25-May-11	Water Quality	Identified need to consider R2 and additional reference site as one of the sites for long-term monitoring. Identified that groundwater may be impacted by the Heap Leach Facility and that a baseline groundwater well may be needed. Identified additional benthos/periphyton sites for 2011 program Identified that Radium 226 is one of the six or so parameters where effluent must meet guidelines in MMER. Identified that spreadsheets would make review process easier and should be made part of the Project Proposal submission.	The water quality and sediment baseline and effects assessment report sections. To respond to specific questions: Radium 226 was sampled and no concern. Yukon Water quality data web-site was reviewed. Se has been assessed in the WQ model and has been identified as a CoC with no significant effect on fish. Ephemeral tribs to Casino Creek were sampled and they do not represent WQ in Casino Creek.
107	Site Visit	June 8, 2011	Tailings Pond/Impoundment	Consideration of an option to construct a number of smaller tailings facilities in fishless headwater areas of Casino, Meloy and Brynelson Creeks to reduce the need for compensation.	The TMF was designed to be stable, operable, and economic, whilst reducing impacts through operation and post closure phases.
107	Site Visit	08-Jun-11	Fisheries and Aquatic Resources	Identified the need for a gradient map to determine extent of fish presence for August sampling program. Identified the need to install minnow traps in headwaters of Casino	This has all been satisfied

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				Creek above gradient barrier to confirm presence/absence of fish. Identified the need to add another electrofishing station on Casino Creek Identified the need to determine if groundwater upward gradients exist in the lower section of Britannia Creek for potential habitat compensation. Identified need to assess opportunities for fish habitat compensation along Big Creek for Chinook spawning in relation to the access road. Identified need to determine if it is acceptable to transplant Chinook salmon into an area they currently are not using. Identified need to seek guidance from DFO on the amount of data necessary to determine the upper extent of fish utilization in cases where there is no obvious barrier to the upstream movement by fish. Identified need to seek guidance from DFO on compensation consideration in cases where stream habitat is converted to lake habitat (i.e., creation of a water reservoir) and where areas are not frequented by fish. Identified the need for a gradient map to determine extent of fish presence for August sampling program. Identified need to seek guidance from DFO on which compensation plan should include the upper stream sections that are expected to be isolated but not flooded by the	

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				tailings impoundment area. need to seek guidance from DFO on which compensation plan should include the upper stream sections that are expected to be isolated but not flooded by the tailings impoundment area.	
107	Site Visit	08-Jun-11	Water Quality	Identified the need to consider costs of habitat compensation for loss of Brynelson in the alternatives assessment.	The decision is that water will be pumped from a rainy well next to the Yukon River. Brynelson Creek is no longer on the options table.
108	Site Visit	12-Jul-11	Fisheries and Aquatic Resources	Presence of Chinook salmon in Casino Creek	This has been confirmed. A juvenile Chinook was captured by Summit, length data was obtained, but no photo or weight taken.
108	Site Visit	12-Jul-11	Fisheries and Aquatic Resources	Site location for suitable fish habitat compensation	Suitable fish habitat compensation has been proposed.
167	Phone Call	October 31, 2011	Tailings Pond/Impoundment	Compensation for placer mine on Canadian Creek.	Options for fish habitat compensation have been considered and proposed.
167	Phone Call	31-Oct-11	Fisheries and Aquatic Resources	Identified need to conduct monitoring if extracting water from Britannia Creek (resulting in a HADD) to produce a viable new rearing/spawning channel.	This concept was an option in the fish compensation plan, but it has not been brought forward into the preferred option.
427	Meeting	05-Dec-11	Fisheries and Aquatic Resources	Identified the need to meet CCME and develop SSWQO Identified concerns over the effects of MMER and seepage on water quality and fish.	See details in the water quality and sediment Baseline and Effects Assessment reports.
428	Meeting	01-Mar-12	Fisheries and Aquatic Resources	Culverts for road crossings of fish bearing streams.	There are no culverts being proposed in fish bearing streams along the Freegold Road upgrade or extension. All fish bearing streams will be crossed with a bridge. All non-fish bearing streams will be crossed with a culvert
153	E-mail	April 19, 2012	Cultural Continuity	Historic sites should be classified as those falling under the Historic Resources Act and those that don't.	CMC completed heritage resource impact assessments on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. A Heritage Management Plan and chance find procedure have been developed. CMC to continue to engage with the Selkirk First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3.7). Resolved, monitor in future, adapt as required.
193	Meeting	October 1, 2012	Land Use and Tenure	Increased competition for hunting because of new infrastructure.	Potential effects on hunting harvests have been considered in the wildlife and land use effects assessments (Sections 19 and 12). Mitigations to avoid or minimize adverse effects have been developed. CMC will implement a variety of plans to minimize adverse effects on hunting, including a Road Use Plan (Section 22.3.9), and a Wildlife Mitigation and Monitoring Plan (Appendix 23C). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access (Section 19.4.2). CMC will also monitor project socio-economic effects and adapt management measures where required (Sections 18.4.2).

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					Resolved, monitor in future, adapt as required.
232	Meeting	October 1, 2012	Economic Development and Business Sector	Need for a procurement strategy.	CMC completed a socio-economic effects assessment that considered potential effects on economic development, employability, and employment and income. Mitigation to address potential adverse effects were developed. Socio-economic monitoring and adaptive management are proposed. CMC will implement a procurement process that gives priority to suppliers from the RSA and in particular rural communities within the LSA; implementing a procurement process that gives priority to contractors who hire local/regional residents to the greatest practical extent; implement a procurement process that manages contract components to meet the capabilities of LSA entrepreneurs; encourage joint ventures between Aboriginal businesses and other regional businesses in the procurement process; require cultural awareness training for employees and contractors; monitor project socio-economic effects and adapt management measures where required; partner with First Nation communities and their development corporations to access additional funding for training; provide on-the-job training to assist local and regional workers to develop mining-specific skills; provide training and education for potential employees from Yukon and in particular the rural communities within the LSA; partner with First Nation communities to access additional funding for training; support for non-mining training and entrepreneurial initiatives; implement career training and development opportunities for employees once hired; and provide continuous, on the job safety training. See Sections 13.4.2, 14.4.2, and 15.4.2. Resolved, monitor in future, adapt as required.
197	Meeting	1-Oct-12	Wildlife	Identified concern of the proposed Freegold Road extension potential effects on caribou migration (Klaza herd).	Potential effects on caribou habitat, migration, mortality, and seasonal use were assessed. Mitigation measures to address these effects have been established. See 12.3.3.4 Potential Effects and Mitigation Measures for Caribou. See Section 19 on land use and access management. Resolved. Ongoing monitoring and adaptive management required.
197	Meeting	October 1, 2012	Design	Design issues related to the by-pass.	The final design of the by-pass around Carmacks will be conducted in coordination with Yukon Government and other stakeholders.
196	Meeting	October 2, 2012	Community Vitality	Increased safety risks to summer traffic.	CMC completed a socio-economic effects assessment that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Sections 17.4.2). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations and Yukon Government on access management agreement (Section 19.4.2). Resolved, monitor in future, adapt as required.
196	Meeting	October 2, 2012	Land Use and Tenure	Reduction of available hunting area.	Habitat, migration and mortality effects for moose and caribou were assessed. Mitigation measures and recommendations are provided in section 12.3.3.4, and 12.3.4.4. The assessment of moose and caribou hunting mortality was considered within the framework of CMC's mitigation and monitoring plans. CMC will ensure application of mitigation measures and undertake the required monitoring and

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					management practices during the development and operations of the project to minimize effects on hunting (Sections 18, 19), moose and caribou (Section 12). This will include implementing the Road Use Plan (Section 22.3.9) and Wildlife Mitigation and Monitoring Plan (Appendix 23C). Resolved, monitor in future, adapt as required.
196	Meeting	October 2, 2012	Community Vitality	Potential for increased project traffic to affect tourism by displacing tourists.	CMC completed a socio-economic effects assessment that considered potential effects from the Freegold Road and associated traffic (Section 17.4.2). Potential effects of traffic on guide outfitters is assessed in Section 19). Mitigation to address potential adverse effects were developed. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13, 15, 17, 19, subsections 4.2). Resolved, monitor in future, adapt as required.
190	Meeting	October 3, 2012	Community Vitality	Adverse effects of using the Freegold Road on the socio-economics of the Village of Carmacks.	CMC completed a number of interviews with First Nations and Village representatives and local service providers to identify current and anticipated conditions. This information was considered in the socio-economic effects assessment. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13, 15, 17, 19, subsections 4.2). Resolved, monitor in future, adapt as required.
190	Meeting	October 3, 2012	Community Vitality	Adverse effects of using the Freegold Road on Carmacks traffic.	CMC completed a socio-economic effects assessment that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Socio-economic monitoring and adaptive management are proposed. A by-pass will be constructed in the vicinity of the Village of Carmacks to mitigate adverse effects from potential increased traffic. CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2, 17.4.2). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means. Resolved, monitor in future, adapt as required.
234	Meeting	October 3, 2012	Land Use and Tenure	Increased use of road, and policies to control access.	CMC completed a land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Socio-economic monitoring and adaptive management are proposed. Potential traffic effects are discussed in Sections 17, 18 and 19. CMC will develop and implement a Road Use Plan (22.3.9). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means. Resolved, monitor in future, adapt as required.
190	Meeting	3-Oct-12	Wildlife	Identified concern of the proposed Freegold Road extension potential effects on wildlife, socio-economics (Village of Carmacks) and traffic.	CMC undertook an effect assessment (See section 12.3.1 Project Interactions and Potential Effects on Wildlife), and has developed an access management plan that will mitigate the risk of increased mortality from harvest by managing the Freegold Road extension as a private resource road./ CMC will work with government agencies and First Nations to monitor and adapt the access management plan as necessary through the life of the project to ensure that effects on

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					wildlife are minimized. CMC will: • Section 19 - Restrict access to the road during operation by installing a continuously manned gate at Big Creek, and • Decommission the road during the reclamation and closure phase. • Develop a wildlife management planning group including regulators, First Nations, and stakeholders, to advise on mitigation, monitoring and adaptive management strategies. See Appendix 23C. Resolved. Ongoing monitoring and adaptive management required.
234	Meeting	3-Oct-12	Wildlife	Identified concern related to the proposed Freegold Road extension and its potential effect on wildlife (need for mitigation plans).	Wildlife effects potentially resulting from the project were dealt with using a key indicators approach. A management prescription has been recommended for each species where effects are likely. See Appendix 23C. CMC will address and mitigate specific effect on specific key indicator wildlife species and populations as required through the development and operation of the project. CMC aims to minimize effects to wildlife, monitor the results of mitigation, and adaptively manage for any unanticipated effects given the final Project footprint. Resolved. Ongoing monitoring and adaptive management required.
440	Meeting	February 13, 2013	Economic Development and Business Sector	Assist local businesses and suppliers with understanding the procurement process.	CMC completed a socio-economic effects assessment that considered potential effects on economic development and business opportunities, employability, and employment and income. Mitigation and enhancement policies to address potential adverse effects were developed. Socio-economic monitoring and adaptive management are proposed. CMC will: implement a procurement process that gives priority to suppliers from the RSA and in particular rural communities within the LSA; implement a procurement process that gives priority to contractors who hire local/regional residents to the greatest practical extent; implement a procurement process that manages contract components to meet the capabilities of LSA entrepreneurs; encourage joint ventures between Aboriginal businesses and other regional businesses in the procurement process, including sharing information about opportunities; require cultural awareness training for employees and contractors; monitor project socio-economic effects and adapt management measures where required; partnering with First Nation communities and their development corporations to access additional funding for training; Providing on-the-job training to assist local and regional workers to develop mining-specific skills; • Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; See Sections 13.4.2, 14.4.2, and 15.4.2. Resolved, monitor in future, adapt as required.
443	Meeting	February 13, 2013	Community Vitality	Increased population means increased need for protection services.	CMC completed a socio-economic effects assessment that considered potential effects. Mitigation to address potential adverse effects were developed. On-site camp and fly in-out staffing included in design. Socio-economic monitoring and adaptive management are proposed. CMC will establish a camp on-site to minimize potential need for increased protection services. CMC will institute traffic management measures to decreased risk of vehicle accidents, and provide security on site (Section 14.4.2) CMC will also implement a Road Use Plan (Section 22.3.9) CMC will monitor project socio-economic effects and adapt management measures where required (Sections 17.4.2). Resolved, monitor in future, adapt as required.
257	Meeting	March 11, 2013	Waste Rock	Use of waste rock (ARD) for onsite road construction.	Waste rock may be used for construction purposes if it is shown to be inert and otherwise suitable.
257	Meeting	March 11, 2013	Tailings Pond/Impoundment	Concern about the stability of the tailings dam due to ice layers.	Freezing and ice formation were considered during the design of the TMF.

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346	Meeting	May 2, 2013	Land Use and Tenure	Increased access leading to higher animal mortality and reduced ability to hunt.	Potential effects of increased access and potential mortality were considered in the land use and wildlife effects assessments. Mitigations to avoid or minimize adverse effects have been developed. Mitigation measures and recommendations are provided in Section 12.3.3.4 Potential Effects and Mitigation Measures for Caribou, and 12.3.4.4 - Potential Effects and Mitigation Measures for Moose. The assessment of moose and caribou hunting mortality was considered within the framework of CMC's mitigation and monitoring plans. CMC will implement a variety of plans to minimize adverse effects on traditional hunting, fishing and harvesting, including a Wildlife Mitigation and Monitoring Plan (Appendix 23C), Road Use Plan (Section 22.3.9). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access (Section 19.4.2). CMC will institute a no hunting policy for workers while onsite (Section 18.4.2). CMC will also monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2). Resolved, monitor in future, adapt as required.
346	Meeting	May 2, 2013	Land Use and Tenure	Enforcement and monitoring associated with the road access management plan. How will this be realized and what conditions will be stipulated.	CMC completed land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Potential traffic effects are discussed in Sections 17, 18 and 19. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3.9). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access (Section 19.4.2). CMC will monitor project socio-economic effects and adapt management measures where required (Sections 17.4.2). Resolved, monitor in future, adapt as required.
346	Meeting	2-May-13	Wildlife	Identified concern regarding the proposed Freegold Road extension and the caribou winter range (potential effects to population and habitat).	Potential effects on caribou habitat, migration, mortality, and seasonal use were thoroughly assessed. Mitigation measures to address these effects have been established. See 12.3.3.4 Potential Effects and Mitigation Measures for Caribou. CMC's goal is to prevent the Caribou from becoming threatened or endangered by engaging responsible agencies to carefully manage caribou and their habitat within the project footprint and access corridor. See Appendix 23C. Resolved. Ongoing monitoring and adaptive management required. Resolved.
346	Meeting	2-May-13	Wildlife	Identified concern regarding the legal ability to manage access on a private resource road.	Appendix 22A presents discussion regarding the proposed road management.
385	Meeting	May 14, 2013	Cultural Continuity	Proponent needs to provide support to First Nations to collect TK information.	CMC has had numerous discussions with the Little Salmon/Carmacks and Selkirk First Nations regarding traditional use studies and traditional use of the Project area and area surrounding the Freegold Road. CMC intends to continue discussions with the First Nations regarding traditional activities and uses of the Project area. Resolved, on-going.
312	Meeting	22-May-13	Wildlife	Identified concerns related to the potential interactions between migrating and/or breeding birds and the open pit and/or tailings management facility.	Project effects on waterfowl health as a result of interactions with the tailings and other mine water bodies were assessed qualitatively as the likelihood of waterfowl experiencing toxic effects from foraging and/or establishing residence on the open water/wetland portion of the tailings management facility or other mine water bodies. The assessment was based on expected water quality, closure plans, and literature on the effects of pH and various contaminants on waterfowl. See section 12.3.9 Waterfowl Effects Assessments. Mitigation measures to address potential health effects on waterfowl will be triggered by Project monitoring. If water quality monitoring results exceed acceptable standards, wildlife monitoring in the vicinity of the affected water body

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
					will be conducted to determine whether waterfowl or other wildlife are using that area. If necessary, wildlife deterrence measures may be implemented to minimize interactions. See Appendix 23C. Thresholds related to water quality are addressed in the water quality volume and the closure plan. Resolved. Ongoing monitoring and adaptive management required.
312	Meeting	22-May-13	Wildlife	Identified concerns related to any interactions with species of conservation concern.	Within the LSA there are a number of bird species at risk or species of conservation concern which have been documented to be present or are likely to occur. The Project species list also includes 14 species that are on the Yukon Conservation Data Centre's track list and 53 species identified as priority species for conservation under the Bird Conservation Strategy for Bird Conservation Region 4. An effects assessment was undertaken to determine required mitigation strategies. See 12.3.1 Project Interactions and Potential Effects on Wildlife. / To address environmental and Project changes through time, an adaptive management approach will be adopted for mitigation and monitoring plans. CMC anticipates that the plan will evolve and be adjusted to incorporate practical and workable solutions to minimize Project effects on species of concern and support regional wildlife research and management initiatives. See section 12.1.1 - Mitigation Measures for Wildlife. / Resolved. Ongoing monitoring and adaptive management required.
331	Phone Call	6-Jun-13	Wildlife	Identified concern related to the assessment of grizzly bears in the Project area.	A detailed effects assessment was conducted. See 12.1.1 - Grizzly Bear Effects Assessment. General Project mitigation measures described Section 12.3.2 (Mitigation Measures) and Grizzly bear-specific mitigation measures were developed. See Appendix 23C.
386	Meeting	June 11, 2013	Environmental Management	Concerns raised: (a) discharges from tailing facility and lessons learned from Minto mine. (b) Water seepage from tailings and water quality. (c) Wildlife interactions and potential contamination from tailings wetlands. (d) Development of fish habitat compensation in Britannia Creek. (e) Contingency plans for downstream effects resulting from malfunctions or accidents.	Management of water, with potential effects to water quality and wildlife have been considered in detail and our found in Sections 7 and 10.
339	Phone Call	June 14, 2013	Cultural Continuity	Need a process to deal with historical finds during project activity.	CMC has completed a heritage resources impact assessment on the proposed road extension and upgrades. A Heritage Management Plan and chance find procedure have been developed. CMC intends to continue to engage with First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3.7). Resolved, monitor in future, adapt as required.
395	Letter	June 20, 2013	Cultural Continuity	Need a process to deal with historical finds during project activity (Heritage Resources Management Plan).	CMC completed heritage resource impact assessments on the proposed access road, including proposed upgrades and extension. CMC has shared heritage and archaeology reports with the Selkirk First Nation, which include proposed mitigation. A Heritage Management Plan and chance find procedure have been developed. CMC to continue to engage with the Selkirk First Nation to discuss topics of interest such as protection of heritage resources. CMC will implement a Heritage Resources Management Plan and chance find procedure (Section 22.3.7). Resolved, monitor in future, adapt as required.
393	Letter	July 17, 2013	Cultural Continuity	Concern about heritage resources protection and management and	CMC completed a heritage resources impact assessment on the proposed road extension and upgrades and the Project footprint. Heritage sites have been identified and marked in the field. A

ROC #	Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
				need to better mark heritage sites in the project and road access areas and ensure workers know the rules associated with these sites.	Heritage Management Plan and chance find procedure have been developed. CMC intends to continue to engage with Yukon Heritage and First Nations to discuss topics of interest such as protection of heritage resources (Sections 2.3.2, 2.3.4, 2.5.2 and 2.5.4). CMC will implement a Heritage Resources Management Plan, including a chance find procedure (Section 22.3.7). Environmental monitoring, including heritage resources, will be completed during road construction (Section 22). Resolved, monitor in future, adapt as required.
350	E-mail	August 5, 2013	Cultural Continuity	Need for consultation with First Nations for whom the Project is in their asserted traditional territory.	CMC has been consulting with the Selkirk and Little Salmon/Carmacks First Nations since 2008 regarding the proposed Project and has consulted other First Nations regarding the proposed Project. CMC intends to continue to engage with the Selkirk and Little Salmon/Carmacks First Nations as well as with other First Nations regarding the Project Proposal as well as during construction and operations. Resolved, ongoing.

2.5 PUBLIC CONSULTATION

This section describes consultation activities undertaken with the public and other key stakeholders, including:

- A list of stakeholders and interested members of the public;
- A description of the consultation undertaken; and
- A detailed summary of issues raised during consultation along with an indication of how they were considered and the degree to which issues have been resolved or addressed by CMC and other parties.

2.5.1 Interested, Potentially Affected Public

During the early stage of the Project, CMC identified a number of public stakeholders that may be affected by or may have an interest in the Project. These stakeholders, as well as those who self-identified as interested, were consulted. The Yukon public and key stakeholders that CMC consulted include:

- Carmacks Health Centre;
- Village of Carmacks;
- City of Whitehorse;
- Local businesses;
- Royal Canadian Mounted Police detachments in Pelly Crossing and Carmacks;
- Tantalus School;
- Tourism Industry Association of the Yukon;
- Trapline holders and guide outfitters;
- Whitehorse Chamber of Commerce;
- Whitehorse General Hospital;
- Yukon Conservation Society;
- Yukon Fish and Game Association;
- Yukon River Panel;
- Yukon Mine Training Association; and
- Yukon College.

Based on consultations and information in the socio-economic impact assessment, two municipalities were identified as most likely to be affected by the Project; the Village of Carmacks and the City of Whitehorse.

The Village of Carmacks was selected due to its proximity to the Project access road. A portion of the proposed access road falls within Little Salmon/Carmacks First Nation Traditional Territory and the road intersection is within the Village of Carmacks. Many of the residents of the Village of Carmacks are members of Little Salmon/Carmacks First Nation. The Village of Carmacks is an independent municipality and is addressed in this section.

The City of Whitehorse was selected because it is the largest Yukon community and plays a significant role in the provision of services, goods and labour.

The footprint of the proposed mine as well as the majority of the proposed access road falls within Selkirk First Nation Traditional Territory.

2.5.2 Public Consultation

Consultation was conducted with members of the public (individuals and groups) that self-identified as having an interest in the Project area. CMC communicated with and consulted in relation to the Project with the public through a number of activities, including community open houses, presentations, interviews, letters, e-mails, phone calls, information booklets, questionnaires and surveys.

2.5.2.1 Project Update Meetings with Municipalities

On several occasions, CMC met with municipal government agencies to provide information about the Project and an update on the Project activities. CMC met with the Village of Carmacks on March 6, 2012 to provide an update on the Project and ongoing interaction has taken place in support of Project-related socio-economic studies and to address questions.

2.5.2.2 Community Open Houses

CMC conducted community open houses to provide information to the public, to introduce the Company and the Project, and to discuss any interests or concerns. From 2008 through 2013, CMC conducted nine community open houses in addition to open houses that were conducted specifically for First Nation communities. Notifications about upcoming community open houses were usually made through publication of notices in The Whitehorse Star and Yukon News at least two weeks in advance of the sessions. Flyers were also placed in key locations in the communities as well as distributed to resident mailboxes in the Village of Carmacks in advance of the sessions. Letters were issued to individuals on the project mailing list, which included Yukon and federal regulators, First Nations, City of Whitehorse and related departments, Village of Carmacks informing them of the upcoming events. Copies of the publications, flyers and letters are presented in Appendix 2B.

At the entrance to each community open house, attendees were asked to sign-in and provide contact details if they wished to be added to the Project mailing list. Each attendee was provided with a comment form and when requested, a copy of the Project booklet. Copies of the information sheet and blank comment forms are presented in Appendix 2B.

CMC and its consultants were available at the community open houses to answer questions. An overview presentation about the project was given.

On December 1, 2009, a community open house was held in Pelly Crossing. It was held at Selkirk First Nation offices meeting room from approximately 4 pm to 6 pm; there were numerous attendees to the session. The community open houses presented information about the proposed access road alternatives and the biophysical baseline program. There were numerous poster boards arranged around the room for attendees to review and formal presentations of the information were provided. Copies of the presentation materials and completed comment forms are presented in Appendix 2B.

On May 28 and 30, 2012, community open houses were held in Carmacks and Whitehorse, respectively. The Carmacks community open house was held at the Carmacks Recreation Centre from 5:00 pm to 8:00 pm; there were approximately 40 attendees to the session. The Whitehorse community open house was held at the Yukon Inn in two sessions, the first from 2:30 pm to 5:00 pm and the second from 6:00 pm to 8:30 pm; there were

approximately 50 attendees to these sessions. The community open houses presented information about the Project and provided a venue for the public to express views and comments on how the Project may affect them and their communities. There were 23 poster boards arranged around the room for attendees to review and formal presentations of the information were provided. Copies of the presentation materials and completed comment forms are presented in Appendix 2B.

On May 14 and 15, 2013, community open houses were held in Whitehorse and Carmacks, respectively. The Whitehorse community open houses were May 14 from 4-7 pm, and the next day over a lunch session from 12-1:30. In excess of 50 people attended the two sessions. The Carmacks community open house was held at the Arena from 4pm to 7pm: there were approximately 45 attendees to the session. The community open houses presented information about the Project and the progress made on the EA studies related to the Project. There were 23 poster boards arranged around the room for attendees to review and formal presentations of the information were provided. Copies of the presentation materials and completed comment forms are presented in Appendix 2B.

Although not identified in the socio-economic impact assessment as a community likely to be affected by the Project, in response to interest expressed by the White River First Nation, a community open house was conducted in Beaver Creek on September 24, 2013,. It was held at the recreation hall from 4pm to 6pm; there were three attendees to the session. The community open house presented information about the Project, and an update on progress of the EA studies related to the Project. There were 23 poster boards arranged around the room for attendees to review and formal presentations of the information were provided. Copies of the presentation materials and completed comment forms are presented in Appendix 2B.

Detailed information about the comments (issues, concerns raised) received at the community open houses is presented in Appendix 2A.

2.5.2.3 Socio-Economic and Land and Resource Interviews

Twenty interviews were conducted with municipal representatives, service providers, and members of the public such as guide outfitters and trappers, to gather pertinent information related to the Project:

- City of Whitehorse (October 1, 2012);
- City of Whitehorse Community and Recreation Services (October 22, 2013);
- City of Whitehorse Fire Department (October 23, 2013);
- Village of Carmacks (February 2 and February 13, 2013);
- Carmacks Health Centre (February 13 and 20, 2013);
- NorthwesTel (October 21, 2013);
- Royal Canadian Mounted Police (July 10, 2012);
- Royal Canadian Mounted Police, Yukon (Whitehorse RCMP Detachment) (October 23, 2013;
- Royal Canadian Mounted Police and Fire Department (no date);
- Tantalus School (February 13, 2013);
- Trappers (October 3 and 15, 2012, and May 10, 2013);
- Whitehorse Chamber of Commerce (October 1, 2012);

- Whitehorse General Hospital (July 10, 2012);
- Whitehorse General Hospital, Community Relations (October 23, 2012);
- Whitehorse General Hospital, Patient Services (October 24, 2013);
- Yukon Chamber of Commerce (October 1, 2012);
- Yukon College (July 10 and 12, 2012 and October 23 and 24, 2013);
- Yukon Electrical Company (October 22, 2013); and
- Yukon Mine Training Association (October 2 and 3, 2012).

In an effort to inform baseline studies and the socio-economic assessment for the Project, representatives of CMC also had interviews with other government agencies including City of Whitehorse Water and Waste Services in October 2013.

Information from the interviews was considered and incorporated into the socio-economic baseline report and effects assessment and, where concerns or issues were raised, they were considered by CMC in Project planning and developing mitigation measures.

Further information about the information collected during these interviews are reported in the Socio-Economic Baseline Report (Appendix 13A) and Land and Resources Baseline Report (Appendix 19A).

2.5.2.4 Communication Materials

CMC developed and distributed a communication booklet to provide accurate, plain-language information about the Project. The booklet was developed and distributed by request, starting in May 2012. The booklet is presented in Appendix 2B.

2.5.3 Issues Raised, Their Consideration and Status

Through CMCs consultation process, the public was able to voice their interests and concerns about the Project. CMC has documented these concerns, which are presented in Table 2.5-1.

Table 2.5-1 Public Consultation Overview

Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
Meeting	31-Mar-09	Fisheries and Aquatic Resources	Baseline information for water quality and fish.	Baseline reports have been written for both Fish and Aquatic Resources and Water Quality - they include sampling from all potentially affected watercourses and water quality has been collected in all seasons and on a monthly basis for a min. 1 year period.
Meeting	31-Mar-09	Water Quality	Will there be water quality effects on fish.	Effect to fish and aquatics are contemplated in Section 10
Open House	May 28, 2012	Community Vitality	Potential social effects on local communities.	CMC completed a socio-economic effects assessment that considered potential effects. Mitigation to address potential adverse effects were developed. On-site camp and fly in-out staffing included in design. Socio-economic monitoring and adaptive management are proposed. CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2, 16.4.2, 17.4.2, 18.4.2). CMC will establish a camp, including recreation services, on-site (Section 4.4). Resolved, monitor in future, adapt as required.
Open House	May 28, 2012	Economic Development and Business Sector	Need to use local suppliers of goods and services.	CMC will implement a procurement process that gives priority to suppliers from the RSA and in particular rural communities within the LSA; implementing a procurement process that gives priority to contractors who hire local/regional residents to the greatest practical extent; implement a procurement process that manages contract components to meet the capabilities of LSA entrepreneurs; encourage joint ventures between Aboriginal businesses and other regional businesses in the procurement process; require cultural awareness training for employees and contractors; monitor project socio-economic effects and adapt management measures where required; partner with First Nation communities and their development corporations to access additional funding for training; provide on-the-job training to assist local and regional workers to develop mining-specific skills; provide training and education for potential employees from Yukon and in particular the rural communities within the LSA; partner with First Nation communities to access additional funding for training; support for non-mining training and entrepreneurial initiatives; implement career training and development opportunities for employees once hired; and provide continuous, on the job safety training. See Sections 13.4.2, 14.4.2, and 15.4.2. Resolved, monitor in future, adapt as required.
Open House	May 28, 2012	Land Use and Tenure	Increased number of large vehicles on local roads, and need for a traffic management plan.	CMC completed land use and socio-economic effects assessments that considered potential effects from the Freegold Road and associated traffic. Mitigation to address potential adverse effects were developed. Potential traffic effects are discussed in Sections 17, 18 and 19. Socio-economic monitoring and adaptive management are proposed. CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Section 17.4.2). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access (Section 19.4.2). Resolved, monitor in future, adapt as required.
Open House	May 28, 2012	Land Use and Tenure	Frequency of truck traffic on road and associated effects on wildlife and use of fish camps and traplines.	CMC gathered detailed information and completed effects assessments that considered traditional uses. Effects assessments identified potential adverse effects, including potential effects of increased access on traditional hunting and fishing. Effects assessments included land use, cultural continuity, as well as wildlife, aquatics, vegetation, noise and dust. Effects assessment results and mitigation and monitoring plans to address potential adverse effects are described in Sections 12, 13, 17, 18, and 19. The assessment of moose and caribou hunting mortality was considered within the framework of CMC's mitigation and monitoring plans. CMC will implement a variety of plans to minimize adverse effects on traditional hunting and fishing. Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with

Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
				Yukon Government and First Nations for access management agreement (Section 19.4.2). CMC will implement and monitor socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2). Resolved, monitor in future, adapt as required.
Open House - Village of Carmacks	28-May-12	Wildlife	Identified issues related wildlife migration routes, effects to wildlife breeding (specifically moose), and the location of the road. Identified concern related to the potential effects to harvesting (game, plants, soil, birds).	Habitat, migration and mortality effects for moose and caribou were assessed. Mitigation measures and recommendations are provided in section 12.3.3.4 Potential Effects and Mitigation Measures for Caribou, and 12.3.4.4 - Potential Effects and Mitigation Measures for Moose. The assessment of moose and caribou hunting mortality was considered within the framework of CMC's mitigation and monitoring plans. / CMC will ensure application of mitigation measures and undertake the required monitoring and management practices during the development and operations of the project to minimize effects on moose and caribou. Land Use section 19 addresses access and access management. Resolved. Ongoing monitoring and adaptive management required.
Open House	May 28, 2012	Water Quality	Potential heavy metals contamination resulting from the mine and affecting subsistence food animals used by the First Nations community.	Water quality effects, and subsequent effects to fish and wildlife have been addressed in detail in sections seven and 10.
Open House	May 28, 2012	Design	Consideration of a power option that runs a power line from Carmacks to Minto via the Casino trail.	LNG chosen to fuel on-site power plant.
Open House	May 28, 2012	Closure	Process for defining scope and cost of reclamation post closure.	During the permitting phase, detailed closure cost estimates will be provided upon which the bond will be based.
Open House	28-May-12	Fisheries and Aquatic Resources	Identified issues related to fish and fish habitat, including: loss of fish habitat and compensation plans, proximity of waterways from effluent discharge points, watersheds potentially affected by the Project, and potential effects on fish camps. Identified need to consult with First Nations on compensation plans.	A fish habitat compensation plan is being developed that answers most of these questions, with the exception of "effects to fish camps". CMC hopes to engage First Nations to sequester information regarding fish camps and other traditional uses. That dialogue is ongoing.
Meeting	October 3, 2012	Land Use and Tenure	Controlling access to new roads built for the project.	CMC completed a land use effects assessment that considered potential effects from Freegold Road access. Mitigation to address potential adverse effects were developed (Section 19.4.2). CMC will develop and implement a Road Use Plan (Section 22.3.9) and CMC will monitor project socio-economic effects and adapt management measures where required (Sections 13.4.2, 14.4.2, 15.4.2). Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations to arrange for access (Section 19.4.2). Resolved, monitor in future, adapt as required.
Meeting	October 3, 2012	Land Use and Tenure	A need to keep trapline holders well informed and engaged in the project plans and development.	CMC has consulted trappers to develop the Project Proposal and intends to continue to consult trappers during the review of the Project Proposal (Sections 2.5.2 and 2.5.4). Resolved, on-going.
Meeting	October 3, 2012	Land Use	Displacement of trap line areas by the airport and access control to protect traplines.	CMC has consulted trappers to develop the Project Proposal and intends to continue to consult trappers during the review of the Project Proposal (Sections 2.5.2 and 2.5.4). Resolved, on-going.
Meeting	May 10, 2013	Land Use and Tenure	Potential for increased employment to have positive and negative effects on local communities.	CMC completed a socio-economic effects assessment that considered both potential positives and negatives effects on local communities. Base on the assessment adequate mitigation or enhancement measures were developed. Socio-economic monitoring and adaptive management are proposed. CMC will monitor project socio-economic effects and adapt

Event Type (Activity)	Date	Valued Component or Subject	Issue(s) Identified*	How Issue Was Considered, Responded to, Commitments Made, and Degree Resolved
				management measures where required (Sections 13 - 19, subsections.4.2). Resolved, monitor in future, adapt as required.
Meeting	May 10, 2013	Land Use and Tenure	Potential for increased noise and dust to affect the number of animals available for hunting.	Potential effects of dust and noise were considered in wildlife, cultural continuity, and land use effects assessments. Design of access road include controls at Big Creek to limit vehicles to authorized mine traffic. Access road will be private from Big Creek to mine. Access will be controlled through gating and other means, but CMC will work with First Nations and Yukon Government to agree to access management (Section 19.4.2). Resolved, monitor in future, adapt as required.
Meeting	May 10, 2013	Cultural Continuity	Reduction in traditional hunting harvests because of the Project.	Potential effects on traditional hunting harvests were considered in wildlife, cultural continuity, and land use effects assessments. Design of access road include controls at Big Creek to limit vehicles to permitted traffic as per Land Use Section 19.4.2. CMC will implement a variety of plans to minimize adverse effects on traditional hunting harvests CMC will institute a no hunting policy for workers onsite (Section 18.4.2). Resolved, monitor in future, adapt as required.
Meeting	May 10, 2013	Land Use and Tenure	How will trappers be involved in ongoing consultation about the project design and development?	CMC consulted the public, including trappers prior to developing the Project Proposal. CMC intends to continue to consult trappers to identify concerns and to develop mitigation to address potential adverse effects (See Sections 2.5.2 and 2.5.4). Resolved, ongoing.
Meeting	10-May-13	Wildlife	Identified concern regarding the potential effects to trapping.	CMC consulted the public, including trappers prior to developing the Project Proposal. CMC intends to continue to consult trappers to identify concerns and to develop mitigation to address potential adverse effects (See Sections 2.5.2 and 2.5.4). Resolved, ongoing.
Meeting	May 10, 2013	Cumulative Effects	How will the cumulative environmental effects resulting from the project be addressed.	A cumulative effects assessment has been included for each VC, conducted as discussed in Section 5.
Meeting	20-Aug-13	Water Quality	Questioned if selenium an issue like it was for Brewery Creek.	See details in the water quality and sediment Baseline and Effects Assessment reports. However, Selenium is a CoC and exceeds CCME. However, our assessment has shown that SE is not a significant impact on fish in Casino or Dip Creek

2.6 KEY CONCERNS RAISED

Through consultation and information-sharing, CMC identified issues and concerns and, in response, identified accommodation, through mitigation or adjustments to the Project to address concerns.

The key issues and concerns raised by First Nations, government, and the public have been arranged into three general categories; summarized as follows:

Biophysical Environment

- Potential effects on surface and sub-surface water quality and hydrology and mitigation;
- Potential wildlife habitat loss, mitigation ;
- Potential fish habitat loss, mitigation and compensation;
- Potential direct effects on wildlife, and mitigation and compensation;
- Potential direct effects on fish, and mitigation and compensation;
- Potential effects on aquatic environments and mitigation;
- Potential effects on heritage resources and mitigation;
- Potential cumulative (environmental and socio-economic) effects;

- Potential effects on air quality and noise levels; and
- Climate change, potential effects on permafrost.

Human Environment

- Project feasibility and sustainability;
- Consultation;
- Agreements, protocols, capacity funding;
- Traditional knowledge protection and integration;
- Traditional practices, land uses and cultural continuity
- Economic benefits;
- Employment, training and capacity-building;
- Potential positive and negative socio-economic effects (infrastructure and services) and mitigation;
- Community engagement in socio-economic studies and assessments;
- Continuity of traditional lifestyle;
- Potential effects on trapping; and
- Potential effects on drinking water.

Physical Environment

- Baseline information and reporting;
- Design of project components;
- Use of waste rock and tailings management;
- Potential effects from increased access, and mitigation;
- Potential effects on and from permafrost;
- Access and transportation options;
- Power supply options;
- Decommissioning (permanent and temporary), planning and closure of project components;
- Environmental and other monitoring and management guidelines, systems;
- Environmental and other contingency or response plans; and
- Responsibility for potential effects.

The issues raised were registered by CMC, who considered and responded in a wide range of ways, including:

- Providing additional information and answering questions or providing information;
- Arranging additional engagement opportunities such as Open Houses and site visits;
- Changing Project design, such as moving from coal as a source of energy to liquefied natural gas;

- Developing monitoring, mitigation and management plans, such as the Spill Contingency Management Plan, the Wildlife Management Plan and the Road Use Management Plan;
- Conducting numerous socio-economic interviews with First Nations and stakeholders; and
- Arranging and facilitating Project Proposal meetings to provide a forum for detailed consultations on technical topics.

2.7 OBSERVATIONS ON THE CONCERNS IDENTIFIED: DIFFERENCES AND SIMILARITIES

There were many similarities and a number of differences in the range of issues and concerns raised by First Nations, Yukon government and agencies, federal regulators, and the public.

First Nations and public both emphasized the importance of minimizing potential negative social and economic effects while ensuring economic benefits and employment and training opportunities will be realized, specifically at the local level.

All groups identified the importance of maintaining their outdoor focused lifestyles, which include hunting, fishing and outdoor recreation. Further, and specifically, First Nations emphasized that it was very important to them to be able to maintain their traditional ways of life, including accessing and using fish camps, hunting and gathering, and trapping areas. Non-Aboriginal trappers also raised concerns about their ability to continue to trap productively.

While all groups recognized the importance of maintaining their current lifestyles, there was also a common recognition that economic benefits, employment and training are a necessary part of the mix of activities that constitute their lifestyles.

Yukon Government and First Nations identified cumulative effects as a common concern.

Government and regulators tended to focus on regulatory process and requirements as they relate to the Project Proposal; ensuring Yukoners' interests and lifestyles are appropriately considered; and that potential negative effects are avoided or mitigated. Consequently, Yukon government and federal regulator issues and concerns focused more on the technical aspects of the Project, data collection and assessment needs and methodologies.

First Nations and members of the public, specifically trappers and guide outfitters, emphasized the importance of consultation. First Nations advised CMC of their aboriginal rights and specifically identified the need for CMC to consider provision of capacity funding to support their consultations as well as participation in the regulatory process and informing the Project Proposal.

First Nations, Yukon and federal regulators and, to a lesser degree, members of the public, shared a common interest in ensuring adequate mitigation for potential effects on fish and wildlife and compensation for unavoidable effects.

2.8 FUTURE CONSULTATION

CMC is committed to ongoing engagement and consultation with interested and potentially affected parties, including First Nations, stakeholders, and government bodies and the public as the proposed Project progresses through the environmental and regulatory phases and through construction, operation, and closure. Guided by the consultation principles, approach, and methods described in Section 2.2 Consultation Principles, Objectives, Approach and Methods, CMC will develop plans to update and consult as Project activities are proposed and completed and in response to expressed interests. CMC will continue to communicate in a timely and transparent manner while ensuring inclusiveness in its consultation activities.

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3 – PROJECT LOCATION

This section presents a general overview of the Project area, within approximately 150 km of the mine site.

3.1 GEOGRAPHIC LOCATION

3.1.1 Latitude and Longitude

The Casino Project site is located on NTS map sheet 115J10 (Figure 3.1-1). The Casino deposit is located at approximately latitude 62°44'N and longitude 138°50'W (UTM Zone 7 611237E 6958508N). The general mine facilities, excluding supporting road and pipeline alignments, extend from approximately 62°45'N and 138°52'W at the northwest corner to 62°40'N and 138°45'W in the southeast corner. The freshwater pipeline and Yukon River access road extend from the project area north to the Yukon River at 62°52'N and 138°41'W, and the airstrip access road extends from the project area southwest to 62°37'N and 138°57'W, the approximate location of the new airstrip . The Freegold Road Extension and Freegold Road Upgrade extend from the Project to the village of Carmacks, southeast of the mine site.

3.1.2 Assessment District

The Property is in the YESAB Central Yukon Assessment District, with the designated office located in Mayo.

3.1.3 Nearest Communities

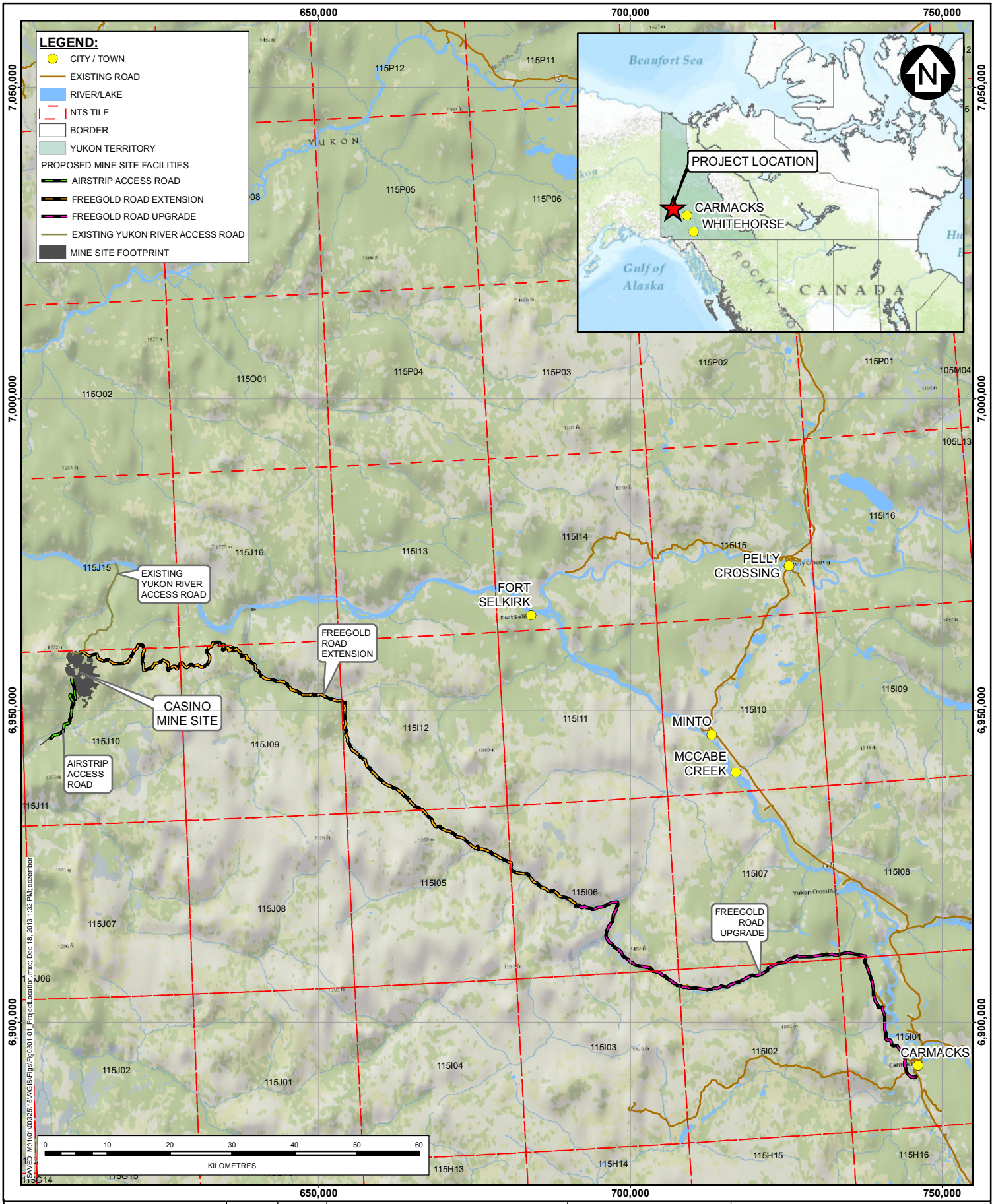
Whitehorse, the capital of the Yukon Territory, is the largest commercial and population center near the Project, located approximately 300 km southeast by air or 380 km by road via the Klondike Highway (to Carmacks) and then along the Freegold Road and Casino Trail (only accessible as a winter road at present). The village of Carmacks is approximately 150 km by air or 200 km via the Freegold Road and Casino Trail, and Pelly Crossing is approximately 115 km east by air or 305 km by road via Carmacks.

The international border with Alaska, at its closest point, is approximately 111 km due west from the Casino mine site. Beaver Creek, a tourist stop on the Alaskan Highway, is located just over the border. Fairbanks is 500 km northwest by air. Road access from the Port of Skagway, Alaska is along the Klondike Highway, through BC, and north to Whitehorse, a distance of approximately 557 km.

3.1.4 Legal Land Description

The Casino Project is located on Crown Land administered by the Yukon Government, and is located within the Whitehorse Mining District. The property consists of 723 full and partial Quartz Claims, totalling approximately 13,339 ha in area, and 85 Placer Leases totalling approximately 747 ha in area, acquired in accordance with the *Yukon Quartz Mining Act* (M3 Engineering and Technology Corporation 2013). All claims are registered to and wholly-owned by CMC, although some parts of the property are subject to royalty agreements.

A total of 28 active placer claims held by others (at the time of writing) are staked around Canadian Creek and overlap the Casino property mineral claims. Western Copper and Gold Corporation (WCGC), the owner of CMC, staked a five mile Placer Lease along Casino Creek and a three mile Placer Lease along Britannia Creek in 2010; in 2011 these leases were converted to claims. In addition, CMC has 30 placer claims on Britannia Creek and 55 placer claims on Casino Creek (M3 Engineering & Technology Corporation 2013).



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CASINO PROJECT

CASINO PROJECT LOCATION

FIGURE 3.1-1

REF 1

P/A VA101-325/15

3.1.5 Climate and Environment

The Casino Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern BC, and within the Klondike Plateau ecoregion (Appendix 8A). The Boreal Cordillera ecozone is broadly characterized by the presence of several mountain ranges, including the Dawson Range, that trend in the north-westerly direction and include extensive plateau regions. The plateaus consist of flat or gently rolling terrain separated by broad valleys and lowlands. The elevation of the Project area ranges from approximately 650 metres above sea level (masl) at the airstrip location to 1,400 masl on top of Patton Hill at the mine site.

The climate is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect. February through April is typically the driest time, while June through August is typically the wettest (Appendix 7B). The mean annual temperature for the Casino Project area (at an elevation of 1,200 masl) is -3 C, with minimum and maximum mean monthly temperatures of -18°C and 11°C occurring in January and July, respectively. The extreme minimum temperature is -50°C and the extreme maximum temperature is 30°C (Appendix 8A).

The Mean Annual Precipitation for the Casino Project area is 460 mm, with 66% falling as rain and 34% falling as snow (Appendix 8A). The 2-year 24-hour rainfall event is 32 mm and the 100-year 24-hour rainfall event is 71 mm. Mean annual wind speed for the Casino Project area is 2.3 m/s with maximum wind gust speed being 14.9 m/s; northerly winds are predominant (Appendix 8A). The annual maximum snow water equivalent (SWE) is typically recorded in April or May with the mean annual maximum SWE over the period of record being 142 mm. The estimated mean monthly snowmelt volumes for the Casino snow survey station in April and May are 22 mm and 120 mm, respectively. Based on the calibration model the site wide mean annual SWE at an elevation of 1,200 masl is estimated to be 100 mm (Appendix 8A).

The Casino Project is situated primarily in the Casino Creek watershed, with some components in the Canadian Creek watershed. Casino Creek flows in a southerly direction before joining Dip Creek, which drains to the southwest, eventually flowing into the White River. The White River is a tributary of the Yukon River. Canadian Creek flows in a northerly direction before joining Britannia Creek, which discharges directly into the Yukon River (Appendix 7A).

3.1.6 Exploration History

The information presented in this section is based on the Casino Project Feasibility Study (M3 Engineering and Technology Corporation 2013).

Placer gold was discovered on Canadian Creek by J. Britton and C. Brown in April 1911. In 1917 the first mineral claims were staked at Casino and in 1936 silver-lead-zinc veins were discovered approximately 3 km south of the Canadian Creek placer workings. Following this, the Bomber and Helicopter vein systems were explored by hand trenches and pits for several years; the Helicopter claim, and the Bomber and Airport groups were staked in 1943 and 1947, respectively. Exploration on the property from 1948 to 1967 focused on lead-silver mineralization at the Helicopter and Bomber veins. In 1948 the property was optioned to Noranda and in 1963 the property was optioned to Rio Tinto.

Casino Silver Mines Limited was formed in 1963 by L. Proctor, who purchased the claims in order to develop the silver-rich veins. The silver-bearing veins were explored and developed intermittently by underground and surface workings from 1965 to 1980, with a total of 372.5 tonnes of hand-cobbed argentiferous galena shipped to a smelter at Trail, British Columbia.

It was first noted in 1963 and again in 1967 that the area had porphyry deposit potential. Based on the porphyry potential, Casino Silver Mines Limited was acquired by the Brynelsen Group. The porphyry deposit was discovered in 1969 during an exploration program jointly directed by Brameda, Quintana, and Teck Corporation. Following the porphyry discovery Brameda Resources, Quintana Minerals, and Teck Corporation, among others, drilled the property; the drilling program included 5,328 m of reverse circulation drilling in 35 holes and 12,547 m of diamond drilling in 56 holes.

Archer, Cathro & Associates (1981) Ltd. optioned the property in 1991 and assigned the option to Big Creek Resources Ltd. Pacific Sentinel Gold Corp. acquired the property from Archer Cathro in 1992, and initiated a major exploration program. In 1995, following metallurgical, geotechnical and environmental work, Pacific Sentinel Gold Corp. completed a scoping study which envisioned a large-scale open pit mine and conventional flotation concentrator that would produce a copper-gold concentrate for sale to Pacific Rim smelters.

First Trimark Resources and CRS Copper Resources obtained the property and used the Pacific Sentinel Gold data to publish a Qualifying Report on the property in 2003. An updated report in 2004 brought the resource estimate into compliance with National Instrument 43-101 requirements. In 2004 First Trimark Resources and CRS Copper Resources combined to form Lumina Copper Corporation and issued an update of the Qualifying Report.

In November 2006 Western Copper Corporation acquired Lumina Copper Corporation and the Casino Deposit, and in 2011 spun out all other assets except the Casino Deposit and became Western Copper and Gold Corporation (WCGC). In the interim, environmental baseline studies were initiated (2007); a new exploration camp was constructed next to the Casino airstrip (2008). A pre-feasibility study was produced by M3 Engineering in 2008 and infill and delineation drilling and geotechnical drilling were conducted between 2009 and 2011. The Casino Mining Corporation, the proponent of the Casino Project, is a wholly-owned subsidiary of WCGC.

3.2 LAND TENURE

3.2.1 Access Road and Highway Use

The Project area is not currently accessible by all-weather road. The Freegold Road, a secondary, unpaved road maintained by the Yukon government extends 83 km northwest of the village of Carmacks. The Project site is also accessible along a 23 km road from an existing barge landing at the confluence of Britannia Creek with the Yukon River. The site was previously accessed via a winter road from Kluane Lake, near the Alaska Highway to the east. Future road access to the Mine site will be via a 120 km extension from the existing Freegold Road, which will run primarily along the route of a winter road that has been used to access Casino as well as other exploration projects in the area. This route is known locally as the Casino Trail.

The existing Freegold Road is a primary supply route for many mining exploration projects in the Yukon; the Casino Trail is also used to haul equipment and supplies by some placer miners and exploration companies (Infrastructure Canada 2013), as well as by other resource users (trappers, outfitters, wilderness tourism operators, and subsistence harvesters) (Yukon Government 2011). Quartz exploration properties along the Casino Trail include the Freegold Mountain Project (Northern Freegold Resources Ltd.); Big Creek (Teck Resources Limited); Prospector Mountain (Tarsis Resources Limited); Toro (Dawson Gold Corp.); Sonora Gulch (Northern Tiger Resources Inc.); Idaho Creek (Golden Predator Canada Corp.); and Betty (Ethos Capital Corp.). There are several Quartz Mining Land Use Permits along the Freegold Road, including Freegold, Revenue and Seymour properties (Northern Freegold Resources Ltd.); Tinta Hill, Caribou Creek and Freegold properties (Bill Harris); and Carmacks Copper (Carmacks Mining Corp.).

Carmacks is situated on the Klondike Highway (Yukon Highway 2) approximately 175 km north of Whitehorse. The Klondike Highway, a paved road, provides the main transportation route in the Yukon, running from the port of Skagway, Alaska (as Alaska Route 98), through BC, and north into the Yukon south of the unincorporated community of Carcross. The Klondike Highway extends up to Dawson City (km 716) on the Yukon River.

3.2.2 Mineral Rights

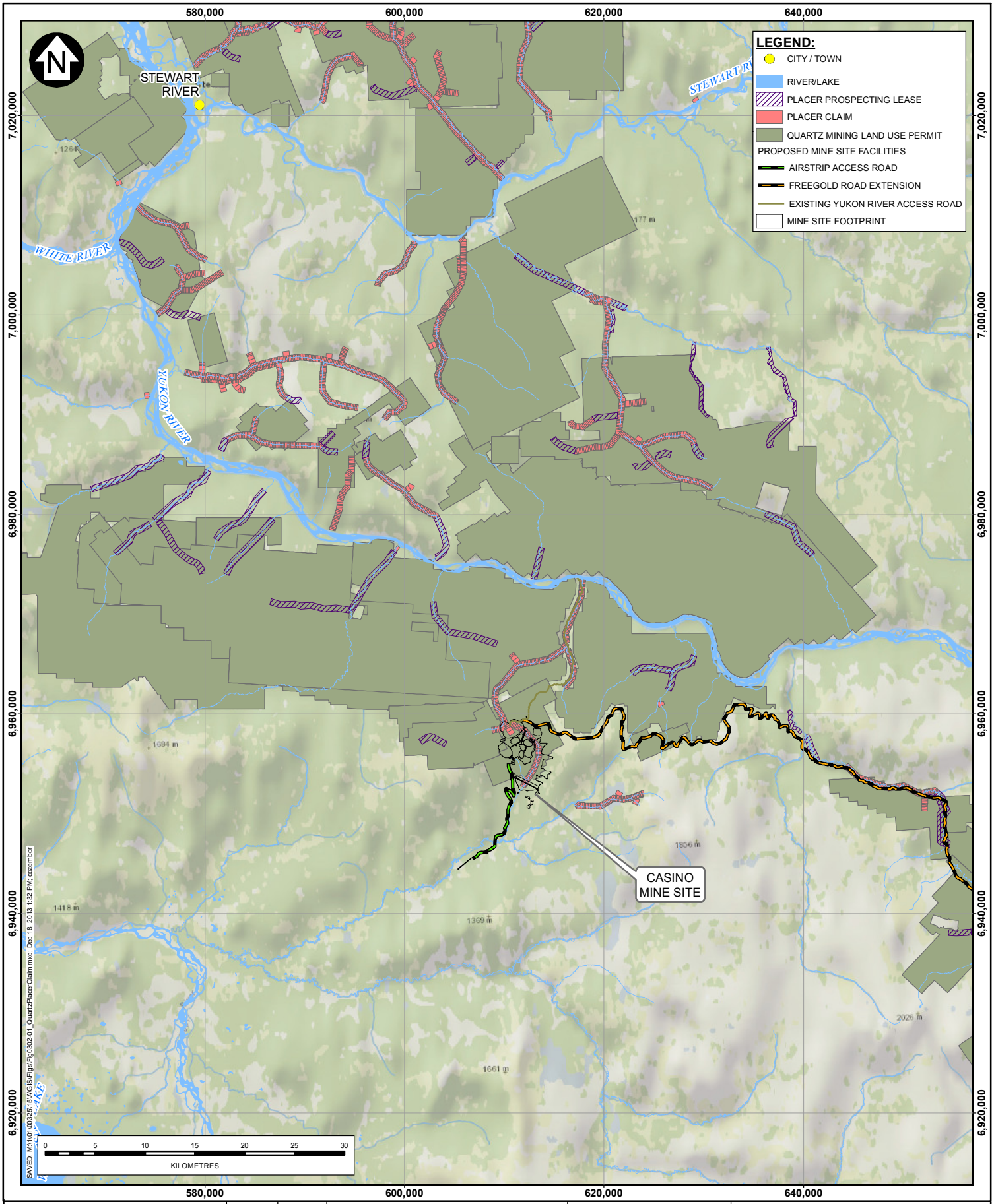
Numerous quartz and placer claims and prospecting leases, as well as placer mining operations and properties, are present around the Casino Property and along the Freegold Road and Casino Trail. There are five valid Quartz Mining Land Use Permits owned by others wholly or partially within an approximately 25 km radius of the Casino Property (Table 3.2-1), and 961 active, 38 expired, and 1 pending quartz claims owned by others (YESAB Geolocator, accessed September 2013). Within 500 metres of the Freegold Road and Freegold Road extension outside of this 25 km buffer around the mine site there are an additional 706 quartz claims.

Mineral rights in the Project area are illustrated on Figure 3.2-1 .

A total of 247 active placer claims and five placer mining land use permits owned by others are present within a 25 km radius of the Casino deposit (YESAB Geolocator, accessed September 2013). A placer mining operation on Canadian Creek is operated by Britannia Pacific Mining Ltd. Two active placer prospecting leases are in the vicinity, owned by Tom Bokenfohr and Kaminak Gold Corp.

Table 3.2-1 Quartz Mining Land Use Permits within 25 km of Casino Property

Permit Number	Permit Class	Permit Operator	Property Name	Issue Date	Expiry Date
LQ00285	3	Kaminak Gold Corp.	Coffe, Cream, Kirkman	6/16/2010	6/15/2015
LQ00309	3	Ethos Capital Corp.	Bridget	07/12/2011	07/11/2016
LQ00312	4	Kaminak Gold Corp.	Coffee Creek	07/12/2011	07/11/2016
LQ00316	3	Ethos Capital Corp.	Betty	5/26/2011	5/25/2016
LQ00320	3	Castillian Resources Corp.	Canadian Creek	07/12/2011	07/11/2016



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QUARTZ AND PLACER CLAIMS

FIGURE 3.2-1

REF 1

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3.2.3 Protected Areas

There are no parks or protected areas in the vicinity of the mine site or access roads. The Fort Selkirk Historic Site is located approximately 70 km to the east of the mine site, near the mouth of the Pelly River. Fort Selkirk was designated as a Yukon Historic Site under the Selkirk First Nation Final Agreement.

Further east, the Łútsäw Wetland HPA is located between Minto and Pelly Crossing, along the Klondike Highway. An HPA is designated under Part 10 of the Yukon *Wildlife Act* if the area is considered sensitive to disturbance and based on the importance of the area as habitat for any population, species, or type of wildlife. The Łútsäw Wetland HPA was identified as a SMA under the Selkirk First Nation Final Agreement; the objectives for the HPA include ensuring conservation of Fish and Wildlife and Fish and Wildlife Habitat for Yukon residents, and recognizing the importance of the area to Selkirk People (Selkirk First Nation Government and Government of Yukon 2006).

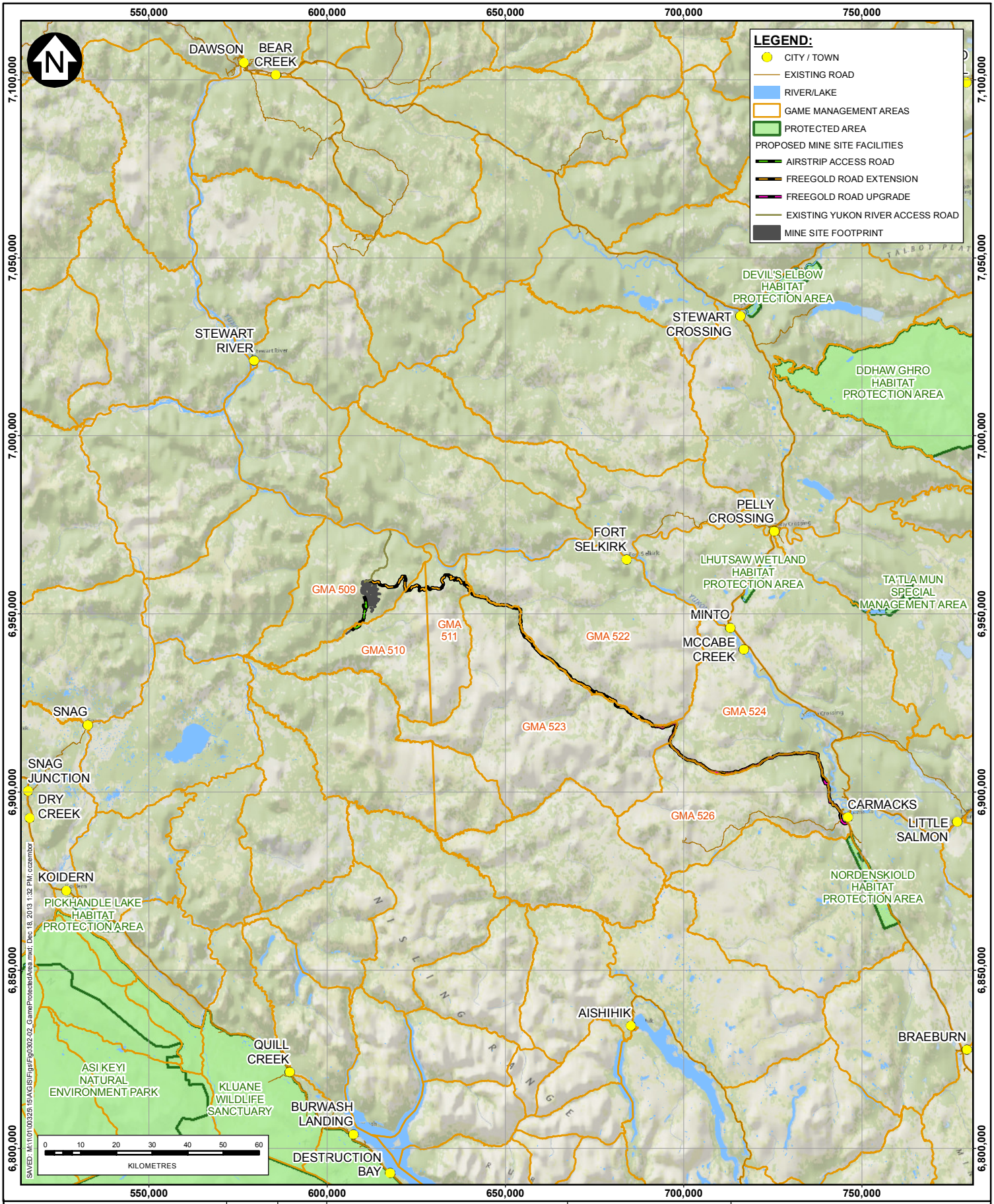
The Pickhandle Lakes HPA is located approximately 120 km to the southwest of the Casino mine site, adjacent to the Alaska Highway. The HPA is in the traditional territory of the Kluane First Nation and the White River First Nation and is comprised of a complex of small lakes, marshes and bogs (Yukon Environment 2012). The area is an important flyway for migratory birds and includes primary nesting areas for the Trumpeter Swan (Yukon Environment 2012).

The Tsâwnjik Chu (Nordenskiold) Wetland HPA is located south of Carmacks; it was identified as a SMA under the Little Salmon/Carmacks First Nation Final Agreement and subsequently as an HPA by the Yukon government in July 2010 (Nordenskiold Steering Committee 2010).

3.2.4 Management Areas

A GMA defines an area within which specific regulations can be set to manage big game. Game Management Areas are a combination of Game Management Zones and Game Management Subzones. There are 443 GMAs and 11 Zones in the Yukon; zone boundaries generally follow highway centrelines, while subzone boundaries follow creeks and rivers. The Project is situated in Zone 5, while the mine, Yukon River Access Road, and airstrip and access road are within GMA 509. The Freegold Road traverses GMAs 510, 511, 522 and 523. Special Area Restrictions, Season Dates, and Bag Limits are set for each zone or subzone for each species hunted.

A SMA is a protected area within the Yukon and is designated as such through land claims processes or established under the *Parks and Land Certainty Act* or *Wildlife Act* (Yukon Government 2013a). Most SMAs are subsequently designated as a Territorial Park, an HPA, an Ecological Reserve, National Park, National Wildlife Area, or a Wilderness Preserve. There are no SMAs in the vicinity of the mine site or access roads. The Ta'Tla Mun SMA is located approximately 135 km east of the Casino mine site; it was designated as an SMA in the Selkirk First Nation Final Agreement. A management plan is developed for each park, Habitat Protection Area, or SMA and managed by the Yukon government, First Nation governments, or Renewable Resource Council (Yukon Government 2013a). The Management Plan for the SMA is directed toward the conservation of eight species of freshwater fish and their habitat (Yukon Government 2013b).



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GAME MANAGEMENT AND PROTECTED AREAS

FIGURE 3.2-2

REF 1

P/A VA101-325/15

3.2.5 Registered Trapping Concessions

A registered trapping concession is a parcel of land in which the holder has exclusive rights to harvest furbearers (Yukon Government 2013c). The mine site is within the boundaries of two trapping concessions (116 and 121). The Freegold Road Extension will traverse several additional concessions (122, 131, 146 – 151, 408) as shown on Figure 3.2-3. The principal species trapped are beaver, coyote, fisher, coloured fox, Arctic fox, lynx, marten, mink, muskrat, otter, squirrel, weasel, wolf and wolverine (Yukon Government 2013c).

3.2.6 Outfitting Concessions

Outfitting concessions, or outfitting areas, are legal boundaries defining an area where the holder of the concession has exclusive rights to outfit non-residents for the purpose of hunting big game animals. The Project falls within Outfitting Concessions 11 (Prophet Muskwa Outfitters), 13 (Mervyn's Yukon Outfitting Ltd.) and 14 (Trophy Stone Outfitting Ltd.).

3.2.7 Settlement Lands

The UFA was signed in 1995 and forms the basis for negotiation of each Yukon First Nation's final agreement; self-government agreements under each final agreement allow the First Nation to make decisions in relation to their land and resources (Indian and Northern Affairs Canada 2008). In addition, First Nations under YESAA are decision bodies for projects that have the potential to adversely affect their settlement land. Self-government agreements were made for the Selkirk and Little Salmon/Carmacks First Nations on 21 July, 1997 and for the Tr'ondëk Hwëch'in on July 16, 1998 (Indian and Northern Affairs Canada 2008). Final agreements identify settlement land for each self-governing First Nation. Self-governing First Nations fully own Category 'A' Settlement Lands, including all surface and subsurface rights, while Category 'B' and Fee Simple Settlement Lands are those on which the self-governing First Nation has only surface rights (Indian and Northern Affairs Canada 2008). The Yukon government retains mines and mineral rights on Category B and Fee Simple Settlement Lands (Indian and Northern Affairs Canada 2008). Interim Protected Lands are parcels set aside for future First Nation Settlement Lands (e.g., for non-ratified First Nations).

The principal Project and accessory activities will be located primarily on non-settlement land. Within an approximately 150 km radius of the mine site there are 392 Surveyed Settlement Lands and 132 Interim Protected Lands (Unsurveyed) (YESAB GeoLocator). A summary of the surveyed settlement land categories and settlement land types by First Nation within 150 km of the Project is presented in Table 3.2-2 and shown on Figure 3.2-4. A section of the proposed Freegold Road Extension will transit through an existing right-of-way on Selkirk First Nations settlement land and a section of the Freegold Road Upgrade will transit through the Little Salmon/Carmacks First Nation settlement land.

Each individual First Nation government is responsible for land-use authorizations and disposition of interests on its settlement lands. Management powers afforded the First Nation as specified in Final Agreements include the power:

- To enact bylaws for the use and occupation of its Settlement Land;
- To develop and administer land management programs on Settlement Land;
- To charge rent or other fees for the use and occupation of its Settlement Land; and
- To establish a system to record interests in its Settlement Land.

Section 13.3 of the Little Salmon/Carmacks First Nation Self-Government Agreement Implementation Plan relates to the power to enact laws on Settlement Lands (Indian and Northern Affairs Canada 1998). The following sub-sections are relevant to the Project:

- Planning, zoning and land development (13.3.11);
- Control or prohibition of the operation and use of vehicles (13.3.13); and
- Control or prohibition of the transport of dangerous substances (13.3.22).

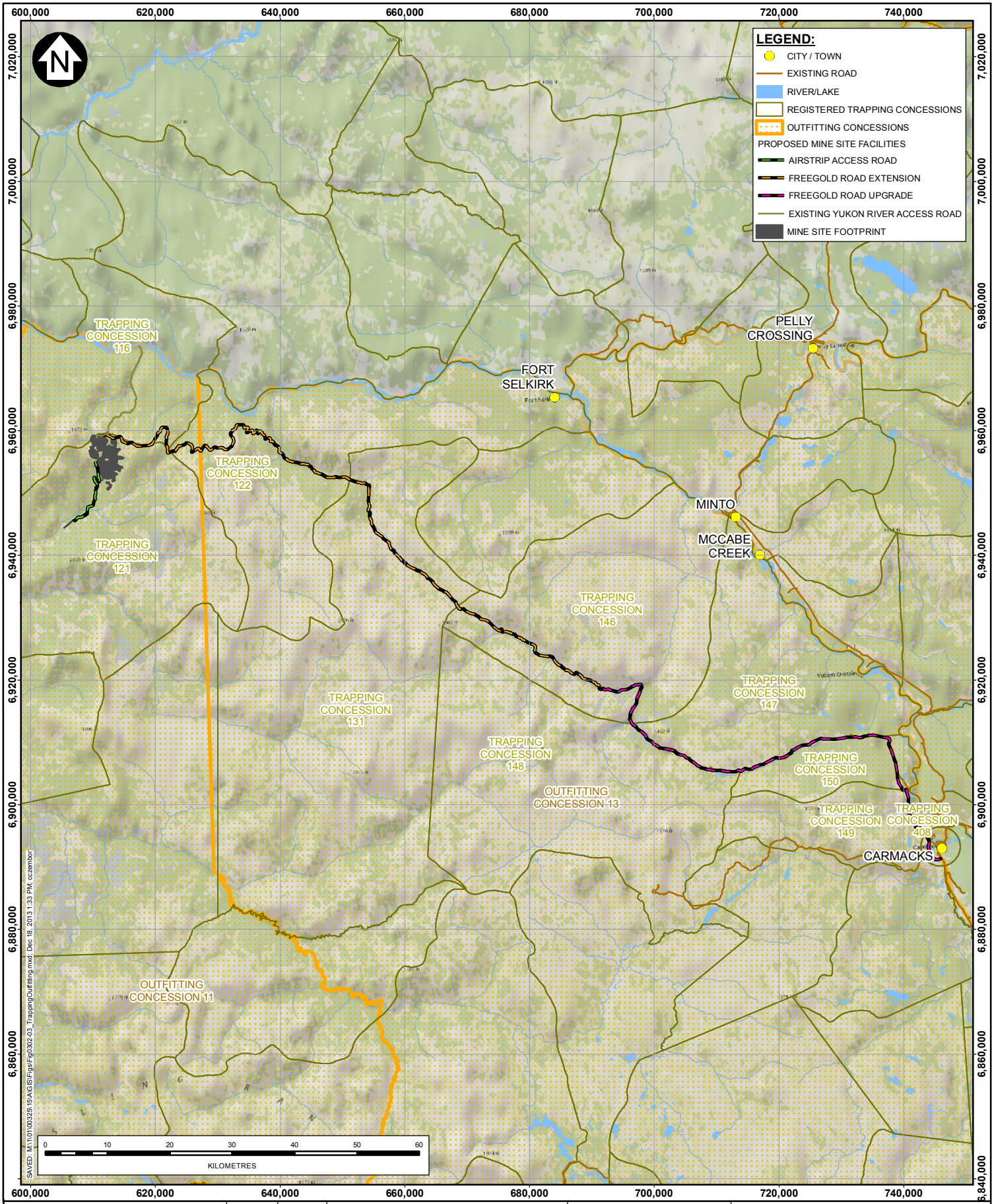
A Decision Document is required from the affected First Nation when a project is located wholly or partially on Settlement Land. The process to alter an existing route or construct a new road on Settlement Land is determined through consultation with the affected First Nation. CMC will either initiate a formal request to allow sections of the Freegold Road to be rerouted onto Little Salmon/Carmacks First Nation settlement land. There are provisions for a "land swap" under the land claims agreements that would see the proposed right-of-way become Crown land, with the First Nation selecting another parcel of land as settlement land in exchange. Alternatively, CMC could enter into an Access Agreement and/or Lease Agreement directly with the Little Salmon/Carmacks First Nation.

Table 3.2-2 Settlement Land Categories and Types within 150 km of the Project

First Nation	Total	Settlement Land Category				Settlement Land Type			
		A	B	Fee Simple	Uncat.	Site Specific	Rural Block	Community	Uncat.
Champagne and Aishihik First Nations	16	6	10			8	8		
Kluane First Nation	74	8	62	3	1	21	44	8	1
First Nation of Na-cho Nyäk Dun	19		17		2	8	5	4	2
Little Salmon/Carmacks First Nation	77	5	57	15		21	20	36	
Selkirk First Nation	75	9	61	5		46	25	4	
Tr'ondëk Hwëch'in	131	17	70	44		44	25	62	

Note:
A = Surface and Subsurface Rights
B = Surface Rights

The majority (113) of the 132 Interim Protected Lands belong to the White River First Nation. The White River First Nation has not settled their land claims and remains as a band under the *Indian Act* (Indian and Northern Affairs 2008). The Interim Protected Lands settlement land types are primarily site specific (68) followed by Community (20) and Rural (25).



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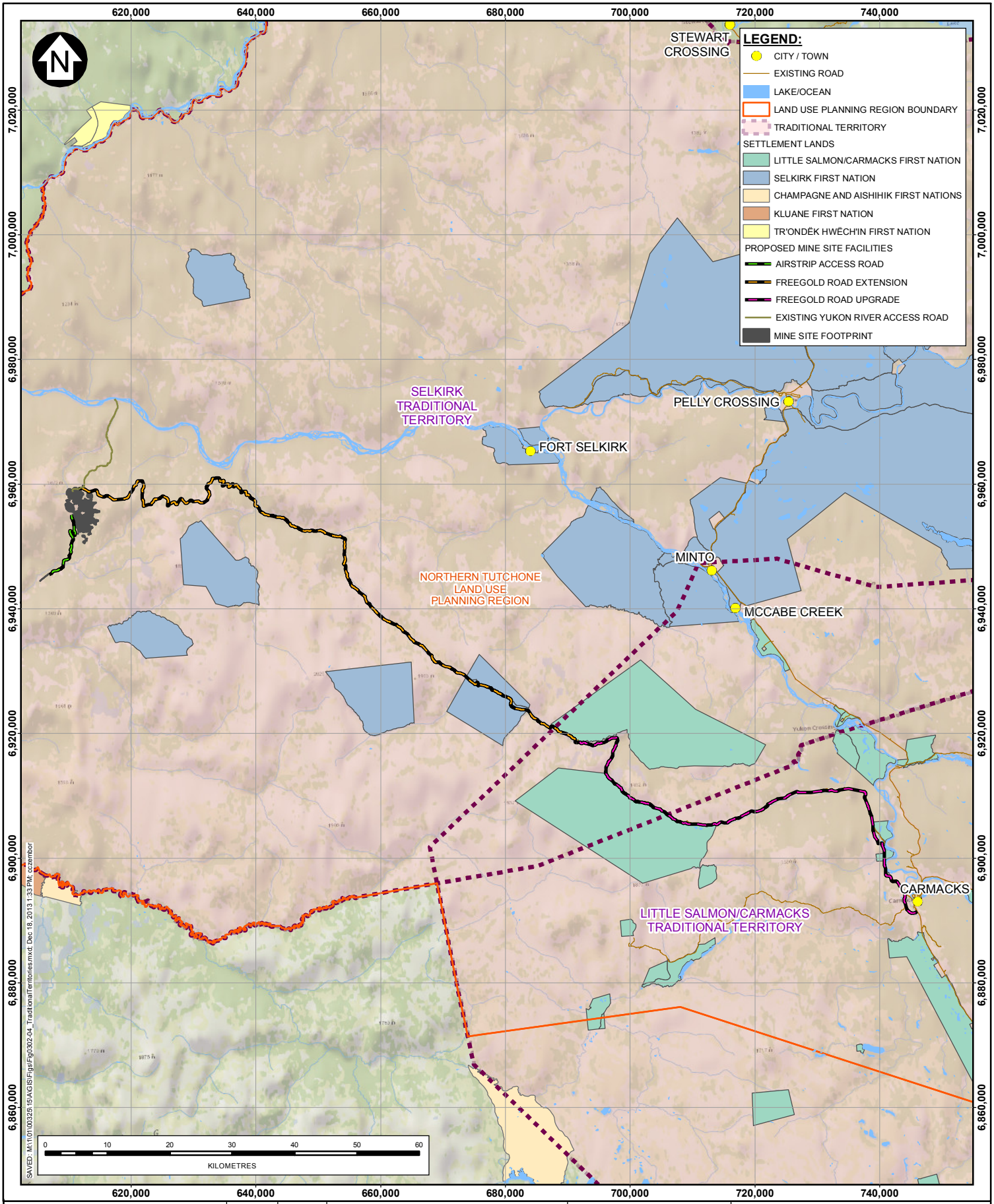
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TRAPLINES AND OUTFITTING CONCESSIONS

FIGURE 3.2-3

REF 1

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FIRST NATION TRADITIONAL TERRITORIES AND SETTLEMENT LANDS

FIGURE 3.2-4

REF 1

P/A VA101-325/15

3.3 TRADITIONAL TERRITORIES

The Project site, including the airstrip access road and the Yukon River access road, is located within the Selkirk First Nation traditional territory, with the Tr'ondek Hwech'in First Nation traditional territory lying to the north. The Freegold Road Extension is located mainly within the Selkirk First Nation traditional territory; the southeastern portion is located within the Little Salmon/Carmacks First Nation traditional territory. The proposed Freegold Road Upgrade will be located within the Little Salmon/Carmacks First Nation traditional territory.

The westernmost portion of the Selkirk First Nation traditional territory encompasses Wellesley Lake, located approximately 55 km from the Yukon-Alaska border east to the headwaters of the Macmillan River; north to south the territory extends from near Tatchn Lake to Stewart Crossing (Yukon Government 2008). Reaches of the Yukon River, MacMillan River, and Pelly River are all located within the territory. The original population centre of the Selkirk First Nation was the trading post of Fort Selkirk, located along the Yukon River, but the current population center is Pelly Crossing, located at the crossing of the Klondike Highway with the Pelly River (Selkirk First Nation 2013). The Selkirk First Nation traditional territory overlaps with the Tr'ondek Hwech'in traditional territories to the north, the Kaska Dena traditional territory to the east, the Little Salmon/Carmacks traditional territory to the south, and the White River traditional territory to the west.

The Tr'ondek Hwech'in First Nation traditional territory extends from the Alaska - Yukon border in the west to the Hart River in the east, and from the Stewart River in the south to the Peel River in the north (Yukon Government 2008). The population center is Dawson City. Reaches of the Yukon River, Stewart River, as well as a number of tributaries to the Peel River and the Porcupine River are located within the territory. The Tr'ondek Hwech'in First Nation traditional territory overlaps with the Vuntut Gwitchin and Tetlit Gwich'in traditional territories to the north, the Na-cho Nyak Dun traditional territory to the east, and the Selkirk and White River traditional territories to the south.

The Little Salmon/Carmacks First Nation traditional territory is situated in south central Yukon, extending from the northern end of Lake Laberge to Minto, and from the Nisling River in the west to east of Little Salmon Lake (Yukon Government 2008). Reaches of the Yukon River and the Teslin River are located within the territory. The Little Salmon/Carmacks First Nation traditional territory overlaps with the Selkirk First Nation traditional territory to the north, the Kaska Dena traditional territory to the east, and the Ta'an Kwach'an, Kwanlin Dun, and Champagne and Aishihik traditional territories to the south.

3.4 YUKON LAND USE PLANNING REGION

There are currently eight proposed or accepted land use planning regions in the Yukon. Planning regions are based on the traditional territories of First Nations or groups of First Nations (Yukon Land Use Planning Council 2013). The Casino Project is located within the proposed Northern Tutchone Planning Region, which encompasses the Na-cho Nyak Dun, Little Salmon/Carmacks, and Selkirk traditional territories and covers an area of 110,225 km^2. Chapter 11 of the UFA specifies how regional planning is carried out in the Yukon. The stated objectives of land use planning in the UFA are:

- "To encourage the development of a common Yukon land use planning process outside of community boundaries;
- To minimize actual or potential land use conflicts both within Settlement Land and Non-Settlement Land and between Settlement Land and Non-Settlement Land;
- To recognize and promote the cultural values of Yukon Indian People;

- To utilize the knowledge and experience of Yukon Indian People in order to achieve effective land use planning;
- To recognize Yukon First Nations' responsibilities pursuant to Settlement Agreements for the use and management of Settlement Land; and
- To ensure that social, cultural, economic and environmental policies are applied to the management, protection and use of land, water and resources in an integrated and coordinated manner so as to ensure Sustainable Development."

Regional land use plans are prepared by Regional Land Use Planning Commissions, which are appointed by the Minister of Indian and Northern Affairs (Yukon Land Use Planning Council 2013). The Regional Planning Commission is responsible for identifying regional issues and preparing recommendations regarding preferred levels and types of human activity. Upon approval by the Yukon Government and affected Yukon First Nations, land use plans, although not legally binding, are intended to provide management direction and an overall vision for land use in a region. To date there are only three accepted plans (North Yukon, Peel River Watershed, and Dawson); there is currently no Regional Land Use Plan for the proposed Northern Tutchone Planning Region.

3.5 CONSISTENCY WITH OTHER PLANS

Other regional or territorial plans relevant to the Project are discussed in this section.

Forest Management Planning in the Yukon is comprised of three levels: Forest Resource Management Plans, Timber Harvest Plans, and Site Plans (Energy, Mines and Resources 2013). Forest Resource Management Plans are strategic landscape level plans that provide broad direction on forest resource management activities over large areas. Timber Harvest Plans are development plans that identify areas proposed for harvesting and identify strategies to reduce or eliminate environmental consequences on other resources identified in the Forest Resource Management Plans. Timber Harvest Plans extend over landscape units or watersheds. Site plans are site specific management plans within the Timber Harvest Plans: they identify stand level management activities for the protection of forest resource values (Energy, Mines and Resources 2013). There is currently no Forest Resource Management Plan for the Project area.

The "Community-Based Fish and Wildlife Work Plan Little Salmon Carmacks First Nation Traditional Territory 2012-2017" developed jointly by the Little Salmon/Carmacks First Nation, Carmacks Renewable Resources Council and Yukon Government is designed to coordinate the efforts of each of the participants in addressing fish and wildlife concerns in the Little Salmon/Carmacks First Nation Traditional Territory (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011). The concerns raised within the plan that could be affected by the Project are discussed in the following paragraphs.

The plan noted that access due to mining and exploration activity was a concern, due to effects on wildlife and wildlife habitat; it was noted that awareness and monitoring of traffic patterns and access routes would contribute to determining how linear features affect wildlife. The plan specifically notes ongoing concerns for the Klaza Caribou herd related to access and high traffic from bison hunters and miners. The proposed work to be conducted by the planning participants includes a full census survey on the herd; collecting baseline information, including project information from other sources; updating habitat information; and monitoring of harvest levels.

The plan also notes a need for more community engagement and a coordinated effort to manage moose in the Klaza caribou herd range. The plan identifies increased exploration activity and the potential for large scale mining in the area northwest of Carmacks to affect the harvest and disturbance of moose.

The need to work with Project proponents to reduce the impact of personal off-road vehicles by exploration and mining camp employees was also noted in the plan.

Authorizations and regulatory approvals required for the Project are discussed in Section 1.4 of this Proposal.

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4 – PROJECT DESCRIPTION

4.1 PROJECT IDENTIFICATION

This section of the Proposal provides an overview of the principal Project, related components and activities and accessory activities, that make up Casino Project (the Project). Accessory activities are defined by YESAB as the activities that must be undertaken for the principal project to proceed (YESAB 2005).

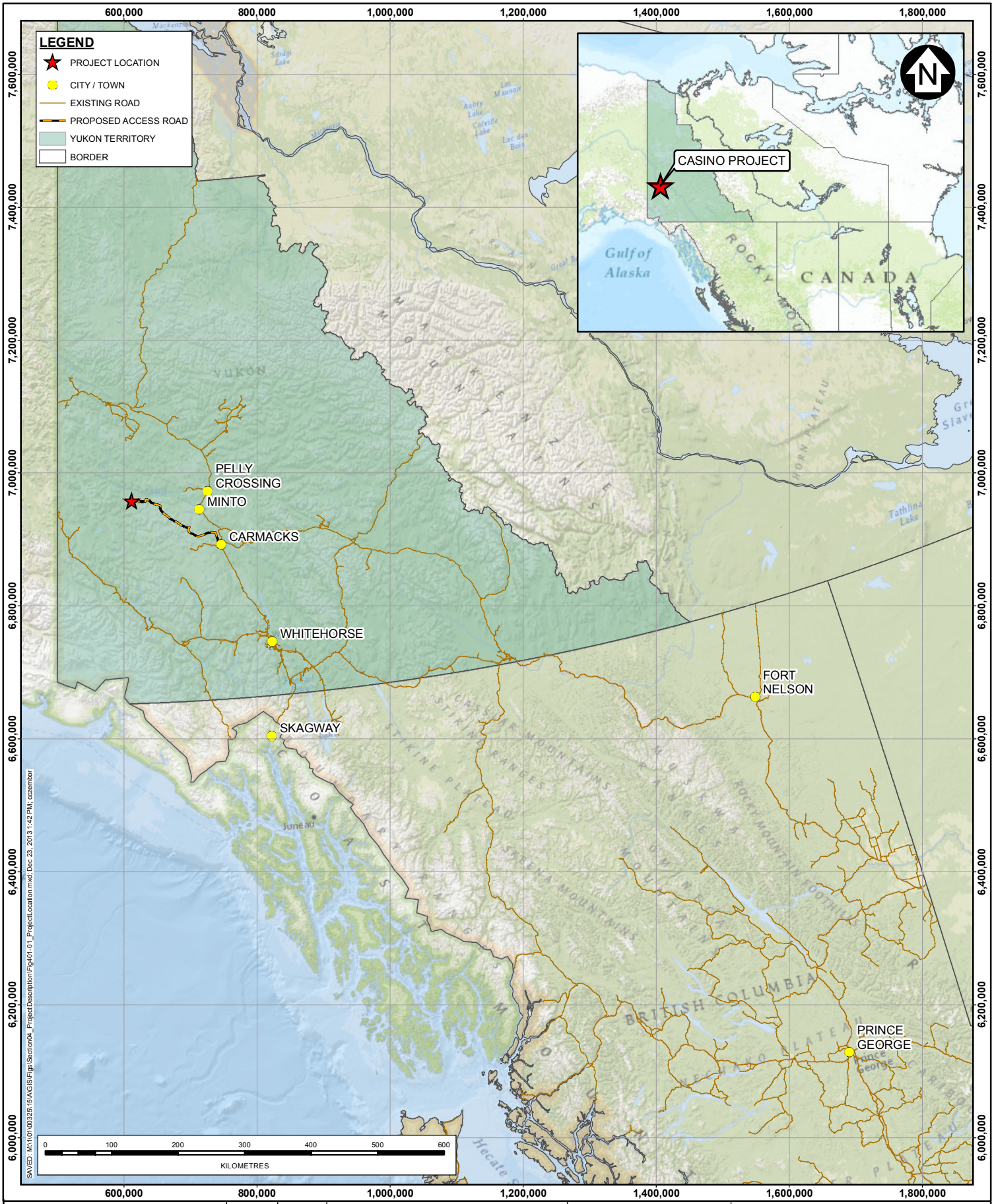
The Project overview is divided into three sections:

- Principal Project Components and Activities (Section 4.1.1.1);
- Related Components and Activities (Section 4.1.1.2); and
- Accessory Activities (Section 4.1.1.3).

The anticipated schedule of the Project, including Project phases and anticipated duration, is presented in Section 4.2. Detailed information on Project components and activities for the construction, operation, closure and decommissioning and post-closure phases of the Project is provided in Section 4.3 to Section 4.5.

4.1.1 Project Overview

Casino Mining Corporation (CMC) proposes to develop the Project located at latitude 62° 44'N and longitude 138° 50'W (NTS map sheet 115J/10), in west central Yukon, in the northwest trending Dawson Range mountains approximately 300 km northwest of Whitehorse (Figure 4.1-1). The UTM coordinates for the Project, centered at the proposed Open Pit, are 611237.19 m Easting and 6958508.48 m Northing in NAD 1983 UTM ZONE 7M. Key facts about the Project are summarized in Table 4.1-1, and the Project components and activities are summarized in Table 4.1-2.



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NOTES:
1. BASE MAP: ARCGIS ONLINE NATIONAL GEOGRAPHIC MAPPING
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CASINO PROJECT

PROJECT LOCATION

FIGURE 4.1-1

REF 1

P/A VA101-325/15

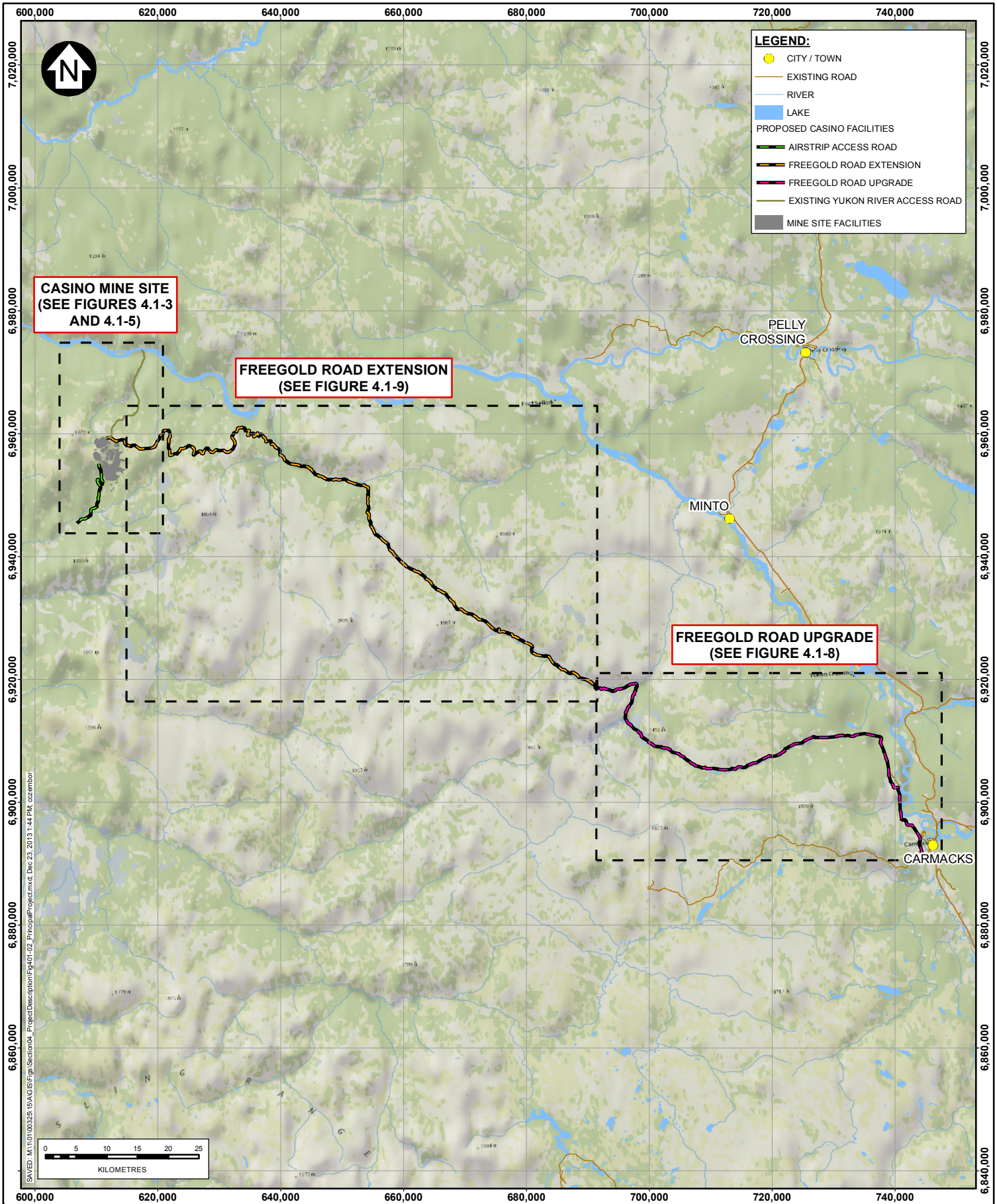
Table 4.1-1 Key Project Facts

Category	Key Facts
Project Name	Casino Project
Proponent	Casino Mining Corporation 1800 - 570 Granville Street Vancouver, British Columbia V6C 3P1
Type of Development	Copper, gold, silver and molybdenum open pit mine
Location	West central Yukon, latitude 62° 44'N and longitude 138° 50'W (NTS map sheet 115J/10), in the northwest trending Dawson Range mountains approximately 300 km northwest of Whitehorse
Life of Project	Anticipated Project life of 34 years (4 years of construction, 22 years of operation, 3 years of closure and decommissioning, 5 years of post-closure)
Anticipated Production Rate	Nominal daily production capacity of 120,000 t/d or 43.8 million t/y of ore over 22 years of full production
Anticipated Life-of-Mine Metal Production	Gold – 5.72 million ounces Silver – 30.26 million ounces Copper – 3.58 billion pounds Molybdenum – 325 million pounds
Products produced at the Casino mine site	Gold-Silver Doré Bars Copper Concentrate Copper Sulphide Precipitate Molybdenum Concentrate
Methods of Ore Processing	Heap leaching and carbon adsorption technology plus SART for oxide ore Conventional grinding, flotation, thickening circuits for sulphide ore
Employment	Peak construction phase of approximately 1000 employees and operation phase of approximately 600
Port of Export	Port of Skagway
Site Access	Road traffic via Freegold Road Upgrade and Freegold Road Extension and aircraft via the Casino Airstrip and airstrip access road. Freegold Road Upgrade and Freegold Road Extension between the Casino mine site and the Village of Carmacks and connections to existing highways to the Whitehorse, Port of Skagway and northern British Columbia
Potentially Affected First Nations	Selkirk First Nation and Little Salmon/Carmacks First Nation

The principal Project, as a whole, will consist of three geographic areas that include the Casino mine site, the Freegold Road Extension, and the Freegold Road Upgrade, as represented on Figure 4.1-2 and outlined in Table 4.1-2.

Table 4.1-2 Principal Project Components and Activities

Geographic Areas	Components and Activities
Casino Mine Site (including the Casino airstrip, airstrip access road and Yukon River freshwater pipeline)	• Open pit, primary crusher and conveyor systems; • Tailings management facility for the combined storage of process tailings and mine waste rock, west saddle and main embankments, cyclone sand plant, dilution head water tank; • Processing facility for sulphide ore; • Heap leach facility for oxide ore; • Temporary ore, topsoil and overburden stockpiles; • Ancillary support facilities; administration building, change house (mine dry) and laboratories; warehouse and laydown area; light vehicle maintenance building; truck shop; guard shed and scale house; explosives facility; • Onsite power generation and distribution consisting of the supplementary power plant, main power plant, and diesel generators; • LNG storage, regasification and distribution; • Diesel storage and distribution; • Waste water treatment plant; • Water ponds including process water pond, fresh water pond, temporary fresh water pond, TMF water management pond, HLF Events Pond; • Accommodations camp; • Service and haul roads; • Communications infrastructure; • Aggregate sources and borrow sites; • Riverbank caisson and radial well system, water pipeline and distribution network from the Yukon River; and • Casino Airstrip and Airstrip access road.
Freegold Road Extension	• Two-lane, gravel resource road; • Stream crossings; • Aggregate sources and borrow sites; and • Temporary construction camp.
Freegold Road Upgrade	• Upgraded two-lane, gravel public road; • Stream crossings; • Carmacks by-pass; • Nordenskiold River bridge; and • Aggregate sources and borrow sites.



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CASINO PROJECT

PRINCIPAL PROJECT

FIGURE 4.1-2

REF 1

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The Project is located on Crown land administered by the Yukon Government and is within the traditional territories of the Selkirk First Nation (SFN) and Little Salmon/Carmacks First Nation (LSCFN). The access road to the Casino mine site will to a large degree follow the existing Casino Trail and Freegold Road (Figure 4.1-3). A section of the proposed Freegold Road Extension will transit through SFN settlement land and a section of the Freegold Road Upgrade will transit through the LSCFN settlement land. Figure 4.1-4 shows LSCFN and SFN Settlement Lands in relation to the Casino Project. The traditional territory of the Tr'ondek Hwechin First Nation lies to the north of the Casino mine site.

The Casino Mine will be a copper, gold, silver, and molybdenum open pit mine that is anticipated to process on average 120,000 t/d or 43.8 million t/y of material over 22 years of full production. There are a total of 965 million tonnes of proven and probable mill (or sulphide) ore reserves and 157 million tonnes of proven and probable heap leach (or oxide) ore reserves (M3 2013).

Access to the Casino mine site during the life of the Project will be by either the Casino Airstrip or the Freegold Road Extension. The Project proposes to construct a 1,600 m airstrip (with 60 m overruns on either end) located approximately 15 km southwest of the Casino mine site to facilitate access by aircraft. A network of existing paved highways currently provides year-round access to the Village of Carmacks from the Port of Skagway, northern British Columbia and Whitehorse. It will be necessary to construct an all-weather access road linking the Casino mine site to existing highway infrastructure in order to construct and operate the Casino Project. Suitable paved roads currently exist up to the Village of Carmacks where an existing limited access Freegold Road begins and extends approximately 83 km northwest towards the Casino mine site. The existing limited access Freegold Road is owned and operated by the Yukon Government and will require upgrades. In addition construction of a new by-pass around the Village of Carmacks and a new bridge over the Nordenskiold River will be required to keep construction and mine traffic away from the Village of Carmacks. For the purpose of the Proposal this portion of the access road is designated as the Freegold Road Upgrade. CMC proposes to develop a continuous all season access road to the Casino mine site by constructing a new 120 km resource road which will generally follow the existing historic Casino Trail and will be owned and operated by CMC for the life of the Casino Project. For the purpose of the Proposal, this portion of the access road is designated as the Freegold Road Extension.

The Project will include the construction of a liquefied natural gas (LNG) fueled power plant at the Casino mine site to generate electrical power for mine operations. Fresh and make-up water for the Project will be sourced from the Yukon River through the installation of a riverbank caisson and radial well system and will be piped to the Casino mine site through an above ground fresh water pipeline.

The Project's open pit will be located between the headwaters of Casino Creek and Canadian Creek and will occupy an area of approximately 300 ha at the end of operations. The open pit will be developed using standard drill and blast technology and large electric cable shovels. Once ore is removed from the pit face, it will be loaded onto 360 metric tonne capacity ore haul trucks and delivered to temporary stockpiles for crushing and processing at one of two facilities; one for sulphide ore and one for oxide ore.

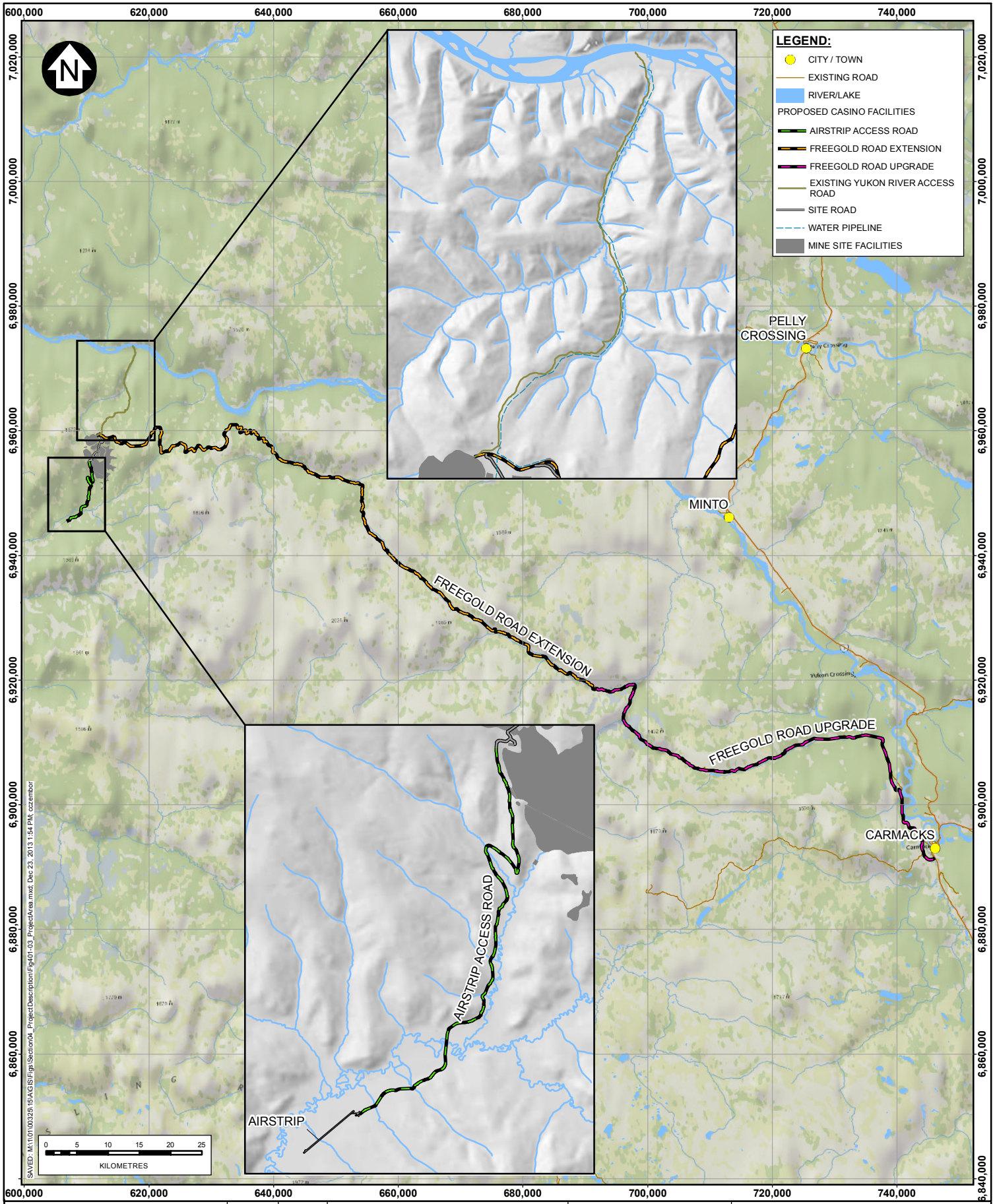
The sulphide ore processing facility will produce concentrates of copper and molybdenum using copper and molybdenum flotation circuits. The copper concentrate produced in the process is dewatered and transported as a as a bulk commodity by highway trucks to the Port of Skagway for ocean transport to market. Molybdenum concentrate produced from sulphide ore will be dewatered and packaged in super sacks and transported by highway trucks to market also through the Port of Skagway.

The oxide ore processing facility will produce gold-silver doré bars via heap leaching and carbon adsorption technology. The heap leach pad, Events Pond, and embankments will cover approximately 100 ha in total.

Oxide ore will be stacked on the heap leach pad and leached with an aqueous cyanide leach (or barren) solution. Gold and silver in the recovered enriched (or pregnant) leach solution will be extracted by using carbon absorption technology to produce gold-silver doré bars. Gold-silver doré bars will be shipped from the Casino site directly to refineries. Copper contained in the oxide ore that is recovered in the pregnant leach solution will be recovered as a copper sulphide precipitate using a Sulphidization, Acidification, Recycling and Thickening (SART) process. The copper sulphide precipitate will be bagged and loaded onto highway trucks for shipment to market through the Port of Skagway.

All potentially reactive waste rock, potentially reactive overburden material, and tailings from the mining and processing operations will be stored in the Project's tailings management facility (TMF) located southeast of the Open Pit within the valley formed by the headwaters of Casino Creek. The TMF has been designed to retain a volume of 947 Mt of tailings together with 658 Mt of potentially reactive waste rock and overburden materials. The TMF will have a footprint of approximately 1120 ha within the Casino mine site.

A brief description of the components and activities that make up the Project follows as part of the Project overview and is divided into three sections: Principal Project Components and Activities, Related Components and Activities, and Accessory Activities.



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CASINO PROJECT

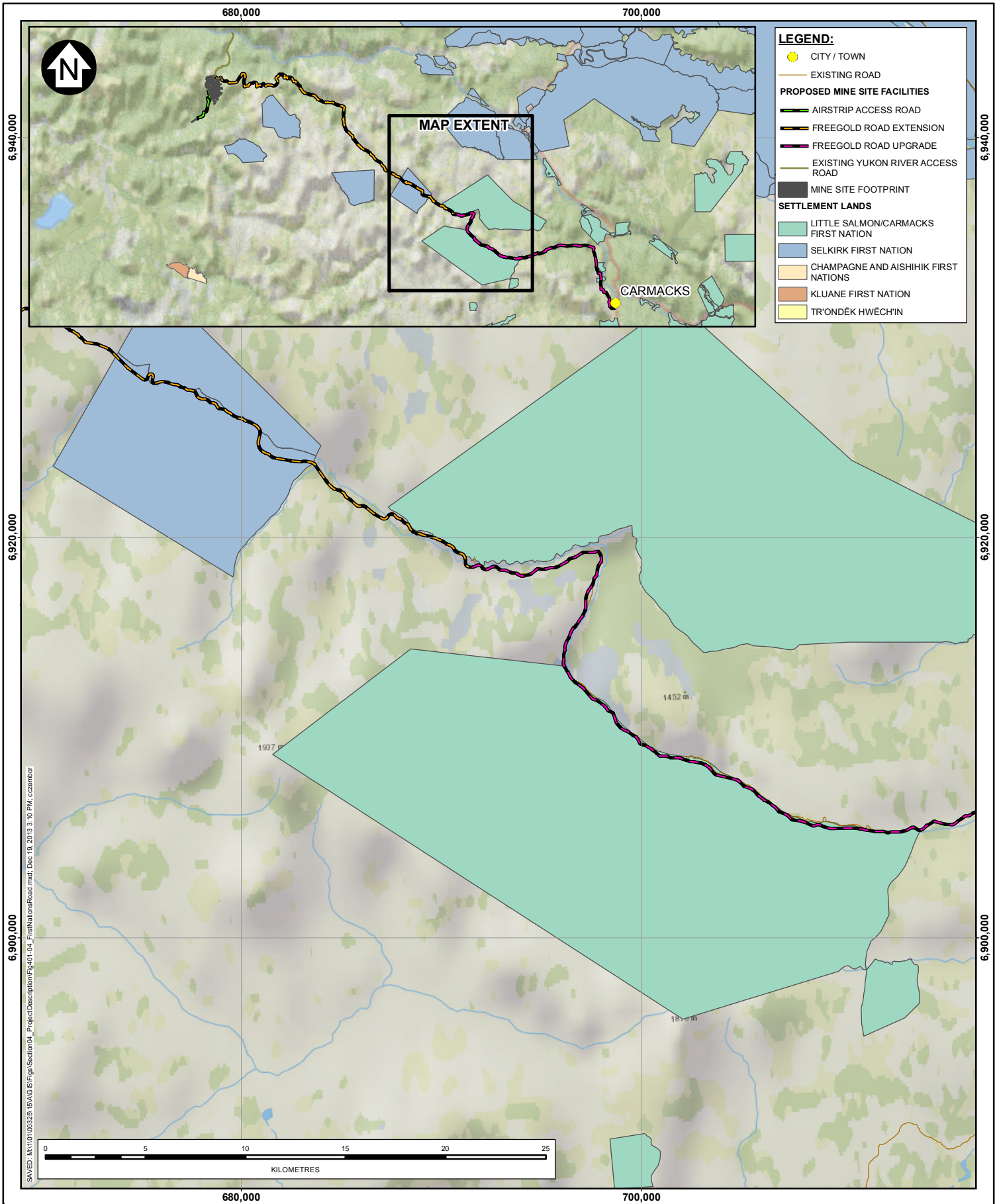
CASINO PROJECT GEOGRAPHIC AREAS

FIGURE 4.1-3

REF 1

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CASINO PROJECT

FIRST NATIONS SETTLEMENT LANDS

FIGURE 4.1-4

REF 1

P/A VA101-325/15

4.1.1.1 Principal Project Components and Activities

This section of the Proposal for the Casino Project provides an overview of the primary Casino mine site components, which will include:

- Open Pit;
- Tailings Management Facility (TMF);
- Processing Plant (used for sulphide ore processing by conventional copper-molybdenum flotation circuits);
- Heap Leach Facility (used for oxide ore processing by heap leaching and carbon adsorption technology plus SART for oxide ore); and
- Temporary Stockpiles.

The spatial extent of the various principal Project components will change over time; some will grow, and others, such as the temporary stockpiles, may grow or shrink. The maximum spatial extent of the principal Project components, irrespective of their temporal footprints, is represented on Figure 4.1-5.

4.1.1.1.1 Open Pit

The Casino Project's Open Pit will be located between the headwaters of Casino Creek and Canadian Creek and will ultimately occupy an area of approximately 300 ha. There will be two designated mining zones that comprise the Open Pit, the Main Pit and the West Pit, which will be developed concurrently. The Open Pit has a total of 965 million tonnes of proven and probable mill ore reserves and 157 million tonnes of proven and probable heap leach reserves (M3 2013) identified. In addition 658 million tonnes of waste material will be excavated during the life of the mine. It is anticipated that the pit will extend to a maximum depth of approximately 600 m (Knight Piésold Ltd. 2012a).

4.1.1.1.2 Tailings Management Facility

The Casino Project's TMF will be located southeast of the Open Pit within the valley formed by the headwaters of Casino Creek. The TMF has been designed to retain 947 Mt of tailings together with 658 Mt of potentially reactive waste rock and overburden; at the end of the operation phase the TMF will cover approximately 1120 ha (Knight Piésold Ltd. 2012b, 2013). The general features of the TMF for the Casino Project are:

- Two earth-rockfill-cyclone sand, zoned embankments (referred to as the Main Embankment and West Saddle Embankment);
- Cyclone plant, cyclone sand and cyclone overflow;
- Tailings distribution system (bulk non-Potentially Acid Generating (non-PAG) tailings launder, non-PAG tailings pipeline, PAG tailings pipeline)
- Two separate reclaim water systems (mill and cyclone plant);
- Waste storage area (for potentially reactive waste rock and overburden);
- Supernatant (surface water) pond; and
- Water management system (seepage collection ditches and pond, and seepage recycling system)

The principal objectives for the design of the TMF are to safely store the required volume of tailings and other materials, while protecting the regional groundwater and surface waters throughout the life of the Casino Project and achieving effective reclamation of the TMF at closure. A dam classification exercise was carried out to establish appropriate earthquake and flood event criteria for the design of the TMF and the final selection of appropriate design criteria was based on the Canadian Dam Association's (CDA) "Dam Safety Guidelines" (2007). The Project's TMF has been designed with considerations for flood events, seismic events and regulations according to the CDA requirements for a "High" consequence dam failure (Knight Piésold Ltd. 2012b).

4.1.1.1.3 Processing Plant

The Casino Project will have two ore processes, a sulphide ore process and an oxide ore process. The process flow sheet depicting the oxide ore and sulphide ore processes is presented as Figure 4.1-6. Table 4.1-3 is an overview of the metals the Casino Project is anticipated to recover over the life of the Project from both oxide ore and sulphide ore processing (M3 2013).

Table 4.1-3 Metals to be recovered over the Life of the Project

Metals	Ore Process	Recovery Technology	Transported Form	Amounts Recovered
Gold	Oxide Ore Process	Heap leach and carbon adsorption	Gold-Silver Doré Bars	5.72 million ounces
	Sulphide Ore Process	Copper flotation circuit	Copper Concentrate	
Silver	Oxide Ore Process	Heap leach and carbon adsorption	Gold-Silver Doré Bars	30.26 million ounces
	Sulphide Ore Process	Copper flotation circuit	Copper Concentrate	
Copper	Sulphide Ore Process	Copper flotation circuit	Copper Concentrate	3.58 billion pounds
	Oxide Ore Process	SART process	Copper Sulphide Precipitate	
Molybdenum	Sulphide Ore Process	Molybdenum flotation circuit	Molybdenum Concentrate	325 million pounds

Note:
Only a small portion of the gold and silver recovered from the Project is in the form of doré bars. The majority of gold and silver recovered will be contained in the copper concentrate.

The sulphide ore process will be comprised of primary crushing followed by conventional single-line semi-autogenous (SAG) mill, ball mill circuit and conventional copper-molybdenum flotation circuits to produce concentrates of molybdenum and copper. The sulphide ore processing facility will include these general features:

- Sulphide ore primary crusher and reclaim course ore stockpile;
- SAG mill, ball mill circuit with pebble crushing;
- Conventional froth flotation;
- Reagents used in the oxide ore processing process (storage, preparation, and distribution);

- Thickened concentrate pressure filters;
- Tailings thickener;
- Tailings distribution pipeline (for PAG tailings) to the TMF;
- Tailings distribution launder (for bulk Non-PAG tailings) to the Cyclone Plant; and
- Tailings distribution pipelines (for bulk, underflow and overflow Non-PAG tailings) from the Cyclone Plant.

Sulphide ore will be trucked from the Open Pit or a temporary ore stockpile to the primary crusher for crushing according to a pre-determined mine production schedule. The primary crushed sulphide ore will be stockpiled on the ground in a covered coarse ore reclaim stockpile until it is fed to the SAG mill circuit. In the SAG mill circuit, sulphide ore will be ground to flotation feed size in two stages: first, a primary SAG mill circuit and, second, a ball mill circuit. Concentration and separation of the copper and molybdenum sulphide minerals by conventional froth flotation will occur as part of the flotation circuit to produce a bulk copper-molybdenum concentrate. The bulk copper-molybdenum concentrate will be separated into separate copper and molybdenum concentrates. The final copper concentrate will be thickened and filtered by pressure filters and loaded into highway-legal trucks for shipment. The final molybdenum concentrate will be filtered, dried, and packaged in super sacks for shipment. PAG tailings (or wastes) from the sulphide ore processing are dewatered and concentrated in a pyrite flotation circuit into thickened tailings prior to flowing by gravity via the PAG tailings distribution pipeline to the TMF for subaqueous disposal. Non-PAG tailings from the processing facility will be distributed, as needed, by concrete lauders to the cyclone plant for processing and use in the construction of the TMF embankment.

4.1.1.1.4 *Heap Leach Facility*

The oxide ore process will take place at the HLF where carbon adsorption will be used to recover gold and silver and SART to recover copper sulphide precipitate. The HLF will process approximately 157.5 million tonnes of oxide ore over the life of the Casino Project. The operations of the HLF will commence during the stripping of the Open Pit towards the end of Year -3 in the construction phase. Oxide ore, intended for the heap leach, will be stored in a temporary stockpile near the dedicated oxide ore primary crusher between Year -3 and Year 15. Crushed oxide ore will be placed on the heap leach in stages over a period of approximately 18 years, starting in the construction phase (approximately 2 years prior to operations of the sulphide process) and continuing up to Year 15. Heap leaching is described in greater detail in Section 4.4.4.2. The oxide ore processing facility will include these general Project features:

- Oxide ore primary gyratory crusher, screening and secondary cone crusher;
- Overland conveyors and a stacker;
- Heap leach facility:
    - Heap leach pad with composite liner system (comprised of a Linear Low Density Polyethylene (LLDPE) liner on a low permeability soil liner);
    - Leachate collection system (solution collection pipes and pumps);
    - Confining embankment;
    - Events Pond; and

- Cyanide destruction plant;

- Carbon adsorption plant (ADR plant) with a Carbon in Column Tanks (CIC) circuit (carbon adsorption process to recover gold and silver);
- SART circuit to recover copper from pregnant solution; and
- Reagents used in the oxide ore processing process (storage, preparation, and distribution).

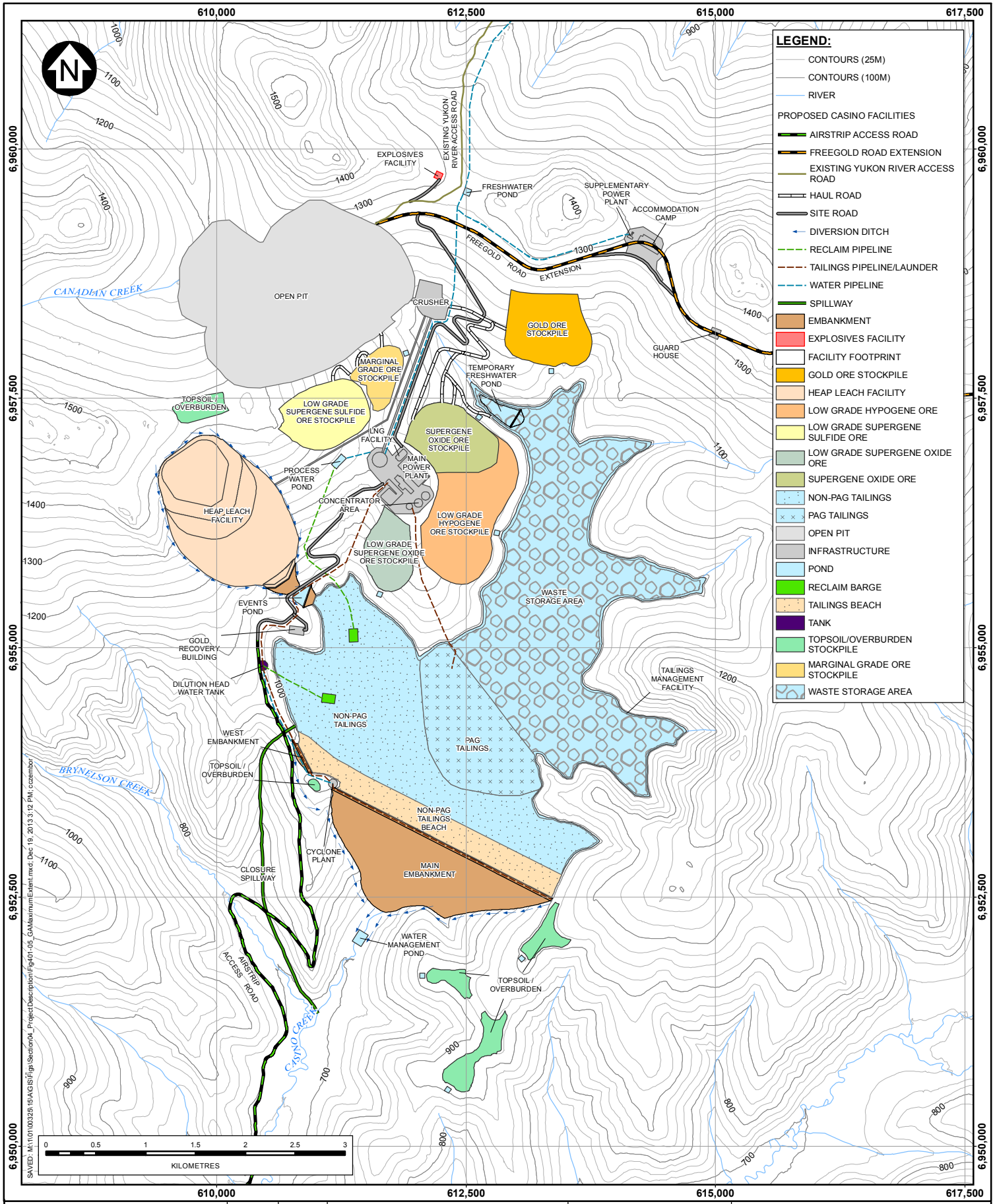
Run of Mine (ROM) oxide ore will be trucked from the Open Pit or an ore stockpile to the dedicated primary gyratory crusher for crushing prior to being discharge onto a screen feed belt conveyor which feeds the secondary cone crusher. The crushed oxide ore will progress onto a series of overland transfer systems that place crushed oxide ore onto the heap leach pad.

A small valley about 1 km south of the Open Pit will be filled with oxide ore to form the heap leach pad. An earthen embankment at the eastern toe of the heap leach pad will provide structural support for the heap leach. A spill and runoff control collection pond termed the “Events Pond” will be built directly downhill from the heap leach pad.

The heap leach pad will consist of geo-membrane liners, a low-permeability soil liner and a perforated pipe drainage system to facilitate recovery of the enriched (pregnant) leach solution. The Events Pond for the HLF will handle excess solution that might occur during a large precipitation event.

The crushed ore, stacked onto the heap leach pile, will be irrigated with a dilute cyanide solution to leach out the gold and silver and the small amounts of copper in the ore. The solution containing the dissolved copper, gold and silver, referred to as the pregnant solution, will percolate through the crushed ore until it reaches the liner at the bottom of the heap. The pregnant solution collected at the bottom of the heap will be pumped to the ARD/SART plant where the dissolved gold and silver will be extracted by a carbon absorption process to produce gold-silver bullion (doré) bars. Copper sulphide precipitate will be recovered from the pregnant leach solution by the SART process. Gold and silver doré will be shipped to metal refineries. The copper sulphide precipitate will be bagged and loaded onto highway trucks for shipment to market.

After separating the gold, silver and copper sulphide precipitate from the pregnant solution, the dilute cyanide solution, referred to now as the barren solution, will be re-used in the oxide ore process or sent to the cyanide destruction plant where the residual cyanide is treated and residual metals are removed.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

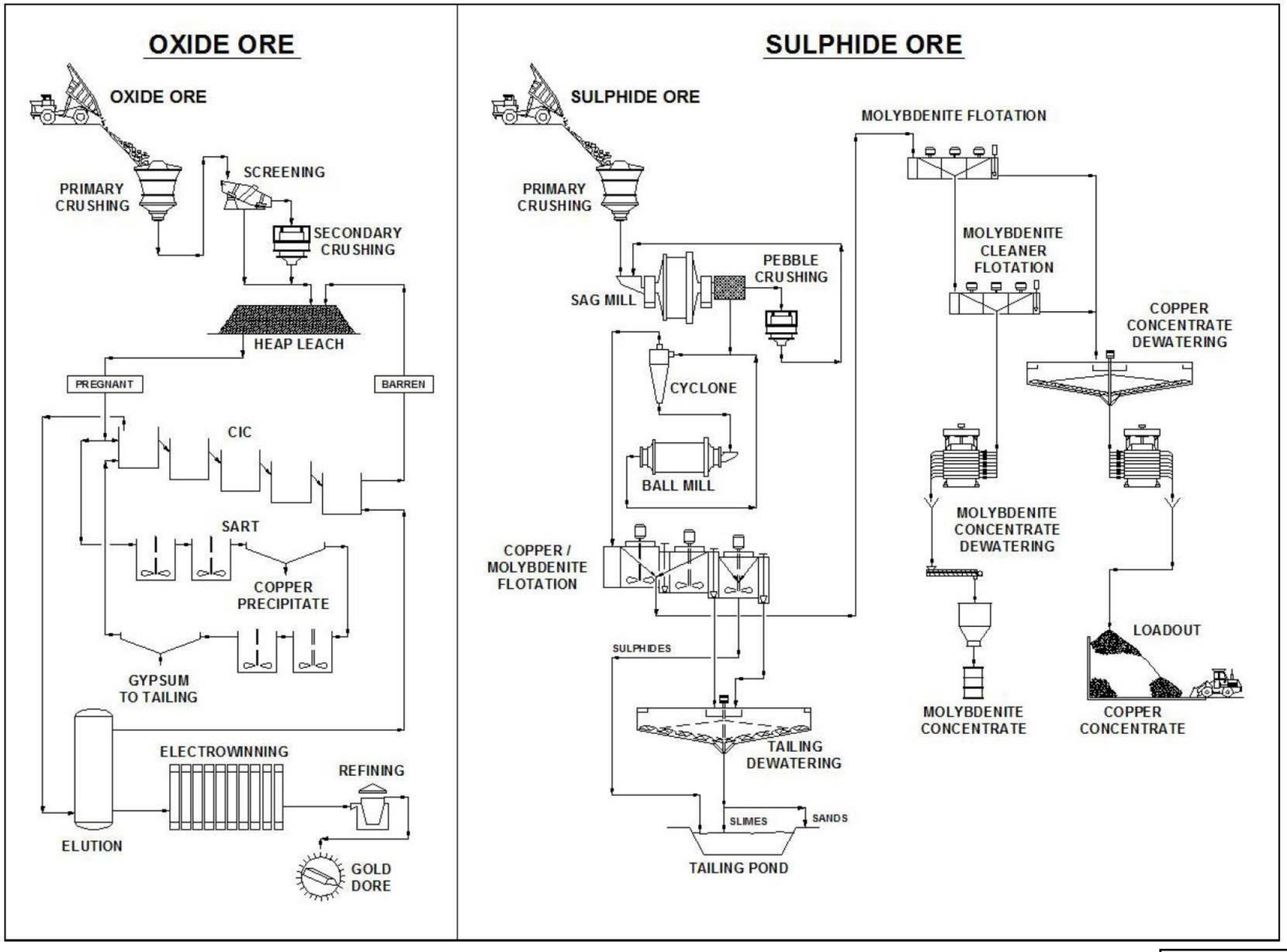
CASINO PROJECT

GENERAL ARRANGEMENT - MAXIMUM EXTENT

FIGURE 4.1-5

REF 1

P/A VA101-325/15



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0	19DEC'13	ISSUED WITH REPORT	JEF	CAH	GLS

CASINO MINING CORPORATION

CASINO PROJECT

PROCESS FLOWSHEET FOR OXIDE ORE AND SULPHIDE ORE PROCESSING

Knight Piésold CONSULTING

P/A NO. VA101-325/15

REF. NO. 1

FIGURE 4.1-6

REV 0

4.1.1.1.5 Temporary Stockpiles

Temporary stockpile areas for gold ore, supergene oxide ore, low-grade ores, marginal grade ore, will be utilized in order to achieve a desired production schedule for the Project. Topsoil and overburden stockpiles will also be generated to store soil material for reclamation use at the end of mine life. The types of temporary stockpiles, descriptions of schedules, purposes and locations are provided in Table 4.1-4. The Project will have additional stockpile capacity within the Casino mine site, if required.

Table 4.1-4 Temporary Stockpiles

Temporary Stockpile(s)	Description	Location(s)
Gold ore stockpile	Gold ore, intended for the heap leach will be stored in a temporary stockpile over a period of approximately 16 years, starting in the construction phase in Year -2 and reaching its largest extent in Year 3. Between Years 4 to Year 14, gold ore from the stockpile will be recovered according to the heap leach stacking and production schedule. Approximately 56 million tonnes of gold ore will be placed in this stockpile throughout the 16 years of its existence.	Near the Open Pit, north of the TMF
Supergene oxide ore stockpile	The supergene oxide ore will be stockpiled adjacent to the Plant Site and crusher during the construction phase from Year -3 to Year 1. It will reach its largest extent in Year 1 and begin to report to the process plant during Years 4 to 12, together with direct feed ore from the Open Pit. Approximately 32 million tonnes of supergene oxide ore will be placed in this stockpile throughout the 15 years of its existence.	Adjacent to the Plant Site and crusher.
Low grade ore stockpiles. The three types of low grade ore stockpiles are listed and described below.	Low grade ore will be placed in several temporary stockpiles within the Casino mine site for processing at the plant in later low grade years of the operation phase. In general, low grade ore will be stockpiled up to Year 17 and milled during the last four years of the operation phase from Years 19 to 22. Approximately 144 million tonnes of low grade ore is placed in the three low grade ore stockpiles over the life of the Project.	Within the Casino mine site
• Low grade hypogene ore stockpile	Low grade hypogene ore will be stockpiled next to the Plant Site and crusher from Year 2 to Year 17. After Year 12 this stockpile will occupy the footprint of the supergene oxide ore stockpile.	Adjacent to the Plant Site and crusher
• Low grade supergene sulfide ore stockpile	Low grade supergene sulfide ore will be stockpiled south of the Open Pit from Years -1 to 16.	South of the Open Pit
• Low grade supergene oxide ore stockpiles	Low grade supergene oxide ore will be stockpiled south of the Plant Site from Years -1 to 15.	South of the Plant Site
Marginal grade ore stockpile	Marginal grade ore will be stockpiled near the Open Pit during Years -2 to Year 4. The maximum footprint of the ore stockpile will occur in Year 4. Approximately 9 million tonnes of marginal grade ore is placed in the stockpile over the life of the Project.	Near the Open Pit
Top soil and overburden stockpiles	During general site preparation, topsoil and overburden will be salvaged and placed in temporary stockpiles located around the Casino mine site for use in reclamation activities.	Within the Casino mine site at various locations.

4.1.1.2 Related Components and Activities

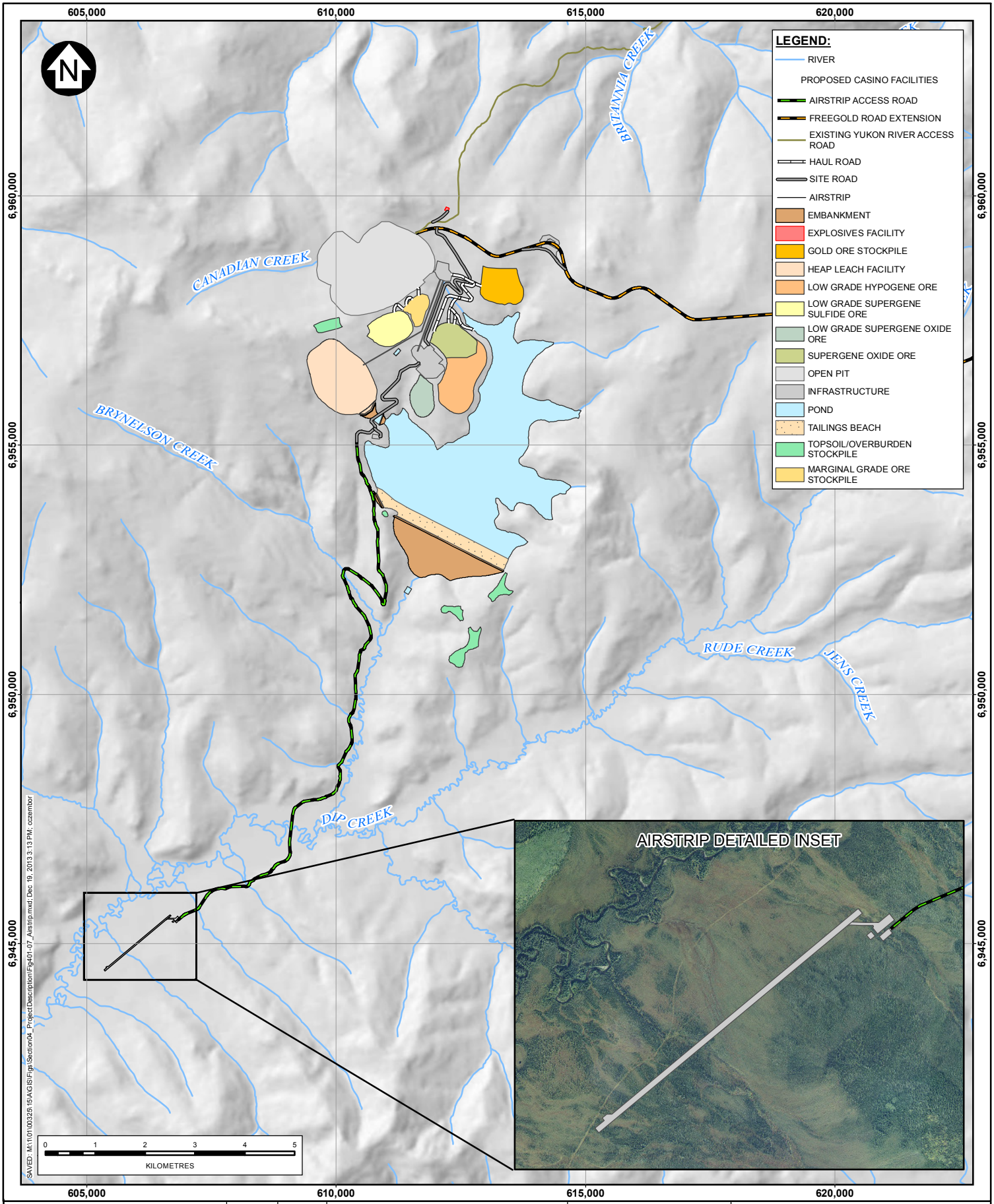
The related components and activities are represented on the General Arrangement – Maximum Extent (Figure 4.1-5), and on the Casino Airstrip and airstrip access road layout (Figure 4.1-7), and include:

- Casino Airstrip and airstrip access road;
- Ancillary support facilities (administration offices, warehouse, etc.);
- Power generation and distribution;
- Fuel supply and distribution;
- Accommodations camp;
- Service roads;
- Water supply and distribution;
- Wastewater treatment and disposal; and
- Communications infrastructure.

4.1.1.2.1 Casino Airstrip and Airstrip Access Road

The Casino mine site is remote, so access to the mine site for employees will be best served by aircraft. The Project will include the construction and operation of a 1,600 m airstrip with a pre-engineered building and an access road to facilitate employee transport to and from the Casino mine site. The new airstrip will be located approximately 15 km southwest of the Casino mine site on a flat area adjacent to Dip Creek as shown on Figure 4.1-7. The existing small airstrip near the Casino mine site will be replaced with the new airstrip to permit all-season operation and accommodate Bombardier Dash 8-100 or 200 series turbo-prop (37-39 seats) or similar aircraft. CMC anticipates that flights will originate from Whitehorse connecting with scheduled flights from Vancouver or other major centres. The airstrip design criteria have been developed to conform to the Transport Canada Aerodrome Standards and Recommended Practices (TP 312).

The airstrip access road will consist of approximately 14 km of single lane gravel road starting from the Casino Airstrip and will connect with the tailings dam access road at the Casino mine site. The road design criteria for the airstrip access road satisfies the guidelines in the BC Ministry of Forests and Range, Forest Road Engineering Guidebook (2nd Edition, 2002) for a 30 km/h design speed.



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PREPARED BY:	Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING, ESRI ARCGIS ONLINE YUKON GOVERNMENT ELEVATION DATA
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

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CASINO AIRSTRIP AND AIRSTRIP ACCESS ROAD

FIGURE 4.1-7

REF 1

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4.1.1.2.2 Ancillary Support Facilities

The majority of ancillary support facilities for the Casino Project will be located at, or close to, the Plant Site. To the extent possible, all support buildings will be consolidated into a single administration / maintenance / laboratory complex to reduce outside travel for in-building workers (with the exception of the staffed security gate and explosives facility). All buildings will be pre-engineered steel structures of modular construction. In general, the ancillary support facilities will include:

- Administration building;
- Change house (mine dry) and laboratories;
- Warehouse and laydown area;
- Light vehicle maintenance building;
- Truck shop;
- Staffed security gate and scale house; and
- Explosives facility.

The administration building will provide office space for both the construction and operation phase activities. A change house (mine dry) and laboratory building will be located near the Plant Site. A warehouse and laydown area will receive and store parts and supplies for used in maintenance of the processing plant's mechanical and electrical equipment. A light vehicle maintenance building will be located at the Plant Site separate from the truck shop which will be located adjacent to the Open Pit. A staffed security gate and scale house will be located at the Casino mine site entrance, and another staffed security gate will be located at the entrance of the Freegold Road Extension at km 83.

4.1.1.2.3 Power Generation and Distribution

Electrical power to the Casino mine site will be supplied by various units, including a Supplementary Power Plant installed during construction, and the Main Power Plant, as well as supplementary diesel generators. The power generation capacities and anticipated requirements over the life of the Project are presented in Table 4.1-5.

Table 4.1-5 Power Sources and Nominal Capacities

Power Source(s)	Nominal Capacity (MW)		
	Construction	Operation	Closure and Decommissioning
Main Power Plant • 2 gas turbine driven generators, 1 steam turbine driven generator = 130 MW • 2 internal combustion reciprocating engine = 20 MW	Will be constructed	150	Will be decommissioned
Supplementary Power Plant • 3 dual fuel (diesel or LNG) internal combustion engine driven generators = 20 MW	20	20	Will be decommissioned
Portable Diesel Generators • small portable diesel generators • large portable diesel generators	As Required	As Required	As Required
Total Power Capacity	20	150	As Required
Typical Operating Condition	10	130	As Required

Note:
Nominal capacities and specific sizes of generating units will vary from vendor to vendor. All values are approximate and will be confirmed prior to construction of the Project.

Supplementary Power Plant

The Supplementary Power Plant will be located near the main accommodations complex and will provide power during the construction phase to the accommodations camp, to construction phase activities and to the HLF. The Supplementary Power Plant will consist of three internal combustion engines, dual fuel driven generators capable of using both LNG and diesel and have a combined power output of approximately 20 MW. Diesel fuel will be used during the first few years until the Main Power Plant is operational.

Main Power Plant

The Main Power Plant will be located at the processing Plant Site and is intended to supply the electrical energy required for the operations phase of the Project, including the HLF, the Processing Plant, the Open Pit mine and all infrastructure. The Main Power Plant will have a total nominal capacity of 150 MW. Electrical power generation will be provided by two gas turbine driven generators and a steam turbine driven generator, operating in combined cycle mode to produce nominally 130 MW. Two internal combustion reciprocating engine driven generators will provide approximately 20 MW of power for black start capability, emergency power, and to supplement the electrical power generated by gas turbine generation, when required. The gas turbines and the internal combustion engines will be fueled by natural gas which is re-gasified from LNG. During normal operations the plant will supply approximately 130 MW of power to the various facilities at the mine site.

Onsite Power Distribution System

The two power generation plants will generate electrical power at 13.8 kV, which is stepped up to 34.5 kV through four 13.8 kV to 34.5 kV transformers for site distribution.

4.1.1.2.4 Fuel Supply and Distribution

Prior to the operations of the LNG storage and regasification facility, diesel will be the primary fuel for the Project; however, over the life of the Project, diesel use will decrease. Some mine site equipment and vehicles (front-end shovel loaders, mine site passenger trucks) will operate on diesel for life of the Project and diesel will also be required for back up diesel generators.

CMC proposes to source LNG for the Casino Project from a supplier in Fort Nelson, British Columbia and anticipates that LNG will be available in the region starting in 2017. LNG will be transported from Fort Nelson to the Project via tanker trucks at an average frequency of 2 trucks per day during the last two years of the construction phase and 11 trucks per day during the operations phase. LNG will be stored at the Casino mine site in a 10,000 m^3 storage tank and re-gasified to natural gas, as required. In addition to providing natural gas for the power generation, CMC is exploring the feasibility of using LNG to power the mine fleet vehicles.

4.1.1.2.5 Accommodations Camp

A 1,000-person capacity construction camp will be located at the Casino mine site to support the construction crew and Casino Project personnel. Additional camps for off-site construction will be provided by individual construction contractors as required such as for the construction of the Freegold Road Extension and Freegold Road Upgrade. Prior to the operation phase of the Project, the construction camp will be converted to serve as residence for the operation phase staff.

4.1.1.2.6 Service Roads

Service roads within the Casino mine site will connect the various mine components, infrastructure facilities and accessory activities. All service roads will be constructed with a minimum 4 m wide all-weather gravel surface and have a maximum grade of 10%.

4.1.1.2.7 Water Supply and Distribution

The Casino Project will require a make-up water supply system to supplement natural run-off and water recycling to meet the overall water demand throughout the life of the Project. The proposed water sources and their designated uses are identified by Project phase in Table 4.1.6. Additional information on the development and operations of the water sources are presented in sections 4.3.1.4, 4.3.4, 4.4.1.3, and 4.5.1.4 of the Proposal.

Table 4.1.6 Water Sources and Uses by Project Phase

Water Source	Use	Project Phase			
		Construction	Operation	Closure and Decommissioning	Post-Closure
Mine Contact Water (which is runoff from mine site facilities)	Site runoff from disturbed areas, or non-contact water discharging to disturbed areas, such as the Open Pit, will be collected, managed and discharged to the TMF; water stored within the TMF will be used at the mill and cyclone sand plant.	✓	✓	X	X
Non-Contact Water (which is runoff from the undisturbed catchment within the mine site)	Non-contact water will be allowed to drain naturally to the TMF pond; water stored within the TMF will be used at the mill and cyclone sand plant.	✓	✓	X	X
HLF Events Pond	During Construction, runoff may be stored in the pond to help supply the process water needs for the HLF.	✓	X	X	X
Groundwater wells located at the Casino mine site	Potable water source for drinking water.	✓	X	✓	X
Water from open pit dewatering	Pit dewatering systems will collect the dewatering flows from the pit sump and pump water for use in HLF operations during Construction, and for use in the sulfide ore process during Operations.	✓	✓	X	X
Temporary fresh water pond located in the TMF catchment	Construction activities, potable water, initial operations of HLF, and firefighting.	✓	X	X	X
Yukon River freshwater pipeline and fresh water pond from the Yukon River to the Casino mine site	Potable water (with water treatment if required), firefighting and general requirements of the Casino mine site including supplementary water for the HLF and processing plant.	X	✓	X	X
TMF supernatant pond	TMF reclaim water will be used at the processing plant, cyclone sand plant, HLF and for general mine activities.	X	✓	X	X
TMF Water Management Pond	Collect surface runoff and seepage from the TMF embankments. During Year -3 the pond will only treat for sediment and then release water to Casino Creek. Starting in Year -2, water will be collected and be pumped back to the TMF.	✓	✓	✓	X
Treated septic and grey water, in small quantities, from the camp and other facilities.	Released and stored in the TMF.	✓	✓	X	X

The initial water requirements for the HLF during the construction phase (Year -3 to Year -1) will be met by pumping water retained within the Temporary Freshwater Supply Pond located within the TMF catchment area along Casino Creek. This temporary water source will be replaced during the operation phase by process water reclaimed from the TMF and processing plant which will be supplemented by fresh water from the Yukon River freshwater pipeline. Water will be collected in a riverbank caisson and radial well system installed adjacent to the Yukon River. The water will be pumped through an aboveground insulated 36" diameter by 17.4 km long pipeline designated the "Yukon River freshwater pipeline" with four booster stations to a 22,000 m^3 freshwater pond located near the accommodations camp.

Potable water during the construction phase will be sourced from groundwater wells located at the Casino mine site. This temporary source of potable water will be replaced during the operation phase with water from the Yukon River water pipeline, and water treatment will be implemented if required.

4.1.1.2.8 Wastewater Treatment and Disposal

A packaged (pre-engineered and pre-fabricated) sewage treatment plant system will be located at the Casino mine site to accept and treat all sanitary wastewater. One type of treatment uses an aerobic process which is a variation of the activated sludge treatment process. This system functions by creating an environment with sufficient oxygen levels and agitation to allow for bio-oxidation of the wastes to suitable levels for discharge into the environment. Any treated water from the wastewater treatment plant will be discharged into the TMF.

4.1.1.2.9 Communications Infrastructure

CMC proposes to develop sufficient and reliable communications infrastructure to meet the needs of the Casino Project throughout the Project's life. An integrated multifunctional, communications and networking infrastructure will service the Casino mine site, the Casino airstrip and other Project facilities. The various communications sub-systems may include a combination of:

- Satellite land stations;
- Telephone exchange switching systems (complete with voice message and plant internal PA capabilities);
- Trucked, VHF radio systems including base stations and vehicle and handheld portable radio equipment; and
- Integrated multi-use fibre-optic network with Ethernet TCP/IP network infrastructure.

The Casino mine site could also be serviced with a permanent telecommunications satellite dish installation for local cellular phone system but this option requires further evaluation.

4.1.1.3 Accessory Activities

CMC has taken into consideration YESAB's guidance on defining accessory activities that must be undertaken for the principal project to proceed (YESAB 2005). Upon applying the YESAB criteria of interdependence and linkage, CMC has determined that the accessory activities to the Casino Project are:

- Freegold Road Upgrade (existing Freegold Road, that requires upgrading and will remain a public road owned and operated by the Yukon Government);

- Freegold Road Extension (new controlled access, resource road that will be constructed and operated by CMC for the Casino Project)

This section of the Proposal provides an overview of the accessory activities that are proposed to be carried out in relation to the Principal Project.

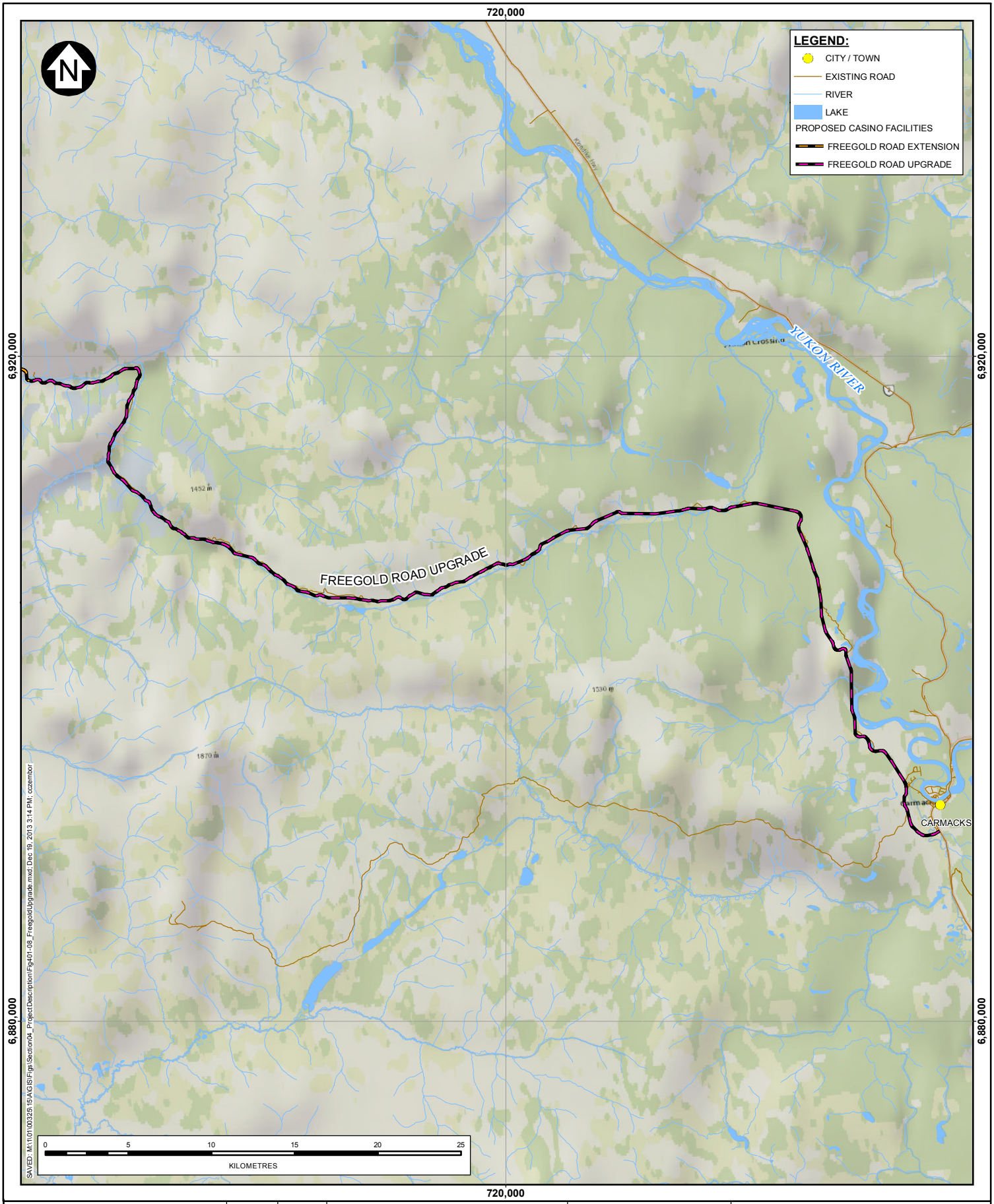
4.1.1.3.1 Freegold Road Upgrade

The existing Freegold Road from the Village of Carmacks to the Big Creek crossing at km 83 is the property of the Yukon Government and will remain a public road throughout the life of the Project. The existing Freegold Road extends approximately 83 km northwest towards the Casino mine site from the Village of Carmacks, as shown on Figure 4.1-8, where it ends and meets the Freegold Road Extension near an old washed out bridge on Big Creek. The existing Freegold Road requires upgrades, including new creek crossings, to make it suitable for volume of traffic that the new mine will generate. The construction of a bypass around the Village of Carmacks, and a new bridge over the Nordenskiold River will be necessary to keep mine traffic away from the Village. CMC and the Yukon Government are in discussions regarding the proposed upgrade of the existing Freegold Road segment to support trucking to the Casino mine site.

4.1.1.3.2 Freegold Road Extension

From where the existing Freegold Road ends near an old washed out bridge on Big Creek, CMC will construct a new, all weather, gravel road to the Casino mine site designated as the Freegold Road Extension. The Freegold Road Extension will be a 120 km, two-lane, gravel resource road designed to accommodate double-trailer and Tridem trucks. There will be 18 major bridge crossings located along the Freegold Road Extension which include crossings of Bow Creek, Big Creek, Hayes Creek, and Selwyn River along with several tributaries and side channels. There will also be 71 major culvert or short span bridge crossings with estimated diameters ranging from 1,500 mm to 2,400 mm. In general, the new extension will follow the existing historic Casino Trail that has been used in the past to service the Casino mine site (Figure 4.1-9), however closer to the mine the road will deviate from the trail in order to ensure better grades and alignment for the mine traffic..

Prior to the construction phase (before Year -4), the existing Casino trail will provide limited access for equipment and fuel during the winter months. The first year of road construction will begin in Year -4 and will include clearing and grubbing of parts of the Freegold Road Extension alignment and development of a “First Stage Road” that will provide a continuous single lane, low speed, access route to the Casino mine site for fuel and materials for the construction phase prior to the completion of the Freegold Road Extension. The completion of the Freegold Road Extension will occur prior to the operation phase of the Project and will establish an all-weather access route and allow for road transportation to and from Whitehorse, the Port of Skagway and Fort Nelson.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE NATIONAL GEOGRAPHIC MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

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FREEGOLD ROAD UPGRADE

FIGURE 4.1-8

REF 1

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FREEGOLD ROAD EXTENSION

FIGURE 4.1-9

REF 1

P/A VA101-325/15

4.2 PROJECT PHASES AND SCHEDULING

4.2.1 Project Phases and Scheduling

The Project phases are defined as Construction (C), Operation (O), Closure and Decommissioning (CD), and Post-Closure (PC); a summary of the Project phases and anticipated duration is shown in Table 4.2-1. A life of project schedule for the primary activities that make up the Casino Project is presented in Figure 4.2-1.

Table 4.2-1 Casino Project Phases and Schedule

Project Phase	Duration	Project Year
Construction (C)	4 years	Year -4 to Year -1
Operation (O)	22 years	Year 1 to Year 22
Closure and Decommissioning (CD)	3 years	Year 23 to Year 25
Post-Closure (PC)	5 years	Year 26 to Year 30

Note:
Continued limited activities will occur as required following the Post-Closure Phase of the Casino Project to ensure protection of the surrounding environment.

Construction of the Project will commence when the necessary permitting and financing is implemented for the Casino Project. The construction phase of the Project is projected to be 4 years. During the construction phase, there are a variety of works that will be developed early on to facilitate the onsite works. The first stage road will be constructed in the first year of the construction phase to facilitate early site access for materials and fuel. After the road and air accesses are developed, the permanent infrastructure for the Casino mine site will be constructed followed by the freshwater supply, ancillary buildings, and power plants.

The TMF construction will commence early in the construction phase with the installation of the temporary cofferdam and construction of the Stage IA Starter Embankment. The HLF, gold recovery plant and oxide ore crusher, conveyor and stacker will be constructed in parallel and are projected to take six months to complete. These facilities will be operated through the construction phase. Following this the concentrator building will be constructed in conjunction with the mechanical components of the processing facilities; pre-operational testing is completed prior to the start-up of full production in Year 1.

The operation phase of the Project will begin at the end of commissioning of the sulphide mill facilities (start of Year 1) and is projected to last 22 years. In Year 1, the Project will operate below full production and will process 34.5 Mt of ore. During the remainder of the operation phase (Years 2 through 22), the ore throughput will vary on a yearly basis, ranging from a low of 44.7 Mt in Year 11 to a peak of 46.2 Mt in Year 13. The total milled ore during the operation phase is projected to be approximately 965.2 Mt. The nominal daily production capacity of the Casino mine during the operation phase will be 120,000 t/d. During the operation phase, the Casino mine is scheduled to operate two 12-hour shifts per day, 365 days per year.

The active closure and decommissioning phase is projected to commence in Year 23 and last three years. During the closure and decommissioning phase, the surface facilities will be removed and the Casino mine site will be fully reclaimed according to the reclamation objectives established in the final Closure and Reclamation Plan for the Casino Project by CMC in consultation with the Yukon Government, First Nations and interested parties.

Post-Closure activities include annual inspections of the Casino mine site. For the purpose of the Proposal and assessment, the post-closure phase is proposed to last five years. Monitoring is anticipated to evaluate the predicted results of reclamation with the onsite conditions within this phase.

Project Activity	Project Phases																															
	Construction				Operation																						Closure and Decommissioning			Post-Closure				
	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30+
Construction activities (Refer to Construction Schedule)	■	■	■	■	■																													
Freegold Road Extension - First Stage Road in use		■	■																															
Freegold Road Extension operations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Freegold Road Upgrade operations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Accommodation camps (pioneer camp, construction camp, operations camp, closure camp)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
Casino Airstrip operations				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Yukon River fresh water pipeline				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Open pit stripping and development	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
TMF development	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Cyclone Sand Plant operations					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Oxide ore processing (mill operations)					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Heap leach operations (sulphide ore processing and gold recovery)		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■												
Stacking of low grade ore in temporary stockpiles	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■													
Processing of low grade ore																						■	■	■	■	■								
Supplementary Power Plant operations		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
Main Power Plant operations					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Heap leach facility rinsing, draindown and reclamation (cover installed at end of reclamation period)																							■	■	■	■	■	■	■	■	■	■		
TMF reclamation																											■	■	■					
Decommissioning of mine site components and support infrastructure																											■	■	■					
Post-closure monitoring																														■	■	■	■	■

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	19DEC'13	ISSUED WITH REPORT	CPK	CAH	GLS

CASINO MINING CORPORATION

CASINO PROJECT

LIFE OF PROJECT SCHEDULE

Knight Piésold CONSULTING

P/A NO. VA101-325/14

REF. NO. 1

FIGURE 4.2-1

REV 0

4.3 CONSTRUCTION PHASE

4.3.1 Overview

This section of the Proposal for the Project describes the components, facilities and activities that are anticipated in the Construction Phase (Year -4 to Year -1). In general, most construction activities for the Project will occur over a period of four years though some construction activities will occur during the operation phase. Similarly, some Project components such as the HLF will be constructed and operational during the construction phase of the Project and are presented in this section of the Proposal. Figure 4.3-1 shows the sequencing of construction phase activities leading to full production (Year 1). The Casino mine site including infrastructure, components and work areas established at the end of the construction phase (in Year -1) for the Project are shown on Figure 4.3-2.

Prior to the start of the construction phase, personnel will utilize existing infrastructure, to the extent possible, from the Casino Project's bulk sample program including:

- 200 person camp;
- Water supply, sewage treatment plant and power supply;
- Existing airstrip (located where the new Plant Site will be located);
- Laydown areas;
- Fuel storage;
- Temporary explosives magazines; and
- Casino Trail.

The clearing and grubbing of the required sections of the Freegold Road Extension and the construction of a limited access first stage road will be the highest priority given the remoteness of the Casino mine site, the present condition of the Freegold Road and Casino Trail. Throughout the entire construction phase, the completion of the all-weather access road to the Casino mine site will be a high priority for the success of the Casino Project.

Prior to the construction phase of the Project and into Year -4, equipment and fuel will be moved to the Casino mine site by the Casino Trail. As well, construction of bridges, borrow pit preparation and vegetation clearing activities associated with the Freegold Road Extension will be completed during the winter months as part of the preconstruction activities. Similarly, the Village of Carmacks bypass road and bridge over the Nordenskiold River will be completed to provide a suitable access route for traffic and deliveries of fuel, supplies, and equipment.

During the construction phase, road access via the development of a limited access "First Stage Road" along the Freegold Road Extension route in Year -4 to Year -3 will provide a continuous route from the Village of Carmacks to the Casino mine site. CMC anticipates that it will take two winter construction seasons to complete construction of all required bridges and the First Stage Road will be completed by the end of the second full construction year (Year -3). The First Stage Road will allow for passage of slow moving vehicles suitable for the rough terrain and provides early access for construction equipment to the Casino mine site.

Primary activities during the construction phase will include:

- Construction of the Freegold Road Extension;

- Construction of the Freegold Road Upgrade;
- Relocation of the existing camp, establishment of the pioneer camp and expansion of the permanent accommodations camp at the Casino mine site;
- Establishment of temporary construction camps for the construction of the Freegold Road Extension and Freegold Road Upgrade;
- Pre-stripping heap leach pad and Events Pond sites;
- Development of rock, sand and gravel aggregate sources;
- Construction of the Casino Airstrip and Airstrip Access Road;
- Preparation of additional laydown areas or work areas;
- Construction of a concrete batch plant;
- Construction of heap leach pad, Events Pond and gold processing facilities;
- Fresh water supply;
- Construction of ancillary buildings (bulk explosives facility, mine shop and warehouse, fuel and lubricant storage facilities and office facilities);
- Construction of the supplementary power plant and main power plant;
- Construction of the Plant Site processing facilities (crushers, conveyors, ore loading, grinding, flotation, thickeners, filtration, reagents and concentrate storage and loadout);
- Development of the TMF;
- Removal of Open Pit overburden and soil salvage,
- Open Pit pre-stripping and ore production; and
- Environmental monitoring and sampling.

The following considerations that are factored into the planning and execution of construction activities for the Casino Project will include:

- Remoteness of the Casino mine site;
- Seasonal conditions; cold and short daylight hours in winter, warm and long days in summer;
- Present condition of the Freegold Road and Casino Trail; and
- Construction on discontinuous permafrost.

Construction activities will follow best practices that will be outlined in CMC's Environmental Health and Safety (EHS) Management System. For example, cofferdams will be constructed to divert water around construction areas and discharge them into their respective watersheds with appropriate siltation mitigation measures and an archaeologist will be available at all times to promptly confirm chance archaeological finds and determine the appropriate mitigation strategy.

Project Activity	Pre-Construction	Construction																Operation			
		Year -4				Year -3				Year -2				Year -1				Year 1			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Notice to proceed																					
Receive permits																					
Procurement and contracts																					
Mitigate designated archaeological sites																					
Pre-construction activities																					
Project mobilization																					
Freegold Road Extension																					
First Stage Road																					
Freegold Road Upgrade																					
Carmacks by-pass and and bridge over Nordenskiold River																					
Casino Airstrip and Airstrip Access Road																					
Heap lead pad construction (5 stages in Years -3, -1, 3, 7 and 11)																					
Gold Recovery Plant (ADR/SART)																					
Accommodations Camp																					
Relocate existing camp and build pioneer camp																					
Yukon River freshwater pipeline																					
Building and major equipment foundations																					
Ancillary buildings																					
Supplementary Power Plant																					
Main Power Plant																					
Tailings Management Facility (progressive construction through Operations)																					
Embankment construction (progressive construction through Operations)																					
Reclaim water system																					
Sulphide ore processing facility																					
Sulphide ore primary crusher																					
Erect Grinding and Flotation Building																					
Mechanical and Electrical Installation																					
Pre-operational testing																					
Start-up to full production																					

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	19DEC'13	ISSUED WITH REPORT	CPK	CAH	GLS

CASINO MINING CORPORATION

CASINO PROJECT

CONSTRUCTION SCHEDULE

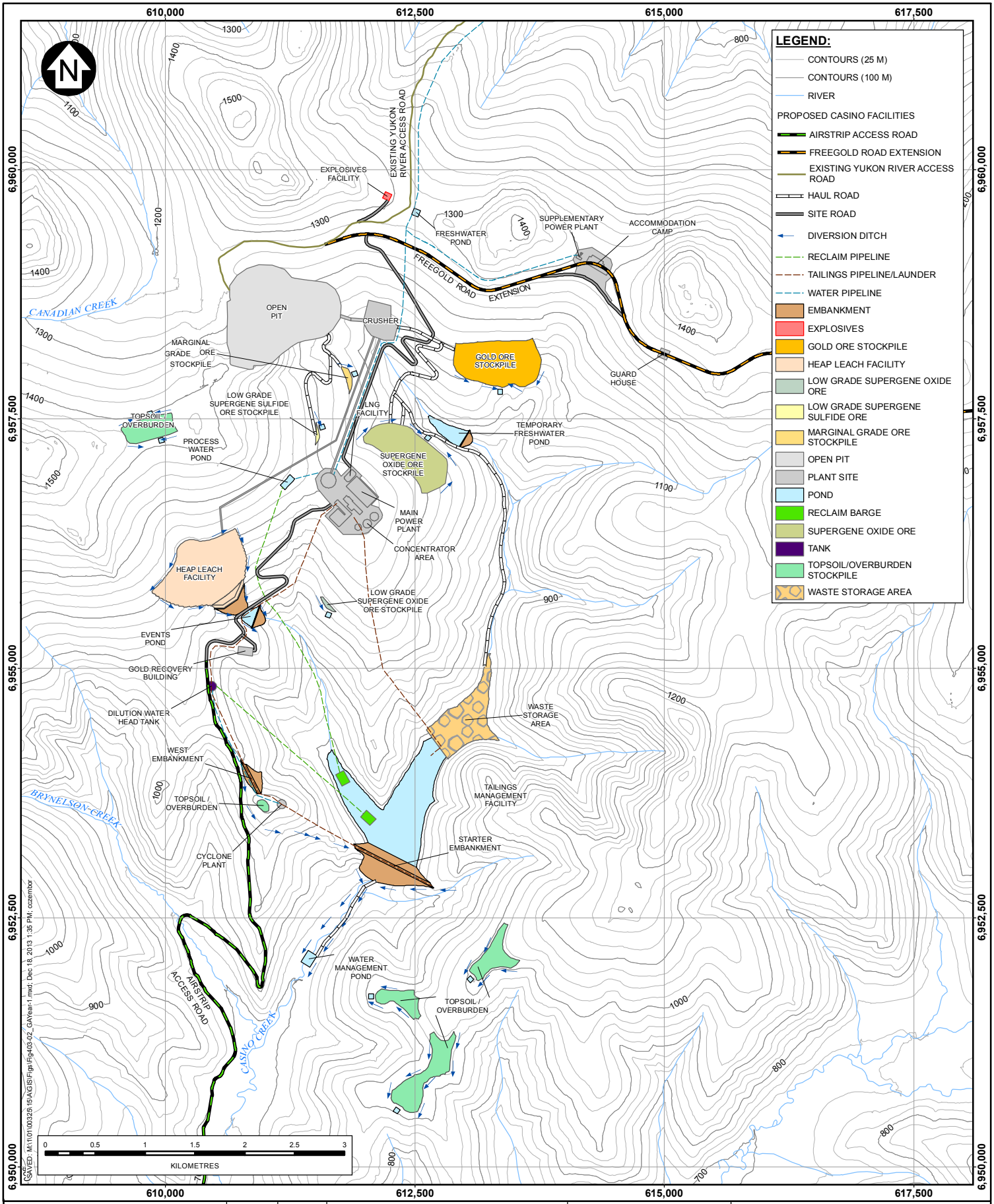
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REF. NO. 1

FIGURE 4.3-1

REV 0



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

GENERAL ARRANGEMENT YEAR -1

FIGURE 4.3-2

REF 1

P/A VA101-325/15

4.3.1.1 Construction Equipment

The construction equipment requirements for the Project will be sized and estimated taking into account the construction schedule and project execution plan developed for the Casino Project, prior to the commencement of the Project. Heavy equipment will be required during the construction phase of the Casino Project to perform the following duties:

- Clearing and grubbing;
- Strip and remove overburden;
- General site earthworks;
- Special transport requirements (e.g. heavy lift cranes and transporters); and
- Steel/building erection and equipment assembly.

It is anticipated that a core fleet of major construction equipment will be developed. This fleet will be developed based on the characteristics of the facilities and their components as well as the rigging and schedule requirements of the Project. The size and types of construction erection equipment are based on the detailed erection plans developed for the Project. Detailed planning and coordination among all of the Project contractors will be required to ensure the most economical use of the equipment on site as well as space for erection and access.

Table 4.3-1 is a preliminary list of the anticipated major heavy equipment requirements for the stripping and operation of the Open Pit. Additional equipment will be required for the site preparation, the airstrip construction and the construction of the various roads. Typically this equipment will include large excavators, dozers, dump trucks, loaders, graders, compactors etc. The excact size and number of units will be determined in conjunction with the selected construction contractors who will obtain and transport them to the mine site. Similarly equipment for the construction of the site facilities will be selected by the appropriate construction contractors. Typically the major items of equipment will include; concrete batch plant, concrete mix trucks, concrete pums, cranes of various sizes, welders, flatbed trucks, hiabs, fork lifts, man lifts etc.

Table 4.3-1 Mine Equipment Requirements during Construction

Mine Equipment		Anticipated Quantity		
Type	**Description**	**Year -3**	**Year -2**	**Year -1**
Drill	P&H320 XPC	1	1	1
Cable Shovel	P&H 4100XPC	1	1	1
Truck	Cat 797F	4	5	8
Track Dozer	Cat D11T	1	2	2
Track Dozer	Cat D10T	1	2	2
Wheel Dozer	Cat 854K	1	1	2
Motor Grader	Cat 24M	1	2	2
Water Truck	30,000 gal	1	2	2
Excavator	Cat 345D	1	1	1
Drill	Atlas Copco ECM 720	1	1	1
Wheel Loader	Cat 992K	1	1	1
Truck	Cat 777F	1	1	1
Total		**17**	**22**	**26**

Note:
The equipment descriptions are considered typical and not indicative of the final equipment selection. The excact size, number of units and types will be determined prior to construction of the Project.

4.3.1.2 Workforce Requirements

This section of the Proposal provides information on the anticipated Casino Project workforce requirements during the construction phase, including location, magnitude, schedule, and infrastructure support components.

Workforce requirements have been estimated for the construction phase is expected to peak at approximately 1,000 personnel; the estimates are approximate and will vary seasonally through the year and between each year of the four-year construction phase. The construction workforce will be a combination of CMC employees and construction contractor skilled and unskilled workers. The expected construction positions will include:

- Heavy and light equipment operators;
- mechanics;
- millwrights;
- carpenters;
- electricians;
- ironworkers;
- concrete finishers;
- pipefitters;
- boilermakers;
- masons
- labourers;
- sheet metal workers;
- insulators;
- painters;
- truck drivers;
- warehousemen;
- construction supervisors;
- catering and services;
- management and technical; and
- specialty trades.

It is the intent of CMC to employ as many people from the Yukon as possible, including from First Nations communities. However, it is anticipated that there will be a shortage of skilled construction workers in the Yukon to fulfill the estimated requirements of the construction phase. Therefore, additional personnel from outside the Yukon will be necessary to fully staff the Project. CMC expects that the additional construction workers will come primarily from elsewhere in Canada.

Transportation of personnel to the Casino mine site during the construction phase is provided by CMC using the Casino airstrip and airstrip access road. Aircraft will be chartered to transport construction workers to the Casino Project from the Whitehorse Airport on a rotational basis. At the Whitehorse Airport, construction workers will use commercial carriers to fly to and from areas outside the Yukon. In addition, small aircraft operated by independent carriers on a chartered basis could transport construction workers from some Yukon communities directly to the Casino airstrip.

The work schedule during the construction phase of the Casino Project will likely consist of 10-hour days, 7 days per week. The scheduled work rotation for most contractors during the construction phase will be 4 weeks on with 2 weeks off. Workers hired from northern communities are anticipated to work 2 weeks on with 2 weeks off during the construction phase. Seventy percent of the workforce is projected to work day shifts and the remaining 30% are anticipated to work night shifts.

CMC anticipates that the number of flights into the Casino mine site per person per year on a 2 weeks on and 2 weeks off rotation will be 13. Based on this anticipation, Table 4.3-2 summarizes the projected average number of flights per year in the construction phase of the Project.

Table 4.3-2 Projected Number of Flights into the Casino Mine Site – Construction Phase

Construction Phase Flights	Number of Flights
Passengers per flight	36
Flights per year, for personnel rotation	359
Flights for other purposes (at 10% of rotation requirements)	36
Total	**395**

NOTE:
Projections are based on 13 flights into the Casino mine site per person per year on a 2 weeks on and 2 weeks off rotation

4.3.1.3 Energy Requirements

The energy requirement for the Casino Project during the construction phase will be less than 20 MW and is anticipated to average around 8 to 10 MW. All power during the construction phase is generated on site by the Supplementary Power Plant. Where appropriate, such as in remote locations, stand-alone diesel generator units will be used as required. CMC anticipates that diesel will be used to power all generators in Year -4 and Year -3, prior to LNG deliveries from Fort Nelson, British Columbia to the Casino mine site which is anticipated to start in Year -2.

4.3.1.4 Water Management

The objective of construction water management at the Casino mine site is to keep contact water and non-contact water separate, to minimize erosion in disturbed areas, and mitigate the release of sediment laden waters to the receiving environment. Any non-contact water will be diverted to the extent practicable to avoid contact with the mine facilities and allowed to rejoin its natural watercourse. Sediment and erosion control strategies will include

establishing diversion and runoff collection ditches, constructing sediment control ponds, and stabilizing disturbed land surfaces to minimize erosion. Water management features that will be established during the construction phase include sediment control structures, cofferdams, pumping systems, runoff collection ditches, and diversion channels. The Casino Project's Water Management Plan contains detailed information on the overall Casino mine site water management approach (Appendix 4C – Water Management Plan).

Construction phase water supply sources include:

- The freshwater supply pond, primarily for HLF operations;
- Groundwater wells at the Casino mine site; and
- Water from the open pit dewatering.

In the construction phase, activities requiring sediment and erosion control will include clearing of vegetation, stripping topsoil, stockpiling topsoil, and constructing roads and infrastructure foundations. Sediment mobilization and erosion will be managed for construction activities by:

- Installing sediment controls prior to construction activities;
- Limiting the disturbance to the minimum practical extent;
- Constructing surface drainage controls to intercept surface runoff;
- Reducing water velocity across the ground, particularly on exposed surfaces and in areas where flow tends to concentrate;
- Progressively rehabilitating disturbed land and constructing drainage controls to improve the stability of rehabilitated land;
- Protecting natural drainages and watercourses by constructing appropriate sediment control devices such as collection and diversion ditches, sediment traps, and sediment ponds; and
- Restricting access to rehabilitated areas.

All temporary sediment and erosion control features will be regularly maintained and will be reclaimed after achieving soil and sediment stabilization.

Tailings Management Facility

During the construction phase of the Casino Project, water management structures and activities will be required for the construction of the TMF. The TMF water management system will consist of the following activities:

- Construction of a cofferdam and diversion ditches to divert runoff from upstream and downstream of the embankment sites. Water will be diverted around the embankment sites in Years -4 and -3;
- Construction of the Stage IA – Starter Embankment and the West and South diversion and collection ditches; and
- Construction of the water management pond downstream of the Stage IA - Starter Embankment. In Years -4 and -3, runoff from, and water diverted around, the embankment construction areas will be routed through the water management pond to settle out sediment, and then be discharged to Casino Creek. Starting in Year -2, the Starter Embankment will begin storing water, and seepage and runoff from the embankment will be collected in the water management pond and then pumped back to the TMF.

Heap Leach Facility

The proposed heap leach pad will be developed in five stages, with the following water management activites beginning in Year -4:

- Install cofferdam and construct the HLF Events Pond and HLF confining embankment;
- Construct the Events Pond at the foot of the HLF downstream confining embankment;
- Construct the HLF embankment and Events Pond spillways.
- Construct interim diversion ditches around the perimeter of the stage 1 heap pad to intercept overland surface runoff and convey flows downstream of the HLF. Diversion ditches will include lining and protection from erosion and scouring.

The HLF will also begin operations during the construction phase of the Project. Water required for HLF operations during the construction phase will be sourced from the temporary freshwater supply pond, which will constructed on upper Casino Creek during Year -4.

Open Pit

During Open Pit construction and pit stripping, water collected within the Open Pit footprint will be gathered at a common sump and transferred to the Mine Water Treatment Feed Pond by pump for use by the process plant or for treatment and release, as required. Contact water from the temporary stockpiles will also be collected and directed to the process plant for use in the mill. During construction, pumping systems will be implemented near the Open Pit to manage pit dewatering requirements. During the construction phase, the upper Canadian Creek will continue to flow naturally northwards to the Yukon River.

4.3.1.5 Waste Management

Several types of solid wastes will be generated during the construction phase of the Casino Project. This section discusses the generation and management of solid wastes other than wastes generated from open pit mining, heap leaching, and ore processing. The management of these other types of wastes are discussed within the descriptions of their respective facilities and processes in Sections 4.4 and Sections 4.5 of the Proposal. Additional information on the management of hazardous materials is provided in Section 4.3.9.4. Anticipated waste types generated during the construction phase of the Casino Project, and proposed handling and disposal methods are summarized in Table 4.3-3.

Table 4.3-3 Construction Phase Waste Management

Waste Streams	Description	Handling Method	Disposal Method
Hazardous Wastes	Explosives residue, cyanide, batteries, paint	Hazardous wastes will be sorted by material and temporarily stored. Cyanide will be specifically managed in accordance with the *International Cyanide Management Code (2012)*.	Hazardous waste will be hauled off-site by truck to an approved facility.
Non-Hazardous Solid Wastes	Including domestic camp wastes (food, plastics, paper), and inert bulk wastes (i.e. rubber belts, lumber, packaging etc.)	Non-hazardous wastes will be sorted by material and bagged.	Non-hazardous wastes will be trucked to an approved disposal area, landfilling on site, or incinerated on site.
Fuels and Lubricants	Petroleum products and oils	Waste oils will be collected in bulk containers specific to the waste type.	Fuels and lubricants for disposal will be hauled to an approved disposal area (or waste oil will be consumed within waste oil burners in the maintenance shops).
Sewage	Human sewage and grey water	Sewage treatment will be managed and treated onsite. Sludge will be managed in accordance with the standards of the *Waters Act* and *Public Health and Safety Act.*	A packaged sewage treatment plant system will be used to treat all sanitary wastewater. Treated effluent will be disposed of in the TMF.
Woody Debris	Brush from site clearing	Woody debris from the clearing and grubbing process will be handled in accordance with the plan developed with the Yukon Government (forestry department).	The wood will be stockpiled for local use, mulched and laid, or burned, in accordance with the standards set forth by the *Forest Resources Act* and the Department of Community Services Wildland Fire Management.

The handling, storage, transportation, and disposal of all solid wastes generated by the Project during the construction phase will be conducted in a safe, efficient, and environmentally-compliant manner designed to:

- Limit the risk of adverse environmental effects;
- Protect the health and safety of site personnel;
- Limit the generation of waste; and
- Reduce costs associated with closure of waste handling, storage, and treatment facilities.

A permanent waste management facility will be established at the Casino mine site during the construction phase. The waste management facility will serve as a central depot where wastes generated across the Casino mine site will be managed, properly processed, packaged, labelled, inventoried, secured (e.g., on pallets) and stored for transport, disposed of on site or reused on site. Where possible and practical, the various waste streams will be sorted at the source. Wastes remaining after the application of waste minimization techniques will be handled and

disposed of in a practical and environmentally responsible manner consistent with the methods outlined in Table 4.3-3. Potential onsite solid waste disposal methods are discussed below.

Incineration

The main disposal method for combustible non-hazardous wastes generated at the Casino mine site will be incineration using an appropriately designed variable flow dual chamber incinerator. The ashes from the incineration process will be placed in closed drums and buried within a designated area of the landfill. Incineration diverts putrescible waste from the landfill and will prevent problems associated with odours which may attract wildlife. Only trained personnel may operate the incinerators in accordance with applicable emission requirements of the Yukon Government. Waste oil will be consumed within waste oil burners in the maintenance shops. An incinerator will be installed at the accommodations camp location.

Landfill

Landfill sites within the Casino mine site will be used to dispose of inert solid waste and ashes from the incinerator. Regular cover will be applied over the landfill sites and a cap of native overburden will be placed on top of the landfill before decommissioning, so that the content of the landfill will remain permanently isolated. Open air controlled burning of inert combustible materials will be conducted on an as-needed basis to eliminate large quantities of construction-related wood waste and cardboard that would otherwise use up landfill capacity.

The footprint of the landfill will be minimized through planned waste minimization and recycling practices, and volume reduction from the incineration of a portion of the waste stream. The landfill will only be operated by trained personnel who will carry out regular inspections and monitoring of the facility.

Sewage Treatment Plant

As described in Section 4.1.1.2.8, a packaged (pre-engineered and pre-fabricated) sewage treatment plant system will be located at the Casino mine site to treat sanitary wastewater with an aerobic process. This system will allow for bio-oxidation of the sanitary wastes to suitable levels for discharge. One sewage treatment plant will be located in the vicinity of the accommodations camp and is sufficient to serve the peak construction workforce during the construction phase.

Wastewater will be collected within each building at the Casino mine site and pumped to the waste water treatment plant through a main pipe. At remote areas, wastewater will be collected in local holding tanks and collected via a tanker truck for treatment at the wastewater treatment plant. Treated effluent will be distributed to the TMF. The wastewater treatment plant will be operated in accordance with effluent discharge requirements of the Yukon Government.

4.3.1.6 Fuel, Hazardous Materials and Explosives Management

Separate structures will be constructed for storage of fuel, hazardous materials and explosives in accordance with applicable regulations and specific permitting requirements. Several regulations and legislative bodies oversee the management of fuel, hazardous materials and explosives, including:

- Fisheries and Oceans Canada policy for the use of explosives in or near fish bearing waters;
- Explosives Act magazine license requirements with respect to storage and handling of explosives; and
- Necessary permits including Blasting Permit, Magazine license, Factory license, ANFO Certificate, Purchase and Possession Permit, Explosives and Hazardous Materials Transport Permit.

The fuel, hazardous materials and explosives facilities, equipment and locations are listed Table 4.3-4.

Table 4.3-4 Fuel, Hazardous Materials and Explosives Management

Facility	Equipment	Location
Diesel fuel storage and distribution	• 6 x 50,000 L storage tanks near truck shop • Enclosed lines, hoses and pumps	Near truck shop
LNG receiving, storage and distribution	• Storage tank of 10,000 m^3 • 2 x Portable fueling stations • 2 x Mobile re-fuelers • Enclosed lines, hoses and pumps	Plant Site
Maintenance shop	• Waste lubricating oil steel tank • Oily water treatment systems	Plant Site
Explosives facility	• Explosives magazine	Northeast of the Open Pit
Processing plant reagent storage, mixing and distribution	• 8,000 t lime silo	HLF Plant Site

Fuels and Explosives

Fuels (primarily diesel and LNG) and other hazardous liquids will be transferred from tanker trucks to storage tanks by enclosed lines, hoses, and pumps equipped with pressure transducers and volume counters to ensure tanks cannot be overfilled. All storage tanks will be constructed and managed in accordance with the *National Fire Code* and in conformity with the *Environmental Code of Practice for Above-ground Storage Tank Systems Containing Petroleum Products*. Storage tanks and associated equipment will be located away from watercourses and will be situated in a designated area that is bermed and lined with an impermeable barrier with a holding capacity equal to 110% of the largest tank within the berm. Explosives will be prepared and stored in accordance with the explosives license issued by Natural Resources Canada to a licensed explosives contractor hired by CMC; explosives and blast caps will be stored in separate facilities, away from operational areas.

Hazardous and Recyclable Wastes

Hazardous and recyclable wastes will be temporarily stored in special containers and/or at designated locations on-site and will be respectively shipped to registered hazardous waste disposal facilities or to recycling depots. Manifests will be prepared for all materials shipped off-site and the receivers will be required to maintain chain of custody records. Estimated volumes of hazardous and recyclable wastes will be developed during detailed engineering design.

Hydrocarbon Contaminated Materials

Soil, water, ice and snow contaminated by accidental oil spills will be collected and deposited within land-farm treatment facilities for remediation at the Casino mine site. The land-farm will be bermed and lined and will consist of multiple cells to handle waste generated from several events separately. Soil remediation will occur through volatilization and natural biological processes and once hydrocarbon levels meet the applicable Yukon Government remediation standards, the soil will be transferred to the landfill, likely to be used as cover material. If treatment is not effective, the material will be disposed of off-site at a licensed disposal facility.

Hydrocarbon contaminated water, snow and ice will be treated within the oily water treatment systems within the maintenance shops located at the Casino mine site. Excessive volumes of contaminated snow and ice will be stored within a dedicated cell of the land-farm until the material has melted and can be transported by pump truck to the oily water treatment system in the maintenance shop.

4.3.1.7 Access and Transportation Management

An existing network of paved highways connects from the Village of Carmacks to the Port of Skagway, Whitehorse and British Columbia. Following the review of different modes of transportation it was determined that the preferred means of transport for the Project will be utilizing highway-capable trucks to carry inbound and outbound materials and supplies. Additional information on the evaluation of alternative transportation options is presented in Section 4.8.4.

In order to develop and operate the Project it will be necessary to construct an all-weather access road linking the Casino mine site to existing highway infrastructure in the Yukon. CMC proposes to accomplish this by constructing a new 120 km road from the western limit of the existing Freegold Road generally following the existing historic Casino Trail. The existing Freegold Road from the Village of Carmacks will require upgrades, a bypass around the Village of Carmacks and a new bridge over the Nordenskiold River.

Preconstruction activity for the access road will involve establishing temporary construction camps to support construction activities prior to Year -4.

The construction of the Freegold Road Upgrade will involve:

- Carmacks By-Pass Road and bridge over Nordenskiold River (starting in summer Year -4); and
- Road construction starting from the Village of Carmacks for the upgrade of the existing Freegold Road (starting in summer Year -4).

The construction of the Freegold Road Extension will involve:

- First Stage Road (cleared and established by summer of Year -3); and
- Freegold Road Extension (constructed by end of Year -2).

Construction for the Freegold Road Extension will start from the western limit of the existing Freegold Road (at km 83) moving westward towards the Casino mine site. As well, construction will commence from the Casino mine site in a generally easterly direction to meet the construction front originating from the Freegold Road Extension, and heading south to construct the Airstrip Access Road and Airstrip.

Prior to construction, tenders will be issued in order to select a qualified contractor or contractors for the construction of the Freegold Road Extension. The selected contractor(s) will be responsible for securing all licenses and authorisations in the provision and delivery of all related services.

All traffic along the Freegold Road Upgrade and Freegold Road Extension associated with the construction phase of the Casino Project will be managed in accordance with the final Road Use Plan (a conceptual Road Use Plan is presented in Appenidix 22A).

Projected Road Traffic Volumes during the Construction Phase

Table 4.3-6 presents the projected traffic volumes by vehicle type and year for the construction phase.

Table 4.3-5 Projected Road Traffic Volumes during the Construction Phase

Year	Avg./Day "Heavy" Traffic	Avg./Day "Light" Traffic	Avg./Day Total
-4	3	1	4
-3	10	8	18
-2	14	14	28
-1	10	16	26

Source: Excerpted from Access Overview for Submission to YESAB, November 2013, Appendix 4B

Note:
Light vehicles include autos and trucks up to 10 tonne capacity.
Heavy traffic includes vehicles greater than 10 tonne capacity.

Mobilization and Re-Supply during Construction

The objective in the first two years of road construction will be to develop a limited access first stage road that will provide a continuous route from the Village of Carmacks to the Casino mine site. The purpose of the First Stage Road will be to provide the ability to supply fuel and materials for the on-going road development and mine construction activities. The First Stage Road will be a single lane road that will allow passage of slow moving vehicles to the Casino mine site. Prior to the construction of the new Casino Airstrip, personnel, equipment and materials will also be flown to the Casino mine site for a limited time using the existing smaller airstrip which will be decommissioned later to accommodate the construction of the process plant in the latter years of the construction phase.

Laydown Areas

At the Casino mine site, a laydown area proposed in the general footprint of the Plant Site will be used to store equipment and materials needed for construction. Smaller laydown areas will be located to cover areas already established as laydown during the bulk sampling program, or at future development areas such as the permanent accommodation camp and temporary ore stockpiles. In addition, a warehouse and laydown area will be constructed at the Plant Site to receive and store parts, supplies, and for maintenance of plant mechanical and electrical equipment. Additional laydown space will be established at the Casino Airstrip and potentially along the existing access roads.

Haul and Service Roads

Two categories of haul and service roads will be constructed to serve the Casino mine site; those designed for mine haul trucks and those designed for light-duty site and commercial traffic. A main haul road, suitable for mine haul trucks, will connect the Open Pit, Plant Site, HLF, and TMF. Access and service roads will be constructed to handle light-duty site and commercial traffic including the road from the Casino mine site to the Casino airstrip and the road to the explosives facility.

Traffic along all site roads will be managed in accordance with the Traffic Management Plan which will be developed for the Casino Mine. Haul roads will be inspected regularly, sprayed with dust suppressants to reduce fugitive emissions and ploughed and repaired as necessary.

Site Access Management System

A staffed security gate and pre-engineered scale house building will be located at the entrance of the Casino mine site and at the eastern edge of the Freegold Road Extension where it meets up with the existing Freegold Road (at km83). The staffed security gate will host 24-hour surveillance and management of site access to the Freegold Road Extension and the Casino mine site. A final Road Use Plan for the Casino Project will be developed and implemented prior to the commencement of the Project (a conceptual Road Use Plan is presented in Appendix 22A).

4.3.1.8 General Site Preparation

Site preparation activities in support of the Project are anticipated to begin in Year -4 and includes typical activities associated with clearing and preparing the land in advance of the construction of the principal Project components and support infrastructure. During general site preparation activities, the Casino mine site, Freegold Road Extension, Casino Airstrip and Airstrip Access Road will be surveyed, lain out, and contoured appropriately for any necessary mine components and infrastructure.

CMC will procure the services of a qualified Engineering, Procurement, and Construction Management (EPCM) contractor for the construction phase of the Casino Project. The EPCM contractor will be responsible for the management and control of general site preparation activities. A dedicated construction team (comprising several construction contractors) with experienced personnel and equipped with the necessary construction equipment and labour, all managed by the EPCM contractor, will implement the following activities associated with general site preparation:

- Clearing and grubbing of vegetation;
- Salvage topsoil and subsoil for future use in reclamation;
- Construct sediment control structures;
- Develop site staging or laydown areas; and
- Foundation preparation for infrastructure.

Details identifying the methods and locations of site preparation activities that are employed for the Casino Project will be outlined in a site preparation plan developed by the EPCM contractor. The EPCM contractor-developed and CMC-approved plan will be implemented in conjunction with the Casino Project's Environmental Management Plans (EMPs) through which engineering, operations, environmental, social and contractor personnel can interact during construction planning efforts to manage and minimise environmental effects during construction activities. The final EMPs will be developed once a positive decision has been made by the Yukon Government and prior to initiation of general site preparation activities. A conceptual description of the proposed EMPs is included in Section 23.0 of the Proposal.

Clearing and Grubbing of Vegetation

In Year -4, clearing and grubbing of vegetation including timber is expected to commence at the Casino mine site, Casino airstrip, haul and service roads and Freegold Road Extension first stage road. Preparations of the sites will include the removal of any salvageable material for reclamation as well as any additional overburden material deemed unsuitable for use as the site base. A detailed schedule identifying the sequence of site clearing and grubbing activities will be developed by the EPCM contractor. At a general level, the sequence of site clearing and grubbing activities will be:

- Freegold Road Extension – First stage road;
- Access roads and laydown areas to stage construction materials;
- Construction camp site and temporary construction camps;
- HLF site clearing;
- Plant site clearing;
- Open pit site clearing, grubbing and soil salvage (excavation of borrow material to be used in construction of various facilities including sediment control structure dams, TMF starter dams, water storage facility dam and roads and ancillary facility yard areas);
- Water storage facility site;
- Water pipeline route; and
- TMF site.

Salvage Topsoil and Overburden

Topsoil and overburden (containing residual and colluvial soils) will be salvaged from disturbed areas during general site preparation activities and stored in stockpiles as shown in the General Arrangement (Figure 4.1-5). Suitable material will be salvaged and stockpiled for reclamation purposes at the Casino mine site.

Construct Sediment Control Structures

Temporary containment and sediment control ponds will be constructed at the potential sources of sediment generation such as topsoil and overburden stockpiles where thawing of ice-rich overburden has the potential to require containment and sediment control.

Develop site staging or laydown areas

Laydown areas will be prepared at the Casino mine site and also at the Casino Airstrip to store equipment and materials needed for construction and operation. Wherever possible, laydown areas will be positioned to cover areas already established during the bulk sampling program, or at future development areas such as the accommodation work camp and ore stockpiles. Additional laydown space will also be established along the Freegold Road Extension in places where ground conditions will support laydown areas and temporary camps with little to no need for additional grading or fill.

Foundation Preparation for Infrastructure

Preparation of the foundation for the infrastructure pads will involve excavating soil and, if required removing the bedrock, and filling using gravel from local borrow sources and crushed excavated bedrock to create the desired pad widths and to level the pads to the desired elevation. The fill used to create the infrastructure pads will be placed and compacted as necessary to support foundations for infrastructure.

4.3.1.9 Strategy for Sourcing Aggregate and Borrow Materials

Casino Mine Site

Borrow material will be required for the construction at the Casino mine site in addition to the cyclone sand and non-PAG waste rock proposed for the TMF. Ongoing testing and consideration is being made regarding the optimal borrow pits to be used for the construction of the Casino Project components and for the low permeability

core of the TMF Stage IA Starter Embankment. Regions within the Casino mine site where sources for core zone material are under consideration are shown on Figure 4.3-3.

The core borrow pit has some specific requirements that must be met to meet specific functional requirements including:

- Material must contain > 20% fines;
- Material must contain no organics; and
- Must be resistant to frost (non-frost susceptible).

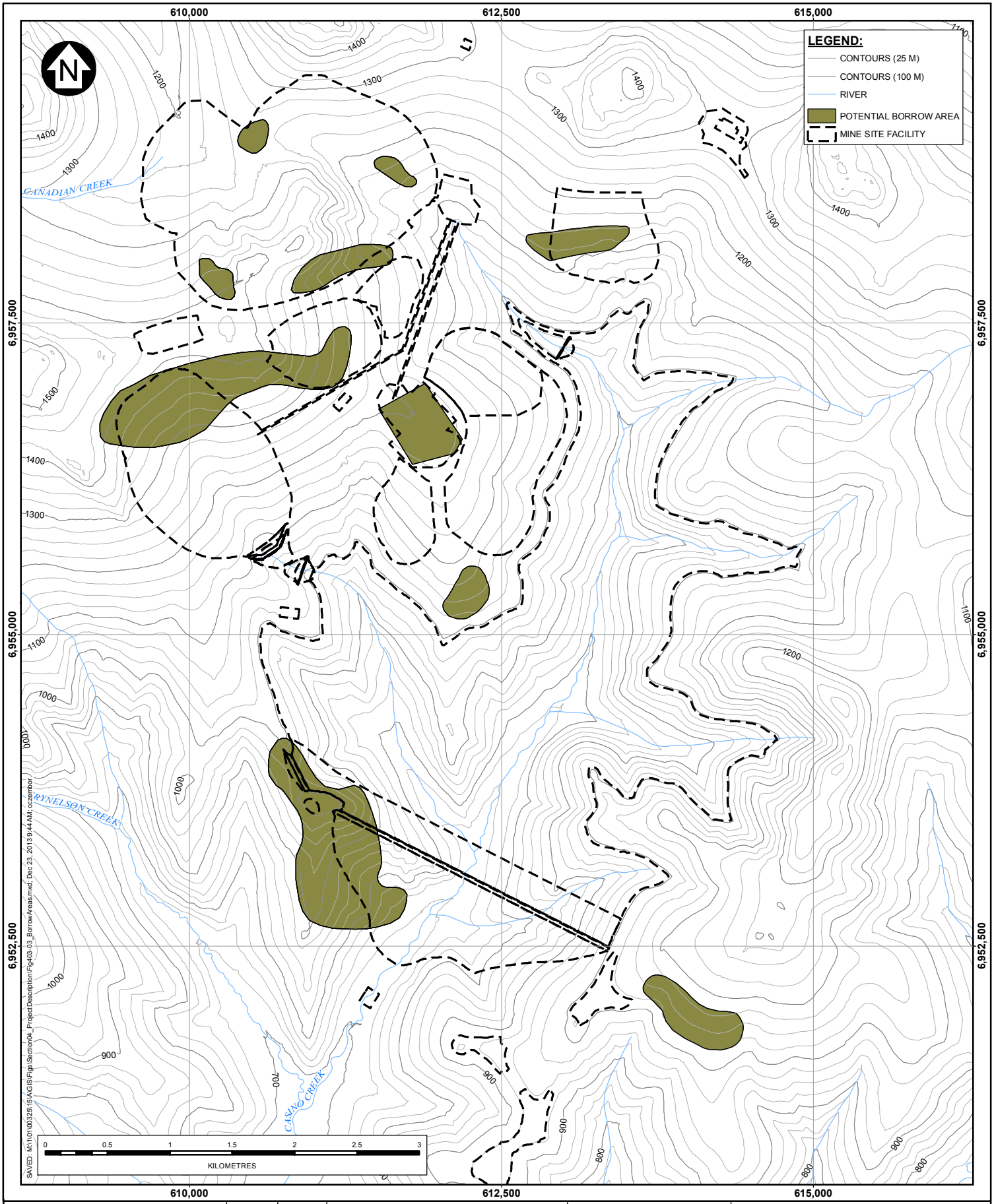
Aggregate is required for concrete (both sand and coarse aggregate), bedding sand of buried pipes, culverts and electrical services and drainage rock for foundation drainage. Additional testing and consideration will occur prior to construction of the Project to maximize the use of available aggregate sources.

Freegold Road Extension, Casino Airstrip and Airstrip Access Road

The majority of the fill required for the construction of the Freegold Road Extension and Casino Airstrip, and Airstrip Access Road will be from borrow pits. The borrow sources for the roads will be located at suitable deposits along the alignment; borrow for the airstrip will be sourced from locations to the north, closer to the Airstrip Access Road alignment The section of the Freegold Road Extension from the Selwyn River to the Casino mine site is located in soil that is mainly suitable for road embankment construction, hence the fill material can be sourced from areas of cut.. Additional soil testing may reveal other locations with borrow suitable for road construction which will result in shorter haul distances. The chosen borrow sites will be located as close to the alignment and fill areas as possible to reduce haul distances. Any areas in close proximity to flood plains, watercourses, unstable terrain, and environmentally sensitive features will be avoided. Areas that are determined to be ice-rich or acid generating will also be avoided.

It is anticipated that borrow pits will be located along the Freegold Road Extension at an average spacing of approximately 3.8 km. The total volumes of materials required for the construction of the Freegold Road Extension will be approximately 1.3M m^3 of borrow material. Three borrow sources are proposed near the Dip Creek valley to provide rock fill to construct the airstrip access road and Casino airstrip embankment.

Development of borrow pit areas will involve clearing of trees and stripping of organic material. Granular borrow source material will be excavated and stockpiled for hauling to the construction areas. Drainage ditches will be constructed to divert runoff around the borrow pits and prevent erosion and transport of sediment into nearby watercourses. Construction of temporary borrow pit access roads will be required to connect the pits to construction areas. Winter preparation of the borrow pit areas is proposed as part of the preconstruction activities and includes clearing and grubbing of the borrow pit areas and temporary borrow pit access roads. The rate of borrow production will depend on construction progress and the demand for material. Borrow pits will be progressively decommissioned when they are no longer needed. Decommissioning will include re-vegetation, slope grading, and restoration of natural drainage patterns.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

POTENTIAL CORE ZONE BORROW MATERIAL

FIGURE 4.3-3

REF 1

P/A VA101-325/15

4.3.1.10 Water Supply System

The Casino Mine will require a make-up water supply system to supplement natural run-off and water recycling to meet the Project water demand as well as a potable water source for drinking water. During the construction phase, natural run-off and wells will provide fresh water sources for staff, construction activities and for the initial operations of the HLF.

Prior to the completion and commissioning of the Yukon River water pipeline at the start of Year 1, water requirements of the Casino mine site will be met using fresh water retained within the Temporary Freshwater Supply Pond (TFSP), and pumped from groundwater wells. Water retained within the TFSP will be used for:

- Operation of the HLF and related activities;
- Water required to support various construction activities, such as concrete manufacture;
- Dust suppression; and
- Emergency water supply, such as firefighting systems.

Potable water during the construction phase will be sourced from groundwater wells near the camp.

TMF Pond Reclaim Water System

Operation of the mill and cyclone sand plant will require the reclamation of supernatant pond water from the TMF facility. Prior to the operation phase, the reclaim barges and associated pumping systems, ponds and tanks will be established. The TMF pond water reclaim system is sized to meet the feed water requirements of the mill and cyclone sand plant.

Permanent Make-Up Water Supply

The permanent make-up water supply system will be constructed during the construction phase. The system will collect water from the Yukon River, and will consist of a riverbank caisson and radial well system, an above ground insulated 36” diameter, 17.4 km long pipeline, and a pumping station plus four booster stations. An example of a typical riverbank caisson and radial well system is shown on Figure 4.3-4. The design capacity of this system will be approximately 3,400 m^3 per hour. The Yukon River water pipeline will be completed prior to the operation phase.

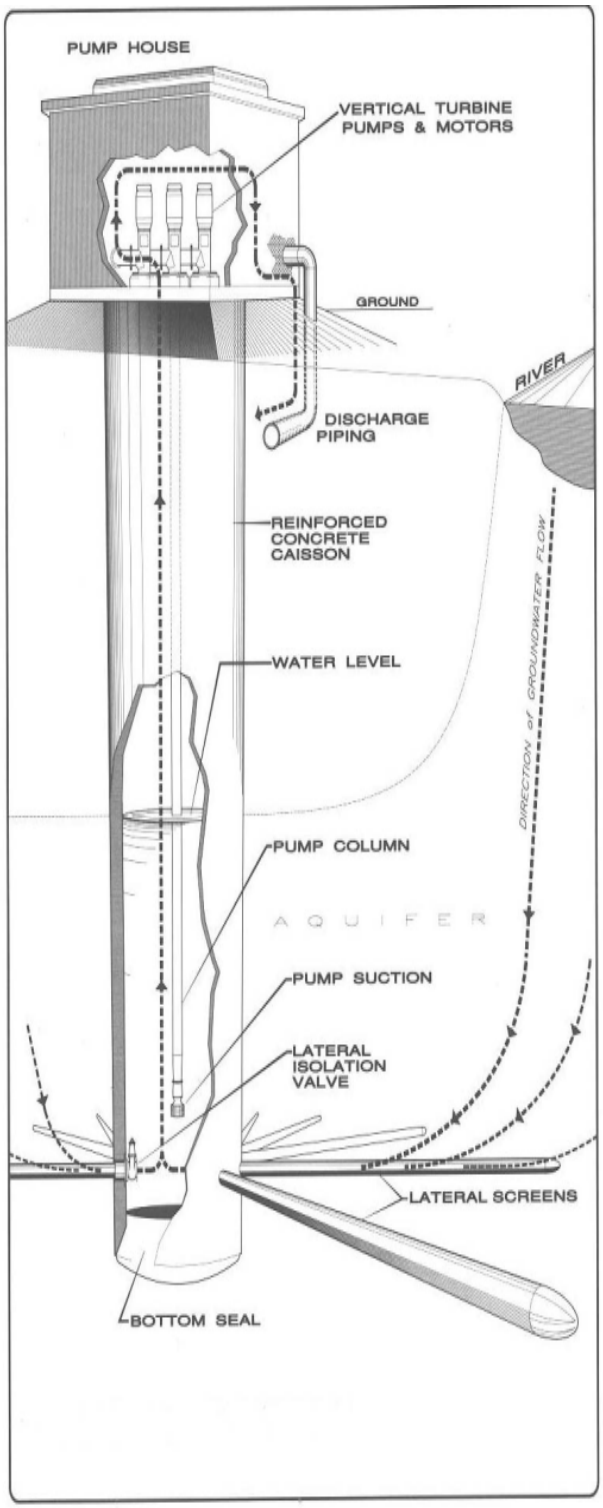


Figure 4.3-4 Riverbank Caisson and Radial Well System – Example

4.3.2 Principal Project Components and Activities

Construction of all the mine and process facilities will be initiated early in the construction phase and in some cases will be further developed in the operation phase of the Casino Project:

- Open Pit - pre-stripping and development;
- TMF embankment - development and cyclone sand plant installation;
- Processing facilities including ore crushing, screening and conveyor systems;
- Heap Leach Facility - construction including pad, embankment, Events Pond and process facilities; and
- Stockpile development for topsoil, overburden, and ore.

4.3.2.1 Open Pit Development

Mobilization of the mine fleet will commence in Year -4 and continue throughout the construction period. Assembly of the equipment on site and testing will occupy the majority of Year -4 so that the fleet will be ready for mining operations in Year -3. The mine fleet is a fairly conventional one for a mine of this size. The primary loading equipment will be a 67.6 cu.m. electric cable shovel (P&H 4100XPC) supported by a 17 cu.m. wheeled loader (Cat 994 size). Initially four, increasing to eight in Year -1, 360 tonne capacity ore haul trucks (Cat 797 Size) will be used as the main transport for ore and waste. Blast holes will be drilled using a 457 mm electric blast hole drill (P&H.320XPC). A 643 kW dozer (Cat D11T size) and a 433 kW dozer (Cat D10T size) will support the initial loading and mine maintenance. Other major equipment required for the mine operations in the construction period is list in Section 4.3.1.1.

The Open Pit will be comprised of two designated zones, the Main Pit and the West Pit. The overburden within the Open Pit area is classified as loose to medium dense sand and gravel with some cobbles and trace clay (Knight Piésold Ltd. 2012a). Overall, the overburden covering the open pit deposit is negligible with the exception of within the northeast rim of the Main Pit, where the overburden is greater than 30 m deep. To provide sufficient exposure to the ore during the full production phase, overburden from the Open Pit will be stripped and if suitable for reclamation purposes, will be stored in stockpiles adjacent to the Open Pit, as shown on the General Arrangement (Figure 4.1-5).

The Open Pit will be excavated using a conventional bench configuration with access via ramps. A qualified explosives contractor will be retained to provided blasting services and will mix and dispense explosives into the blast holes, drilled by CMC. The blast sequences will be established by agreement between the blasting contractor and CMC. The strictest safety protocols will be observed during blasting operations.

During initial open pit mining operations in the construction phase, approximately 70 million tonnes of material will removed. Of this the majority (42 million tonnes) will be gold ore which will be directed towards the HLF operations. Of the remaining, approximately 9 million tonnes is leach cap waste material and the rest is sulphide ore which will be stockpiled for later mill processing. Roughly 2 to 3 million tonnes of waste rock (leached cap) material removed from the Open Pit will be suitable for reuse as fill material for the construction of the embankment shell zones for the Stage IA Starter Embankment of the TMF, and will supplement rockfill sourced from local borrow sources or excavated from other part of the construction site. The gold ore that is removed from the Open Pit during the early construction phase will be placed in a temporary stockpile east of the Open Pit (the Gold Ore Stockpile). Once heap leaching begins towards the end of Year -3, the stockpiled material will be consumed and further gold ore from the pit will be fed directly to the HLF.

The supergene oxide (SOX), supergene sulphide (SUS), and hypogene ores will be removed from the Open Pit and either placed in temporary ore stockpiles or trucked to the Plant Site for processing via conventional copper sulphide flotation. The plant production schedule will be based on the mine plan proposed in the Casino Project Feasibility Study (M3 2013). It is meant to optimize the throughput of the mill for the size and nature of the ore body.

4.3.2.2 Tailings Management Facility Development

The embankments of the TMF will be developed in stages throughout the life of the Casino Project using a combination of suitable non-reactive waste rock from both the pit (as available) and from the Plant Site excavation, together with cyclone sand produced from plant tailings during the mill operation phase and distinct local borrow sources for dam core material.

Each stage of TMF embankment development will be sized to store tailings from the sulphide ore processing activities (based on the Casino Project production schedule), together with PAG waste rock and overburden from the Open Pit, and a supernatant water pond. Additional capacity will be provided for in the design of the TMF for stormwater storage for the inflow design flood event and an allowance of two additional metres of embankment freeboard for wave run-up protection. Seepage water losses from the TMF will be collected in seepage collection systems constructed downstream of the embankments. Any TMF seepage will be collected and pumped back into the TMF. In summary, the design of the TMF has taken into account the following requirements of the Casino Project:

- Permanent, secure and total confinement of all solid waste materials within an engineered disposal facility;
- Control, collection and removal of free draining liquids from the tailings during operations for recycling as process water to the maximum practical extent;
- The use of cyclones to generate clean sand, from the bulk non-PAG tailings for embankment construction;
- The inclusion of monitoring features for all aspects of the facility to ensure performance goals are achieved and design criteria and assumptions are met; and
- Staged development of the facility over the life of the Project.

The Casino Project TMF will be designed to accommodate approximately 947 million tonnes of tailings from milled ore and 658 million tonnes of waste rock and overburden materials from the open pit mining process. The waste rock and overburden materials that are disposed of in the TMF will consist of:

- 17.5 million tonnes of overburden;
- 210.0 million tonnes of leach cap material;
- 49.2 million tonnes of supergene oxide material;
- 138.0 million tonnes of supergene sulphide material;
- 241.9 million tonnes of hypogene material; and
- 1.3 million tonnes that is not classified.

This subaqueous disposal of tailings, waste rock and overburden in the TMF will prevent PAG materials from substantially oxidizing. Approximately 157.5 Mt of additional mined ore will be processed at a HLF which does not generate tailings.

Three types of tailings will be disposed of in the TMF:

- PAG tailings (12 months of the year);
- Bulk non-PAG tailings (assumed for the purpose of design to be three months of the year but may be less depending on weather conditions plus any periods when the cyclone plant is not operating); and
- Cyclone overflow, fine fraction of bulk non-PAG tailings (approximately 9 months of the year, see previous note).

The PAG tailings from milled ore are assumed to require complete subaqueous disposal in the TMF, to maintain a saturated state and inhibit oxidation. The TMF will be designed to isolate PAG tailings in a centrally located region in the TMF to reduce potential mixing and contact with the embankments and to decrease overall seepage potential. The PAG tailings will be transported from the mill to the TMF via a single floating pipeline discharging from the northwest side of the TMF, near the waste storage area. In the TMF, the PAG tailings will remain subaqueous at all times.

Non-PAG tailings from milled ore will be suitable for the production of cyclone sand fill material for embankment construction. The discharge of bulk non-PAG tailings and cyclone overflow will be from valved off-takes located along the Main Embankment and from the West Saddle Embankment. Deposition of non-PAG tailings will be developed and managed, with the intent to maximize storage efficiency in the TMF and to maintain the deeper, cleaner locations of the supernatant pond in the vicinity of the reclaim barges.

Tailings Characteristics

Geotechnical site investigations and laboratory testing on samples of the bulk tailings stream were completed to support the Feasibility Study for the Casino Project (M3 2013). The following are highlights of the investigations and tests:

- approximately 20% by mass of the total tailings is PAG material;
- approximately 80% by mass of the total tailings is non-PAG material;
- whole tailings material can generally be described as non-plastic sand and silt with trace clay, the particle size distribution of the whole tailings sample comprises approximately 58% fine sand, 35% silt and 7% clay;
- cyclone overflow material target particle size distribution comprises approximately 75% fines (silt and clay fraction); and
- the specific gravity of the tailings solids is 2.70 for the whole tailings material, 2.71 for the cyclone overflow material, and 2.80 for the cyclone underflow material.

The PAG tailings is assumed to require complete subaqueous disposal in the TMF, to maintain the tailings deposit in a saturated state and inhibit oxidation. The non-PAG tailings are assumed to be suitable for production of cyclone sand fill material for embankment construction.

Design Considerations

A preliminary dam classification has been carried out to enable the selection of appropriate design earthquake and flood events for the Casino Project TMF. The Casino Project TMF will be designed with considerations for flood events, seismic events, and meets regulations and requirements according to the CDA for a "High" consequence dam failure (Knight Piésold Ltd. 2012b). The selection of appropriate design earthquake and flood events is based on classification of the tailings dam using criteria provided by the CDA Dam Safety Guidelines 2007 as shown for the Casino Project in Table 4.3-9. Based on the results established, the Casino Project dam is assigned an overall "High" consequence dam classification.

Table 4.3-6 Dam Safety Guidelines Classification for the Casino Project

Criteria	Population at Risk	Incremental Losses		
		Loss of Life[1]	Environmental and Cultural Values	Infrastructure and Economics
Casino Project	There is no permanent population at risk downstream of the TMF.	The potential for loss of life from a dam failure is likely minor but cannot be discounted; particularly during operations when there will be work activities in the waste storage area and intermittently in areas downstream of the TMF.	An uncontrolled release into Casino Creek may flow into Dip Creek and potentially to the Yukon River by way of the Klotassin, Donjek and White Rivers. Fish species present in Casino Creek include Arctic Grayling, Burbot, and Slimy Sculpin.	The economic consequences (including clean-up, repair and remedial works) would be high.
CDA Guidelines	None, there is no identifiable population at risk so there is no possibility of loss of life other than through unforeseeable misadventure.	10 or fewer	Significant loss or deterioration of important fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transportation, and commercial facilities
CDA Dam Classes	LOW	HIGH	HIGH	HIGH
Overall Dam Classification for the Casino Project			**"HIGH" Consequence Dam**	

NOTE

1 Implications for Loss of Life: The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

Consistent with the current design philosophy for geotechnical structures such as dams, two levels of design earthquake will be considered in the design of the Casino Project's TMF: the Operating Basis Earthquake (OBE) for normal operations, and the Maximum Design Earthquake (MDE) for extreme conditions (ICOLD 1995). For the Casino Project, a design earthquake magnitude of 8.0 has been selected as the MDE, based on a review of regional tectonics and historical seismicity.

Based on the CDA Guidelines classification for a "High" consequence dam, the Casino Project TMF was designed for a probabilistically derived event (defined as the Earthquake Design Ground Motion) having an annual exceedance probability (AEP) of 1/2500 (Table 4.3-10). The MDE corresponding to a "High" dam class is the 1 in 2500 year earthquake and the median PGA is 0.13g.

Table 4.3-7 Inflow Design Flood and Earthquake Design Ground Motion

Dam Class	Annual Exceedance Probability (AEP)	
	Inflow Design Flood (IDF)[1]	Earthquake Design Ground Motion (EDGM)[2]
Low	1/100	1/500
Significant	Between 1/100 and 1/1,000[3]	1/1000
High	1/3 between 1/1,000 and Probable Maximum Flood[4]	1/2,500[6]
Very High	2/3 between 1/1,000 and Probable Maximum Flood[4]	1/5,000[6]
Extreme	Probable Maximum Flood (PMF)[5]	1/10,000

NOTE:

[1] As defined by the CDA Dam Classification

[2] AEP levels for EDGM are to be used for mean rather than median estimates for the hazard

[3] Selected on the basis on incremental flood analysis, exposure and consequence of failure

[4] PMF has no associated AEP. The flood defined as 1/3 between 1/1000 year and PMF or 2/3 between 1/1000 year and PMF has no defined AEP

[5] The EDGM value must be justified to demonstrate conformance to societal norms of acceptable risk. Justification can be provided with the help of failure modes analysis focused on the particular modes that can contribute to failure initiated by a seismic event. If the justification cannot be provided, the EDGM should be 1/10,000

Temporary Cofferdam

A temporary cofferdam will provide a working window for the construction of the Stage IA Starter Embankment. The cofferdam will be constructed entirely of locally sourced borrowed material from the Casino mine site. During construction of the cofferdam, all contact runoff water will be collected in temporary ponds and stored to prevent sediment laden water from entering the downstream watercourse. The ponded water will be pumped to the TMF once the Starter Embankment is ready to store water. Closure of the cofferdam is anticipated to occur following the annual freshet, which generally provides the vast majority of the run-off at the Casino mine site.

Foundation Preparation

Geotechnical site investigations have determined that the area of the TMF is underlain by the following types of materials:

- Overburden;
- Topsoil;
- Silty sand to gravel with some cobbles, trace clay (residual soil and colluvial veneer) along valley ridges and upper slopes;

- Silt and sand with some gravel and cobbles, trace clay (colluvial apron) and interbedded sand and gravelly sand with some cobbles (alluvium) along the lower slopes and valley bottom;
- Weathered bedrock; and
- Fresh bedrock.

Foundation preparation for the TMF embankments will involve stripping of topsoil and vegetation and the removal of all talus boulders at the embankment footprint area. Suitable topsoil / overburden will be placed in temporary stockpiles adjacent to the TMF for future reclamation purposes. The underlying colluvium or other ice rich soil at the embankment footprint area will be excavated to stable bedrock or competent non-frost susceptible overburden. The average thickness of the underlying ice-rich soil is expected to be approximately 10 m. Ice-rich and frost-susceptible soils that are removed are expected to be unsuitable for use as borrow material and are slated for disposal in the TMF. The removed material is replaced with core, filter or shell zone material, depending on the location relative to the embankment.

The Casino Project TMF will have two embankments. The Main Embankment will be constructed gradually in stages during the life of the Project, while the smaller West Embankment will be constructed during the latter part of the construction phase of the Project.

Main Embankment Stage IA – Starter Embankment

The Main Embankment will expand across the Casino Creek valley in stages throughout the life of the Project using a combination of suitable non-PAG overburden and rock fill borrow materials. Potential sources for borrow materials are discussed in detail in Section 4.3.8.5 of the Proposal. The Stage IA Starter Embankment will be designed to store runoff as a source for mill start-up water, heap leach water and accommodate tailings and PAG rock and overburden production for approximately one year of initial operations.

The Stage IA Starter Embankment will be 105 m in height from crest to toe and up to 830 masl in elevation. A low permeability cut-off trench will be constructed beneath the core zone of the Main Embankment to provide a seepage control barrier. The cut will be approximately 10 m deep and imbedded in solid bedrock beneath the impermeable core of the dam, along with an approximately 5 m thick upstream blanket. The 20 m wide low permeability core located in the Main Embankment will be surrounded by filter and transition zones constructed from crushed and screened rock. The filter zones will function in the prevention of piping and porewater pressure increases, while the transition zone prevents migration of fines.

4.3.2.3 Processing Plant Development

As described in Section 4.1.1.1.3, the Casino Project will consist of two ore processing facilities, one for sulphide ore and one for oxide ore.

The sulphide ore processing facilities at the Plant Site will include primary and secondary crushers, screens and associated overland conveyor systems. These processing facilities will be constructed as follows:

- Rough grading and bulk excavations of the Plant Site where the processing facilities are located;
- Forming and pouring large foundations;
- Backfilling;
- Perimeter building foundations, floor slabs and minor footings;
- Rough settling of major equipment (including the primary and secondary crushers) and large bins;

- Installation of conveyor sections, pulleys, drives and take-up mechanisms;
- Structural work, including cladding and roofing; and
- Mechanical and electrical installation.

Based on the proposed mine production schedule, the sulphide ore processing facility will not be operational until the start of Year 1. Whereas, crushed gold (oxide) ore is placed on the heap leach in stages starting later in the second year of the construction phase.

Two primary crushers will be located at the Plant Site. One crusher will be intended for the initial crushing of the sulphide ore, and the other will be intended for the initial crushing of the oxide ore. Each primary crusher will be housed within a concrete structure (measuring 38 m or 34.5 m high) to reduce dust and noise exposures. The concrete structures will be placed a few meters below existing grade in order to minimize blasting of bedrock. These structures will be surrounded by "U"-shaped Mechanically Stabilized Earth (Hilfiker or equivalent) retaining walls to form the truck maneuvering area around the dump hopper, roughly at the elevation of the exit from the Open Pit.

Material handling equipment, including reclaimers, stackers and conveyors will be installed outdoors. Conveyors will be covered and equipped with wind hoods to reduce wind exposure and the potential for ore fines to be blown off the conveyors. Dust collectors will be installed at transfer points and other required areas to limit fugitive dust emissions.

Starting in the construction phase, the primary crushers are anticipated to feed the HLF with crushed oxide "gold" ore either directly from the open pit or from the gold ore stockpile. The HLF will return the leached solution from the heap leach to a gold recovery building which houses the ADR and SART facilities. The development of the HLF is described in Section 4.3.8.4.

Grinding facilities for sulphide ore processing will be located in a mill which houses a 12 m diameter SAG mill as well as two 8.5 m diameter ball mills. The mill house will also contain a 90 tonne overhead bridge crane to provide maintenance to the machinery. The flotation building will be constructed adjacent to the reagent storage and mixing facility which is structurally independent, but attached to the mill house. The reagent storage and mixing building will be fully enclosed. Separate from the mill house and the flotation building will be an 8000 tonne silo for lime storage. A water reclaim facility will be constructed to reclaim water from the TMF for process water requirements at the Plant Site.

4.3.2.4 Heap Leach Facility Development

The Heap Leach pad construction will consist of five stages of development with liner expansions occurring every 3-4 years to accommodate the continued ore stacking plan represented in Figure 4.3-6. Heap leach pad construction will commence in Year -4 and the pad will be loaded with oxide gold ore in successive eight metre thick lifts for 300 days a year while the leaching process operates year round. Table 4.3-12 presents the development stages, proposed stacking schedule, the respective footprint of the HLF and oxide gold ore volume. From Year -3 to Year 15 gold ore to feed the HLF will be stored in the gold ore temporary stockpile east of the Open Pit, close to the primary and secondary crushers. The oxide gold ore will be crushed and transported to the heap leach pad by conveyor. The location of the gold ore stockpile, crusher and conveyor are shown on Figure 4.1-5. An insulated drip-type irrigation system is proposed for the HLF to enable a year round leaching operation. The five development phases involve the following construction activities:

Phase 1: Construction, installation, and development of the following:

- Confining embankment;
- Pad liner system;
- Leachate collection system;
- Leak detection and recovery system (LDRS);
- Events Pond;
- Freshwater supply pond; and
- Stormwater management system including sediment control ponds and surface runoff diversions.

Phase 2: Expansion to provide for three additional years of operations:

- Expansion upslope of the HLF;
- Raising of the confining embankment; and
- Liner extension.

Phase 3: Expansion to provide for four additional years of operations:

- Expansion upslope of the HLF;
- Raising of the confining embankment; and
- Liner extension.

Phase 4: Expansion to provide for four additional years of operations:

- Expansion upslope of the HLF;
- Raising of the confining embankment; and
- Liner extension.

Phase 5: Expansion to provide for four additional years of stacking operations, as well as three more years of gold recovery:

- Expansion upslope of the HLF;
- Raising of the confining embankment; and
- Liner extension.

The Heap Leach pad will consist of a confining embankment, pad liner system and leachate collection system to collect and convey the leachate solution to the gold extraction plant, which will be located to the southeast of the HLF. The following subsections outline the general design features and construction aspects for each of the main components of the heap leach pad.

Foundation Construction

At the start of each of the five development stages, the pad foundation will be prepared by removing topsoil, vegetation and boulders from the foundation footprint. Suitable topsoil will be stockpiled at a temporary stockpile location north of the HLF and used for reclamation of the HLF during decommissioning and closure. The cold climate and potential presence of ice-rich soil will require special consideration. The heap leach pad foundation will be excavated to a stable bedrock foundation. Removing frozen overburden will mitigate the risk of potential settlement events and instability resulting from melting of frozen overburden. The bedrock surface will be graded and backfilled to ensure a positively graded slope of a minimum of 2% on which to place the pad liner system. Grading of the pad foundation will direct leachate towards the leachate collection piping system and sump located at the centre of the confining embankment upstream toe.

Confining Embankment Construction

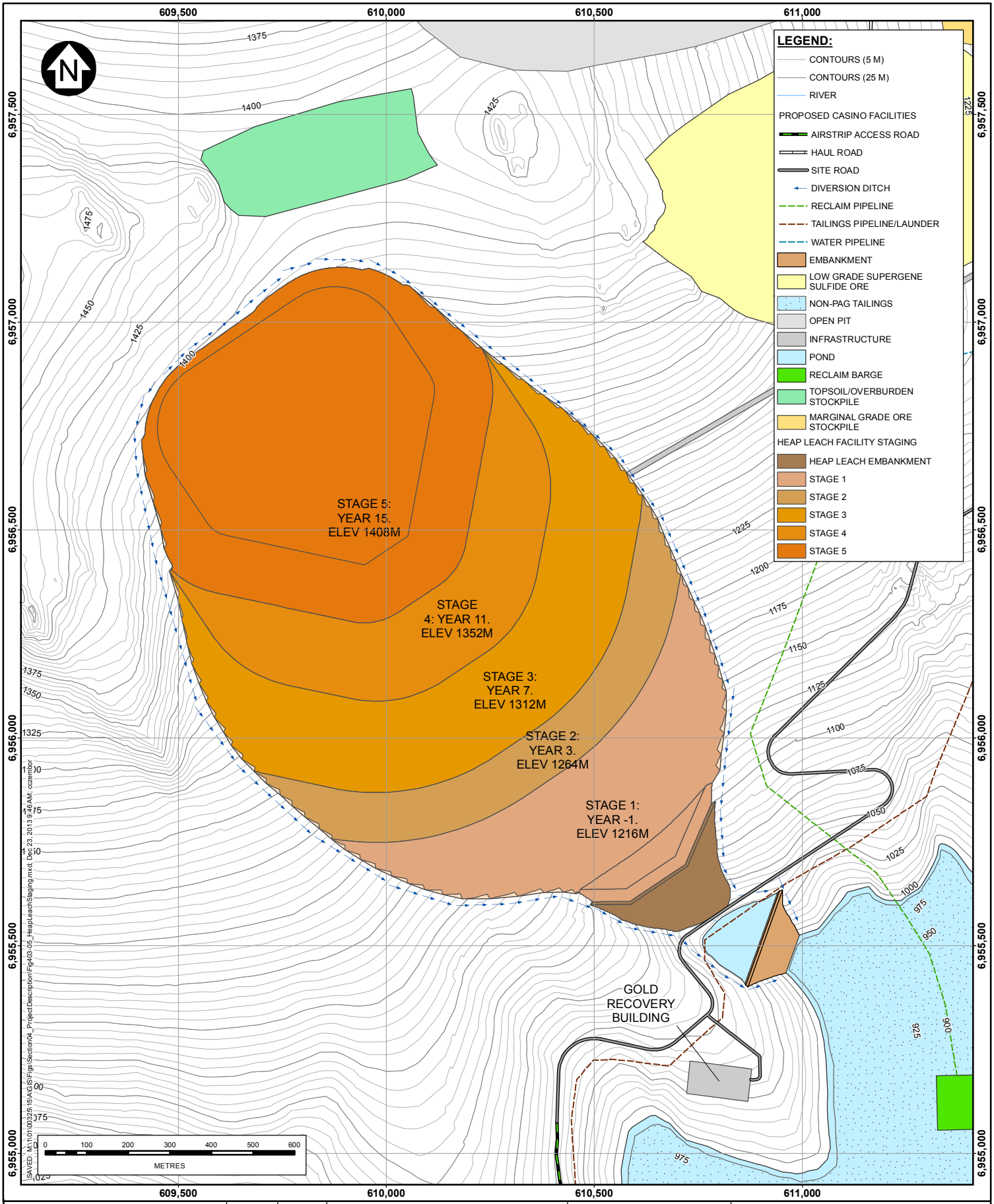
The confining embankment will be constructed in Year -4 at the toe of the heap leach pad to provide stability to the stacked ore and to provide in-heap storage for leach solution. The confining embankment will be constructed progressively with an upstream slope of 3H:1V and a downstream slope of 2H:1V and a final crest elevation of 1103 m and a final crest width of 7 m.

During the construction phase, the foundation of the confining embankment will be prepared in the same manner as the foundation for the heap leach pad to expose stable bedrock. The main section of the confining embankment will be constructed from structural fill which consists primarily of locally sourced rock and earth fill. The embankment will be constructed by placing the fill material in lifts and compacting to a specified density. Borrow materials will be required for the development of the confining embankment. The borrow materials can be obtained from local rock excavation and quarries. Earthfill can be sourced from areas along the south facing slopes adjacent to the HLF. As well, suitable non-PAG waste rock from open pit mining can be used if available. A 0.3 m thick bedding sand layer will be placed over the final upstream slope of the confining embankment in preparation for installation of the liner system.

The in-heap storage capacity is summarized in Table 4.3-11 below. If the storage requirement is greater than the in-heap storage capacity, excess leachate solution will pass through the confining embankment spillway into the Events Pond (see Figure 4.1-5).

Table 4.3-8 In-Heap Solution Storage Capacity

Storage Objective	Volume (m^3)
Operational Capacity – ensure submergence of pumps, moderate temperature fluctuations	90,000
Storm Event Capacity – 1 in 25 year, 24 hr duration rainfall event	86,200
Total In-Heap Storage Capacity	172,600



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

HEAP LEACH FACILITY STAGING PLAN

FIGURE 4.3-5

REF 1

P/A VA101-325/15

Table 4.3-9 Heap Leach Stacking Schedule

Year	Development Stage	Heap Leach Facility			
		Liner footprint (expansion area)	Stacked Ore Mass [1]	Stacked Ore Volume [1]	Cumulative Stacked Ore Volume
		m^2	Tonnes	m^3	m^3
-3	1	498,456	6,580,000	3,760,000	3,760,000
-2			9,125,000	5,214,286	8,974,286
-1			9,125,000	5,214,286	14,188,571
1	2	292,660	9,125,000	5,214,286	19,402,857
2			9,125,000	5,214,286	24,617,143
3			9,125,000	5,214,286	29,831,429
4	3	299,680	9,125,000	5,214,286	35,045,714
5			9,125,000	5,214,286	40,260,000
6			9,125,000	5,214,286	45,474,286
7			9,125,000	5,214,286	50,688,571
8	4	220,610	9,125,000	5,214,286	55,902,857
9			9,125,000	5,214,286	61,117,143
10			9,125,000	5,214,286	66,331,429
11			9,125,000	5,214,286	71,545,714
12	5	189,542	9,125,000	5,214,286	76,760,000
13			9,125,000	5,214,286	81,974,286
14			9,125,000	5,214,286	87,188,571
15			4,874,000	2,785,143	89,973,714

NOTE:
1 Assumes stacked gold ore density of 1.75t/m^3

Liner Systems

The Casino Project heap leach pad will be designed to operate as a 'dry' pad with limited solution storage occurring in the in-heap storage during normal operating conditions. Regardless, liner systems are proposed to minimize leakage losses of pregnant solution through the bottom and sides of the leach heap pad and to maximize pregnant solution recovery. The liner systems will be designed to meet current performance standards that assume fully saturated solution storage conditions behind the confining embankment. The Casino Project heap leach pad will include the following two liner systems:

- An "Upper" engineered single liner system for the upper portion of the leach pad (above the in-heap leachate solution storage elevation); and
- "Ponded" composite double liner design for the lower portion of the leach pad which has the potential to store leachate solution.

The "Upper" engineered single liner system will be installed on the heap leach pad upper sloped surfaces which drain towards the leachate collection pipes and sump. The liner system will consist of the following components:

- 1 metre thick overliner (38 mm minus with less than 10% fines content);
- 80 mil (2 mm) linear low-density polyethylene (LLDPE) geo-membrane; and
- 0.3 metre thick compacted low permeability soil liner.

The portions of liner that are located directly below the leachate collection pipes will have leak detection and recovery system (LDRS) layers which consist of the following:

- Non-woven, needle punched geotextile layer; and
- Leak Detection and Recovery System (LDRS).

The 'Ponded' composite double liner system will be installed on the heap leach pad lower slopes, an area that may experience hydraulic loading from in-heap solution storage. The "Ponded" liner will consist of 'barrier' and 'drainage' layers using a combination of synthetic and natural materials to contain leachate solution and drain it towards the leachate collection pipes and sump. The surface grades under the double lined portion will drain towards the leachate collection pipes and sump. The double liner system will consist of the following components:

- 1 metre thick overliner (38 mm minus with less than 10% fines content);
- 80 mil (2 mm) linear low-density polyethylene (LLDPE) geo-membrane;
- 0.3 metre thick compacted low permeability soil liner;
- Non-woven, needle punched geotextile layer;
- Leak Detection and Recovery System (LDRS); and
- 60 mil (1.5 mm) linear low-density polyethylene (LLDPE) geo-membrane.

The heap leach liners will be constructed in five development stages consistent with the ore stacking schedule presented in Table 4.3-12. Liner expansions are proposed every three to four years to meet ore stacking requirements. The liners will be anchored and backfilled in a trench along the perimeter of the heap leach pad and confining embankment crest to ensure that ore loading does not pull the liners into the heap leach pad and compromise the liner coverage.

Along the embankment toe, all liners will be connected or 'tied-in' with their corresponding liner layer along the foundation of the heap leach pad to provide a continuous liner seal and drainage connection. A small perimeter berm will be constructed as part of the liner tie-in around the perimeter of the pad footprint to ensure that heap solution is contained within the pad footprint and to also prevent surface runoff from the adjacent slopes entering the pad collection system. A 0.3 metre thick bedding sand layer will be placed on the upslope face of the confining embankment directly underneath the second (bottom) geo-membrane liner to provide additional integrity to the liner.

A protective layer, referred to as the "overliner", will be placed over the geotextile liner system for protection of the liner system during ore stacking. The overliner will be a 1 m thick layer of coarse crushed ore that doubles as a drainage layer, promoting leachate solution drainage into the leachate collection system.

Leak Detection and Recovery System

The leak detection and recovery system (LDRS) will be designed to capture and convey any solution leakage from the overlying geo-membrane to the recovery system sump at the toe of the confining embankment. The LDRS will be constructed under the double lined area and the portion of the single lined footprint below the 'Collection Header' and 'Main Collection Header' pipes of the leachate collection system. The LDRS will consist of

a 0.3 m thick sand layer with 100 mm diameter perforated high-density polyethylene collection pipes. A non-woven needle punched geotextile overlying the LDRS will prevent particles from the low permeability soil layer from entering the LDRS and clogging the sand and impeding drainage flow. The LDRS will also be constructed under the single lined area (upper portion of the leap leach pad) and is constructed as a network of 'trenches' placed underneath the liner areas

Leachate Collection System

The leachate collection system will be designed to collect and recover the pregnant solution in conjunction with the heap leach liner, overliner and leak detection and recovery systems. The leachate collection system will facilitate solution transport off the heap leach pad as quickly as possible to reduce the potential risk of leachate solution losses through the liner system. The leachate collection system will consist of the following pipe and sump components:

- Lateral collection pipes;
- Collection header pipes;
- Main header collection pipes; and
- Leachate collection sumps.

The entire piping system will be constructed from perforated corrugated plastic tubing pipe which will be embedded within the 1 m thick over-liner. The lateral collection pipes, which will be spaced approximately 6 m apart under the entire leach pad footprint, will feed directly into the collection header pipes which will then flow into the main header collection pipe. The main header collection pipes will be positioned along the centerline of the heap leach pad and end at the upstream toe of the confining embankment at the leachate collection sumps. Three leachate collection sumps will be located at the toe of the confining embankment, spaced equally across the base width of the heap leach pad.

The sumps will consist of two sections, the lower 'collection zone' and the upper zone. The lower zone will consist of a 3 m thick zone of clean screened gravel placed around a 600 mm diameter perforated steel vertical riser pipe. The upper zone will consist of a 3 m thick zone of compacted crushed ore placed around a 600 mm diameter non-perforated steel vertical riser pipe. The compaction of the crushed ore will be critical to ensure that settlement around the vertical riser does not occur and damage the collection system.

Leakage Detection Cells

The heap leach pad leachate collection system will be sub-divided into 16 independently monitored areas or "cells" separated by small cell division berms. Each cell will have a dedicated leakage detection collection system comprising a drain gravel layer beneath the inner composite liner system which conveys the leakage to a 100 mm diameter perforated collection pipe within the LDRS collection trench. The LDRS ditches will flow by gravity at a minimum 0.5 % slope towards the LDRS collection sump structures located along the right and left sides of the leach pad. The flow rates from the dedicated collection pipes will be continuously monitored and measured prior to discharging into a collection sump. A float switch within the sump triggers a submersible pump which pumps the accumulated solution via a pipe, located between the two liners on the confining embankment, back onto the heap pad.

Events Pond

The Events Pond will be constructed to full size prior to commencing operations of the HLF. Construction of the Events Pond will involve stripping the topsoil and overburden to expose bedrock beneath the footprint of the Events Pond embankment and pond area. The embankment is likely to be constructed from colluvial and residual soil borrow materials, quarried rockfill, and possibly non-PAG mine waste rock from Open Pit development. The embankment will be designed with a 2H:1V downstream slope and a 3H:1V upstream slope.

An engineered double liner system will be installed for the Events Pond and constructed in the same manner as the 'ponded' heap leach pad liner system. However, a high density polyethylene (HDPE) geo-membrane will be used for the Events Pond liner system rather than the LLDPE geo-membrane, which is used for the heap leach pad. Unlike the heap leach pad, the Events Pond liner system will not be subjected to high confining stresses from ore stacking. The HDPE geo-membrane liner will have a higher ultraviolet resistance than a LLDPE geo-membrane liner which is critical for exposed surfaces like that of the Events Pond.

The ground interfacing with the lower geo-membrane layer will be prepared to ensure that conditions are acceptable to install the geo-membrane liner without compromising the liner integrity. The liner system installed on the upslope of the events pond embankment will have an additional 0.3 metre thick bedding sand layer which will interface with the lower geo-membrane layer to protect the integrity of the liner. The events pond liner system will consist of the following:

- 60 mil (1.5 mm) high-density polyethylene (HDPE) geomembrane;
- 0.3 metre thick low permeability soil liner;
- Geosynthetic 'geonet' drainage layer; and
- 60 mil HDPE geomembrane.

The Events Pond for the HLF will provide storage for excess leachate and runoff generated as a result of rainfall events that cannot be accommodated by the in-heap storage capacity. The events pond will be located immediately down gradient of the HLF embankment as illustrated in Figure 4.1-5. Leachate and surface runoff flows will be conveyed via the HLF spillway to the events pond. The events pond will be designed with the following considerations:

- Sufficient storage capacity to contain the excess HLF leachate and surface runoff from the 1 in 100 year 24-hour storm event without discharge to the environment; and
- The spillway will be designed to discharge the 1 in 200 year 24-hour storm event with a minimum embankment crest freeboard of 0.3 metres.

The storage requirements for the events pond are based on modelled surface runoff results using the Hydrologic Modeling System (HEC-HMS) which was designed by the Hydrologic Engineering Centre (U.S. Army Corps of Engineers) to simulate precipitation-runoff processes of dendritic drainage basins. The total capacity is 74,400 m^3.

Solution that is retained in the events pond will be pumped to the ADR Plant The pump station will be constructed adjacent to the events pond embankment and will pump solution back to the Pregnant Solution Distribution Tank or the Barren Solution Tank as required by the process for re-use in leaching. The pump station will be designed to be able to empty the 1 in 10 year storm runoff volume (approximately 79,900 m^3) over ten days, and the 1 in 100 year volume (98,600 m^3) over 12.5 days.

If the rate of recycling is not sufficiently high to empty the pond in a timely manner, excess solution will be treated using the Inco-SO_2 cyanide destruction plant, and the treated water discharged to the TMF pond. The cyanide

destruction plant will be constructed and commissioned during facility start up, and will also be used during closure rinsing and draindown.

Installation of a LDRS is not required for the events pond as the pond will be operated as a dry-facility and will only receive solution and runoff during significant storm events. In the event that leakage does occur through the double liner system, this water will be conveyed via the geonet layer to a 1 m thick drainage blanket which underlies the events pond embankment. This drainage blanket will discharge directly to the TMF.

4.3.2.5 Temporary Stockpiles Development

During the construction phase, temporary stockpiles within the Casino mine site will be established to accommodate the following materials:

- Topsoil / overburden materials; and
- Stockpiled ore (low grade ore, marginal grade ore, supergene oxide ore and gold leach ore);

In general, temporary stockpiles will be located within 2 km of the material source to keep haul distances to a minimum. Figure 4.1-5 shows the location of temporary stockpiles at their largest footprint. The temporary stockpiles will be designed to remain stable under both static and seismic loading conditions. As well, surface water diversion ditching will be constructed to divert surface flow around the stockpiles to minimise contact with water. The design storm event for ditch sizing will be the 1 in 100 year event.

Topsoil / Overburden Stockpiles

During the construction phase, heavy equipment will be used to clear vegetated areas, remove the organic layer and to initiate the melting of permafrost or frozen soils above the foundations of facilities. Topsoil will be stripped during the construction of the Plant Site, the open pit, ore stockpiles, HLF and TMF embankments. The suitable stripped topsoil and overburden will be stored in temporary stockpiles for use as reclamation medium. Topsoil recovered during the construction phase will be stockpiled at select locations close to the material source.

Soil salvaging and stockpiling operations will require a variety of management practices to ensure that soils are handled and stored properly during all phases of the mine development. Soil management practices to be carried out for soil stripping, salvage and stockpiling are summarized below:

- Wet conditions will be avoided when possible during soil salvage operations;
- Excessive traffic will be avoided during the salvage process to minimize admixing, compaction and rutting;
- Traffic will be confined to established routes to avoid unnecessary compaction of soil in undisturbed areas;
- Erosion control measures will be implemented;
- Soil will be stockpiled in locations to minimize the possibility of further disturbance;
- Stockpile locations will, where possible, be located a sufficient distance away from operations to protect soils from contamination from risk of spills or metal deposition;
- Protective ditches will be constructed where practical around stockpiles to prevent any spill reaching stockpiles and prevent any erosion from stockpiles escaping;

- Erosion will be managed by limiting the height and slope of stockpiles. Erosion control measures will be implemented including prompt vegetation establishment on topsoil stockpiles to reduce exposure of bare soil; and
- Where possible, soil stockpiles will be oriented to reduce wind erosion and located to reduce wind exposure.

Toe berms to ensure stockpile stability may be required, based on foundation conditions and the strength characteristics and condition of the stockpiled material. The topsoil stockpiles will be limited to a maximum height of about 20 m (crest to downstream toe), with consideration of site-specific ground conditions, and constructed as wrap around dumps in an ascending sequence. This construction method will be used to improve overall stability as each constructed lift will act as a buttress for the toe of the next lift. In addition, the topsoil stockpiles will be constructed such that the overall slope angle will average 14 degrees (4H:1V). These flat overall topsoil / overburden stockpile slopes will minimize the risk of slope instability, reduce erosion potential and improve the amenability for vegetation growth. The use of topsoil for concurrent reclamation activities will reduce the quantity of material required to be stockpiled. It is anticipated that some overburden material will also be required for reclamation and erosion control of the downstream slopes of TMF embankments. Overburden and topsoil materials will be stockpiled separately.

Ore Stockpiles

During the construction and operations phases of the Casino Project, approximately 56 million tonnes of gold ore, 144 million tonnes of low grade ore and 32 million tonnes of supergene oxide (SOX) ore will be stored in temporary stockpiles. These temporary ore stockpiles will be:

- Gold Ore Stockpile
- Supergene Oxide (SOX) Ore Stockpile (after processing, the footprint becomes an expansion of the 'Low Grade Hypogene (HYP) Ore Stockpile')
- Low Grade Hypogene (HYP) Ore Stockpile
- Low Grade Supergene Sulphide (SUS) Ore Stockpile
- Low Grade Supergene Oxide (SOX) Ore Stockpile
- Marginal Grade Ore Stockpile

During the construction phase, gold ore will be stored in a temporary stockpile near the crusher on the valley slope east of the Open Pit at the northern end of the TMF. The gold ore will be stacked on the heap leach over a period of 18 years, starting in the first year of construction (Year -3) three years prior to mill start-up and continuing up to Year 15. The maximum size of the temporary gold ore stockpile is estimated at 40 million tonnes at the end of Year 3 and will be totally reclaimed by the end of Year 15.

The SOX ore will be stockpiled at a location between the crusher and Plant Site during the construction phase and into Year 1. The maximum size of the temporary SOX ore stockpile is estimated at 32.4 million tonnes. The SOX ore reports to the mill during Years 4 to 12 together with direct feed mill ore from the Open Pit. Since the SOX ore stockpile is anticipated to be depleted by Year 12, low grade HYP ore mined after Year 12 can also be stockpiled at the same location that was used for the SOX ore.

Low grade ore will be stockpiled up to Year 17 in locations between the Plant Site and Open Pit, as well as generally east and south of the Plant Site, on valley slopes above the TMF. The stockpiled low grade ore will be milled during the last four years of the operations phase (Years 19 to 22). The size of the low grade ore stockpiles

will vary over the operations phase, with a peak of approximately 144 million tonnes of low grade ore stockpiled in Year 17. There will be separate HYP, SUS and SOX low grade ore stockpiles, as shown on Figure 4.1.4.

Marginal grade ore will be stockpiled near the Open Pit during Years -1 to Year 4. The maximum footprint of the ore stockpile will occur in Year 4. Approximately 9 million tonnes of marginal grade ore is placed in the stockpiles over the life of the Project.

4.3.3 Related Components and Activities

A number of mine site facilities will be initiated early in the construction phase and continue to be in place through the operations phase of the Casino Project:

- Casino Airstrip and Airstrip access road;
- Power generation plants (Supplementary Power Plant and Main Power Plant);
- Accommodations camp;
- LNG fuel facility; and
- Ancillary support buildings (explosives facility, administration offices, maintenance shop etc.).

These mine site facilities have been sited with considerations for:

- Limiting environmental effects by reducing the overall footprint;
- Providing a safe working facility, i.e locating explosives storage areas remotely from camps and other facilities;
- Limiting earthworks;
- Minimizing mining haul distances;
- Providing efficient heat recovery from power plants;
- Providing effective living accommodation for employees; and
- Reducing the distance between the accommodation area and work areas to the maximum practical extent.

4.3.3.1 Casino Airstrip and Airstrip Access Road Construction

During the construction phase, the existing air strip will be replaced with a larger facility designated as the Casino Airstrip. The Casino Airstrip will be located in the Dip Creek Valley 12 km southwest of the Casino mine site at an elevation of 650 m (Figure 4.1-7). The airstrip will be 1,600 m long, 30 m wide, with a 80 m grade width and a run out of 60 m at each end. The airstrip design has been developed to conform to Transport Canada's Aerodrome Standards and Recommendations Practices (TP312). The runway will be a Code 3C Non-instrument runway that is oriented northeast to southwest.

Ice-rich soils beneath the airstrip embankment may cause seasonal surface and subsurface water flows and long term thaw and creep settlements. These considerations have been taken into account in the design of the airstrip to prevent airstrip degradation. Construction will begin by preparing the foundation of the embankment of the airstrip. The airstrip will be built on undisturbed ground with geotextile to support insulatinginsulating rock fill that will be used to raise the airstrip embankment to at least 1.8 m above the ground surface in order to prevent the degradation of permafrost. In addition, water management for the airstrip will include the construction of an

interceptor ditch and berm 20 m up-slope from the embankment, and a collection ditch running the length of the up-slope toe of the airstrip. Water that is collected behind the interceptor berm and in the collection ditch will be routed to existing drainage channels down-slope.

The Casino Airstrip will be accessed from the Casino mine site via the Airstrip Access Road. This access road will be a 14 km single lane gravel road that meets the BC Ministry of Forests and Range Forest and Road Engineering Guide Book (2nd Edition, 2002) guidelines for a 30 km/h design road.

Construction of the Casino Airstrip Access Road will be similar to the methods for constructing the Freegold Road Extension. Road embankments will be filled in for valley bottoms and cut and filled for the sections climbing out of the valley bottoms. The Airstrip Access Road construction will include two bridges and nine major culvert crossings ranging in size from 1500 mm to 2500 mm or short span bridges. Water will be managed using ditches and 500 and 600 mm culverts for cross drainage.

4.3.3.2 Supplementary Power Plant Construction

Initially, the Supplementary Power Plant will be built in the main workforce housing complex to supply power to the Casino Project during the construction phase, as shown on Figure 4.1-5. The supplementary power plant will provide power for the accommodations camp, construction activities, oxide ‘gold’ ore crushing at the Plant Site and conveyance to the heap leach and the operations of the HLF. The supplementary power plant will meet the power requirements for the Casino mine site preceding the construction of the Main Power Plant.

The Supplementary Power Plant will consist of three internal combustion engines, dual fuel driven generators capable of operating under diesel or LNG. The combined output of the internal combustion engines and fuel driven generators will be nominally 20 MW. The supplementary power plant will generate power at 13.8 kV, and will connect to the 34.5 kV distribution system through one transformer.

Once the Main Power Plant is functional, power from the Supplementary Power Plant will be used to supplement the Main Power Plant as required and to a limited extent act as a back-up supply if the Main Power Plant is out of commission.

4.3.3.3 Main Power Plant Construction

The Main Power Plant will be located at the mill and contractor complex and will be constructed prior to the operations of the mill. The main power plant is intended to supply electricity for the operations phase of the Casino Project and for the remainder of the Project life.

The Main Power Plant will produce power from two gas turbine driven generators and one steam driven generator. These generators will operate in combination cycle mode and have a combined power output of nominally 130 MW. The internal gas combustion engines will operate solely on LNG. An additional 20 MW will be supplied by two internal combustion engines at the Main Power Plant which provides black start capability, emergency power, and function in complimenting the gas turbines as required.

The Main Power Plant will generate power at 13.8 kV which is stepped up to 34.5 kV through four transformers and connects to the distribution system. The 34.5 kV distribution systems will branch from a 34.5 kV switchgear line-up with feeders to the SAG mill, Ball Mill #1, Ball Mill #2, and feeders to the mill and flotation areas in cable tray using insulation copper conductors. Overhead feeder circuits with aluminum conductor steel reinforced lines will be used for the tailings reclaim water, fresh water from the Yukon River, crushing/conveying and SART/ADR, camp site, and two feeders to the pit loop.

4.3.3.4 Accommodations Camp Construction

The construction camp will be developed in two phases. The first phase, scheduled to start in the construction phase of the Project in Year -4 and will involve the relocation of the existing exploration camp from the new mill site to its permanent location and the construction of the pioneer construction camp southeast of the Open Pit, on the south end of the access road (Figure 4.1-5). The pioneer construction camp will be comprised of three worker's dorms, one supervisor's dorm, and a kitchen, diner, and recreation unit that can accommodate approximately 264 personnel.

The second phase of the construction of the accommodations camp is scheduled to begin in 2017 with further site preparation and construction of the foundations of the construction camp. The second phase expands the pioneer construction camp by approximately 684 personnel to be able to accommodate approximately 948 personnel. It includes seven additional worker's dorms, one additional supervisor's dorm, and two executive dorms. Additional kitchen, dining and recreation facilities will be constructed. The construction camp is scheduled to be completed in May 2018.

The accommodations camp will be utilized by all construction contractors during the construction phase with the exception of early earthwork contractors who are expected to provide their own camps, as they are on site prior to the construction of the pioneer camp and off site contractors. CMC intends to contract the operations of the construction camp to a contractor.

The construction camp will be converted to act as the residence camp for operations staff as construction activities wind down. This transition occurs during the late stages of construction prior to Year 1. CMC staff will use the accommodations camp throughout the Casino Project life from the construction phase to decomissioning and closure.

4.3.3.5 LNG Facility Construction

Beginning in Year -3, the LNG receiving, storage, regasification and distribution facility will be constructed. The LNG receiving, storage and distribution facility will be located at the Plant Site. Construction of the LNG facility involves preparation of the foundations, impermeable liners and bedding, layout and welding of floor plates, erecting the LNG storage tank and receiving unit, erecting the vaporization facility, leak testing, installation of interconnecting piping, and installation of dispensing modules for fuel offloading.

The receiving station will unload and transfer the LNG from tanker trucks into the 10,000 m^3 site fabricated storage tank. The LNG will be stored in the tank at -162°C, at 1+ atmosphere pressure. A vaporization facility will convert the LNG into natural gas form at an appropriate pressure for use at the power plants or for gas distribution. In addition to providing fuel for the power plants, the LNG facility may provide fuel for the mine haulage fleet, and fuel for over-the-highway tractors hauling concentrates, lime, grinding media, and the LNG tanker trucks. Two mobile re-fuelers and two portable fueling stations will supply LNG to required locations throughout the Casino mine site. The equivalent of about 10 days of LNG consumption will be stored on site.

CMC anticipates that LNG will be transported to the Casino mine site from Fort Nelson, British Columbia via double wall vacuum tanker trucks at an average frequency of 2 trucks per day in Years -2 to -1 and 11 trucks per day from Years 1 to 22. During the first year of the construction phase, it is primarily diesel fuel that will be transported to the Casino mine site and stored in a diesel fuel storage tank that is installed next to the supplementary power plant. The equivalent of about 10 days of diesel fuel consumption will be stored on site.

Appropriate safety and protective measures will be taken at the fuel storage and distribution facilities. Fuel spills will be managed as described in the Emergency and Spill Response Plan and the Waste Management Plan.

4.3.3.6 Operational Support Facilities

All ancillary support buildings will be pre-engineered steel structures of modular construction and are established at the Casino mine site during the construction phase. Prior to erection of the operational support facilities, the soils in the footprint of the buildings will be salvaged and stockpiled locally adjacent to the disturbance sites or in designated soil stockpile areas. These buildings will consist of the following:

- Administration building;
- Change house (mine dry) and assay laboratories;
- Warehouse and laydown area;
- Light vehicle maintenance building;
- Truck shop;
- Guard shed and scale house; and
- Explosives facility.

The support buildings will include a fire protection system comprised of a primary fire pump (and backups) and sprinkler systems for the accommodation, administration, laboratory and warehouse facilities, and a dry sprinkler system for the maintenance facility. Fully-equipped hose cabinets will be available in the heated buildings.

Administration Building

The administration building will be constructed of structural steel with a prefinished metal roof and wall cladding supported on a pile supported foundation. Office space will be provided for both the construction effort and operations by the administration building which will be located at the Plant Site.

Assay Laboratory

The assay laboratory will house the metallurgical office and will be used for ore sample storage, preparation and analyses. The assay laboratory will be located at the Plant Site.

Truck Shop

A truck shop and maintenance facility will occupy approximately 2.4 ha adjacent to the Open Pit's eastern exit. This building will provide all associated facilities for truck repair and maintenance.

Light Vehicle Maintenance Building

A light vehicle maintenance building will be located at the Plant Site separate from the truck shop.

Guard Shed and Scale House

A guard shed/scale house will be located at the Casino mine site entrance (in addition, another guard house will be located at the entrance of the Freegold Road Extension, if required), and will house a guard around the clock. The guard will also operate the truck scale for incoming and outgoing concentrate trucks.

Explosives Facility

CMC will engage in discussions with potential licensed explosives contractors to determine final requirements for the explosives facility. As currently shown, the explosives facility will be located at the north end of the Casino mine site, taking into consideration Natural Resources Canada (NRCan) requirements for siting (Figure 4.1-5). All materials will be stored in accordance with the applicable regulations and standards and are managed by an NRCan licensed explosives contractor.

Prior to construction of the explosives facilities, the soils in the footprint of the buildings will be salvaged and stockpiled locally in windrows adjacent to the disturbance sites or in designated soil stockpile areas. The designated areas will be graded and surrounded by a perimeter berm with a minimum height of 1.2 m, and a single gated lockable entry point, as per requirements of the explosive‘s license.

The specifications of the explosives facility will be determined by the explosives contractor to match the anticipated rate of use for the Casino Project. In general, an explosives facility consists of:

- Bulk ammonium nitrate outdoor storage area (silos);
- Bulk fuel area;
- Magazine for storage of detonators, detonating cord, boosters ;
- Emulsion manufacturing facility;
- Wash bay;
- Maintenance facility; and
- Trucks.

The licensed blasting contractor will supply all the surface facilities for the explosives magazines and for storage of blasting supplies.

4.3.4 Accessory Activities

4.3.4.1 Freegold Road Extension

The Freegold Road Extension will be a new all-weather resource road that connects the Casino mine site with the western edge of the existing Freegold Road approximately 83 km northwest of the Village of Carmacks. The Freegold Road Extension will be a 120 km long, two-lane, gravel resource road designed to accommodate double-trailer and Tridem trucks. Construction of the Freegold Road Extension will be a priority for the Casino Project in the construction phase. The all-weather access road will be required to support the level of traffic anticipated with year round haulage of materials into and out of the Casino mine site during the operation phase. The Freegold Road Extension will generally follow the existing Casino Trail that has been used in the past to service the Casino Project site. The Freegold Road Extension transects the Selkirk First Nation settlement land for one portion of the alignment (Figure 4.1-4).

The construction of the Freegold Road Extension is anticipated to proceed from the western limit of the existing Freegold Road (at km 83) moving westward towards the Casino mine site. At the same time, construction from the Casino mine site will proceed in a generally easterly direction to meet the construction front originating from the western limit of the existing Freegold Road. Starting in Year -4, an initial first stage road with limited access will be constructed along the Freegold Road Extension alignment to provide early access to the Casino mine site. This will be followed by the construction of the all-weather resource road along the same alignment during Years -3 and -2.

Casino Mining Corporation intends to issue tenders in order to select a qualified contractor or contractors for the construction of the Freegold Road Extension. The contractor(s) will be responsible for securing all licenses and authorisations in the provision and delivery of related services. As well, CMC intends to control access on the Freegold Road Extension during the life of the Casino Project by installing a staffed security gate at the entrance of the Freegold Road Extension at approximately km 83 near Big Creek. Additional information on managing access on the Freegold Road Extension is included as part of the Project's conceptual Road Use Plan (Appendix 22A).

Existing Casino Trail

The Casino Trail winter road will be utilized for preconstruction activities and during the winter months of Year -4 to move fuel and equipment to the Casino mine site. The winter road will be expected to be open for approximately 2-4 months and will be used by CMC to mobilize heavy equipment, supplies and construction materials required for the construction of the mine site facilities and by the contractor responsible for the Freegold Road Extension.

Temporary Construction Camp

At the western front of the Freegold Road Extension, construction crews will utilize the Casino mine site accommodations camp during the construction phase. A temporary construction camp will be required at the eastern front, near the end of the existing Freegold Road. This proposed temporary camp location is an open, flat, valley section near the confluence of Seymour Creek and Bow Creek. Extensive clearing has already been completed at this site for previous access roads and mining activities. This camp will support construction of the new Freegold Road extension towards the mine and possibly the construction of the Freegold Road Upgrade towards the Village of Carmacks. The temporary camp will consist of prefabricated modular trailer units with the capacity to accommodate and support up to 84 people.

Provided facilities will include bunk houses, kitchen, dining area, recreation space, office space, washrooms, showers, and a camp dry. Other camp infrastructure related to support of personnel will include diesel generators for power, propane fired heat, water supply, solid waste disposal, and an approved septic tank/field or lagoon sewage treatment system. Solid waste will be incinerated or hauled off site for recycling or disposal.

A laydown area will be required for construction materials and equipment. A small area will be needed for parking of pickups and other vehicles. Construction vehicles and heavy equipment will be serviced in a proposed truck shop adjacent to the camp. Fuel storage and distribution will be required with enough vehicle fuel capacity to support two weeks of construction. The fuel storage will be enclosed within a lined earthen berm for secondary containment. The berm enclosure will be sized to contain 110% of the fuel tank capacity with a 300 mm freeboard. The fuel storage enclosure will be located a minimum horizontal distance of 30 m from the water's edge of adjacent watercourses and it will be constructed sufficiently above normal high water elevation.

This facility will be owned and operated by the contractor constructing the Freegold Road Extension and will be removed and the area reclaimed by the contractor upon completion of the road.

Initial First Stage Road

The objective of the first year (Year -4) of road construction will be to clear and grub, as necessary, the complete road alignment and to develop a limited access, single lane first stage road that will provide a continuous route from the Village of Carmacks, through the Freegold Road Upgrade to the Casino mine site. The first stage road will allow passage of slow moving vehicles suitable for the rough terrain conditions. The purpose of the first stage road will be to provide the ability to supply equipment, fuel and materials for the on-going road development and to support construction activities at the Casino mine site. The early establishment of a limited access capability is necessary to support the subsequent road construction and greatly increased construction activity level beginning in Year -3 at the Casino mine site.

To the extent practicable, permanent stream and river crossings will be constructed to provide a limited access road capability within the first construction year. In some instances it may be necessary to employ temporary (leased) bridges until the permanent bridges can be constructed. Bridges will be constructed in accordance with Fisheries and Oceans Canada Operational Statements for temporary structures during construction and pursuant to the requirements of *Fisheries Act* authorisations or direction received from Fisheries and Oceans Canada.

All-Weather Resource Road

The Freegold Road Extension will be an all-weather resource road and has been designed to meet the BC Ministry of Forests and Range Forest Road Engineering Guidebook (2nd Edition, 2002) guidelines for a 70 km/h design speed with some 50 km/h sections where road geometry is limited by the terrain.

In order to maximize the design speed and avoid unstable terrain, the route will be located as much as possible in valley bottoms. In the valley bottoms fill materials are used to ensure that the road surface elevation is 2.0 m above the existing ground. This embankment height will stabilise the road against washouts and protects against permafrost degradation under the road. The majority of fill required for construction of these sections will be developed from borrow pits located along the access road alignment and further explained in Section 4.3.3.

In regions where the road climbs out of the valley bottoms, the road construction method will include both cut and fill. A majority of the cut material is expected to be suitable for fill with shortfalls in fill material being obtained from borrow pits. Areas rich in permafrost may require buttressing of cut slopes with a layer of angular rock fill on top of filter fabric to prevent permafrost degradation and act as a retaining structure to improve slope stability.

There are 71 new creek or stream crossings proposed for the Freegold Road Extension. All proposed crossings are expected to be conventional circular embedded CSP culverts with diameters ranging from 1500 mm to 2400 mm or short-span bridges. Short span bridges are deemed to be more appropriate at fish bearing streams to prevent the loss of habitat. A list of proposed stream crossings is included in Appendix 4B.

Given that construction of the Freegold Road Extension will be proceeding simultaneously from the western limit of the existing Freegold Road moving westward towards the Casino mine site and from the Casino mine site in a generally easterly direction to meet the other construction front, CMC anticipates that construction of the Freegold Road Extension will be completed by the end of Year -2, prior to the start of the operation phase of the Project.

4.3.4.2 Freegold Road Upgrade

The existing Freegold Road is a single lane road of 4.5 - 6.0 m in width and has a posted speed limit of 40 km/hr. It starts at the intersection of the Mt. Nansen Road in the Village of Carmacks and runs north and west to the confluence of Seymour and Bow Creeks. This existing road section currently provides access to resource properties along its length and the Yukon Government maintains the road on a seasonal basis up to

approximately km 60 of the total 83 km. The road is unmaintained for an additional 23 km until it ends at Big Creek, where an existing bridge crossing has been washed out.

Freegold Road Upgrades

From the intersection of Mt. Nansen Road (km 0) to km 32 at the intersection of the Carmacks Copper Access Road, the design and construction of the road will be based on the engineering work already completed by the Yukon Government. In the mid-1990s, the Yukon Government selected a route and completed a design for the upgrade and realignment of the Freegold Road for this section of the existing Freegold Road. The Yukon Government completed a significant amount of fieldwork in support of the road design and CMC has confirmed that proposed upgrades up to this point will meet the required design criteria for the Casino Project.

From the Carmacks Copper Access Road to km 83 near the washed out bridge at Big Creek, the existing Freegold Road will be upgraded to meet a 70 km/hr design speed with an 8.2 m wide gravel surface with a maximum grade of 8%. Sketches of this section of the Freegold Road alignment can be found in the Appendix 4B.

Construction of the Freegold Road Upgrade will include a combination of cut and fill activities and overlanding. Cut and fill construction will involve excavating suitable material and placing it to construct the road embankment. Overlanding will be used through areas of low lying wet lands, and areas of permafrost and will involve the placement of suitable embankment material over organic material. Borrow pits will be required as a source for embankment and road surfacing material. CMC has completed preliminary geotechnical investigations to identify potential borrow sites along the Freegold Road and additional information on these sites is available in the Appendix 4B. As well a number of existing bridge crossings will be replaced to accommodate the required traffic loads.

Little Salmon/Carmacks First Nation settlement land is located on the south side of the existing Freegold Road right-of-way from Blue Ribbon Road (km 48) to the confluence of Seymour Creek and Big Creek. A roadway alignment for the Freegold Road Upgrade that meets the requirements of a 70 km/hr design speed cannot be achieved within the existing right-of-way adjacent to the settlement lands. The existing right-of-way will require realignment from km 49 to km 62.6 through LSCFN settlement land in order to meet the required design criteria. CMC has considered realignment of the existing right-of-way upslope, though this is not possible due to steep terrain. An additional realignment of the right-of-way through settlement land will be required at km 67.7 for a length of 2.5 km. This portion of the Freegold Road Upgrade is located through the previously mined area of Seymour Creek, and is required to meet design criteria.

Carmacks By-Pass and Nordenskiold Bridge

The Carmacks By-Pass will provide a route for mine related traffic to bypass the Village of Carmacks. Yukon Government surveyed the route and prepared a road design in 1997. In 1998-1999 the right-of-way was cleared, and the first section of By-Pass road was constructed from the Klondike Highway to the east side of the Nordenskiold River. The route is 5 km long beginning at the Klondike Highway in the Garvice Industrial Subdivision. The route crosses the Nordenskiold River and ascends to join the Mt. Nansen Road. The route is then generally a realignment and upgrade of the Mt. Nansen Road to where it ties into the Freegold Road. The design prepared by Yukon Government is a 9.0 m wide gravel road that meets a 70 km/hr design speed. The Carmacks By-Pass design is included in Appendix 4B.

A detailed site survey of the Nordenskiold River at the crossing was completed in June 2013. A hydro-technical analysis of the crossing was performed, and a bridge concept was developed based on the results of that analysis. The proposed Nordenskiold Bridge is a single lane bridge, with steel girders and concrete deck. Pullouts are provided at each approach to allow for the safe passing of vehicles. The bridge will have two spans with a pier

located in the river channel. Two metres of freeboard above the 1 in 100 year flow elevation is provided to allow clearance of debris during a flood event.

4.4 OPERATION PHASE

4.4.1 Overview

This section of the Proposal for the Casino Project describes the Project components, facilities and activities that are anticipated to occur during the operation phase of the Project from Year 1 to Year 22. Figure 4.2-1 shows the sequencing of activities for the life of the Project. The extent of the Casino mine site, including Project infrastructure, components, and work areas developed as of Year 10 and Year 22 (at the end of the operation phase) for the are shown on Figure 4.4-1 and Figure 4.4-2 respectively. The following major activities characterize the operation phase of the Casino Project:

- Open pit mining of ore deposit;
- Crushing, screening and conveyance of ore;
- Stockpiling of ore;
- Sulphide ore processing via copper and molybdenum flotation;
- Oxide ore processing via heap leaching;
- Waste rock management;
- Tailings management; and
- Progressive reclamation.

The rate of open pit mining and ore processing (including both heap leaching and sulphide ore processing) will vary somewhat based on the mine production schedule established for the Project in the Feasibility Study (M3 2013). The target mine production and processing rate is approximately 120,000 tonnes of sulphide ore per day, which will vary slightly depending on the quality of the ore. This rate is achieved in Year 2 of operations and all mining operations are basically in support of this sulphide ore production rate. The rate of oxide ore mining, both prior to and during the mining of sulphide ore, will vary considerably; the ore is taken as it becomes available during the pit development and sulphide ore mining. Oxide ore processing will be limited to 25,000 tonnes per day and as a result excess oxide ore will need to be taken to stockpile for later introduction into the circuit. Low grade and marginal sulphide ore will be taken to stockpile as it is encountered for processing at the end of the mine life. Supergene oxide ore feed to the mill must be blended in with the sulphide ore feed and hence excess supergene oxide will also need to be stockpiled. Ore stockpiles at the Casino mine site have been sized to consider the rate of ore extraction, production and shipping. All ancillary support facilities and activities established during the construction phase, such as the accommodations camp, the supply of consumables such as LNG and diesel fuels, ammonium nitrate for explosives manufacture and other materials, will support the production activities of the Casino Project during the operation phase.

4.4.1.1 Workforce Requirements

The Casino Project is anticipated to employ approximately 600 permanent mining personnel at the Casino mine site during the operation phase. An additional 100 to 200 contractor support personnel will also be at the Casino mine site at any given time. As described in Section 4.3.1.2, CMC intends to employ as many people from the

Yukon as possible, including from First Nations communities. Additional personnel from outside the territory will be necessary to fully staff the Casino Project during the operation phase.

The construction accommodations camp will be converted to serve as the residence camp for operations staff during the late stages of the construction phase, prior to Year 1. CMC personnel continue to use the accommodations camp throughout the Casino Project life, up to and including decomissioning and closure. Additional information on the accommodations camp is presented in Section 4.3.9.3.

As in the the construction phase, operations personnel will continue to be transported to and from site by mean of aircraft from Whitehorse.

Table 4.4-1 Projected Number of Flights into the Casino Mine Site – Operation Phase

Projected Number of Flights	Flights
Passengers per flight	50
Flights per year, for personnel rotation	152
Flights for other purposes (at 10% of rotation requirements)	15
Total	**167**

NOTE:
Projections are based on 13 flights into the Casino mine site per person per year on a 2 weeks on and 2 weeks off rotation

4.4.1.2 Energy Requirements

During the operations phase, the Casino Project has an energy requirement of approximately 130 MW which will be supplied by operating both the Main Power Plant and the Supplementary Power Plant. An additional 20 MW will be available from two standby internal combustion engines located at the Main Power Plant; though the primary purpose of the standby units is to provide black start capability and emergency power. Additional information on the Supplementary Power Plant and Main Power Plant is presented in Sections 4.3.9.1 and 4.3.9.2 respectively.

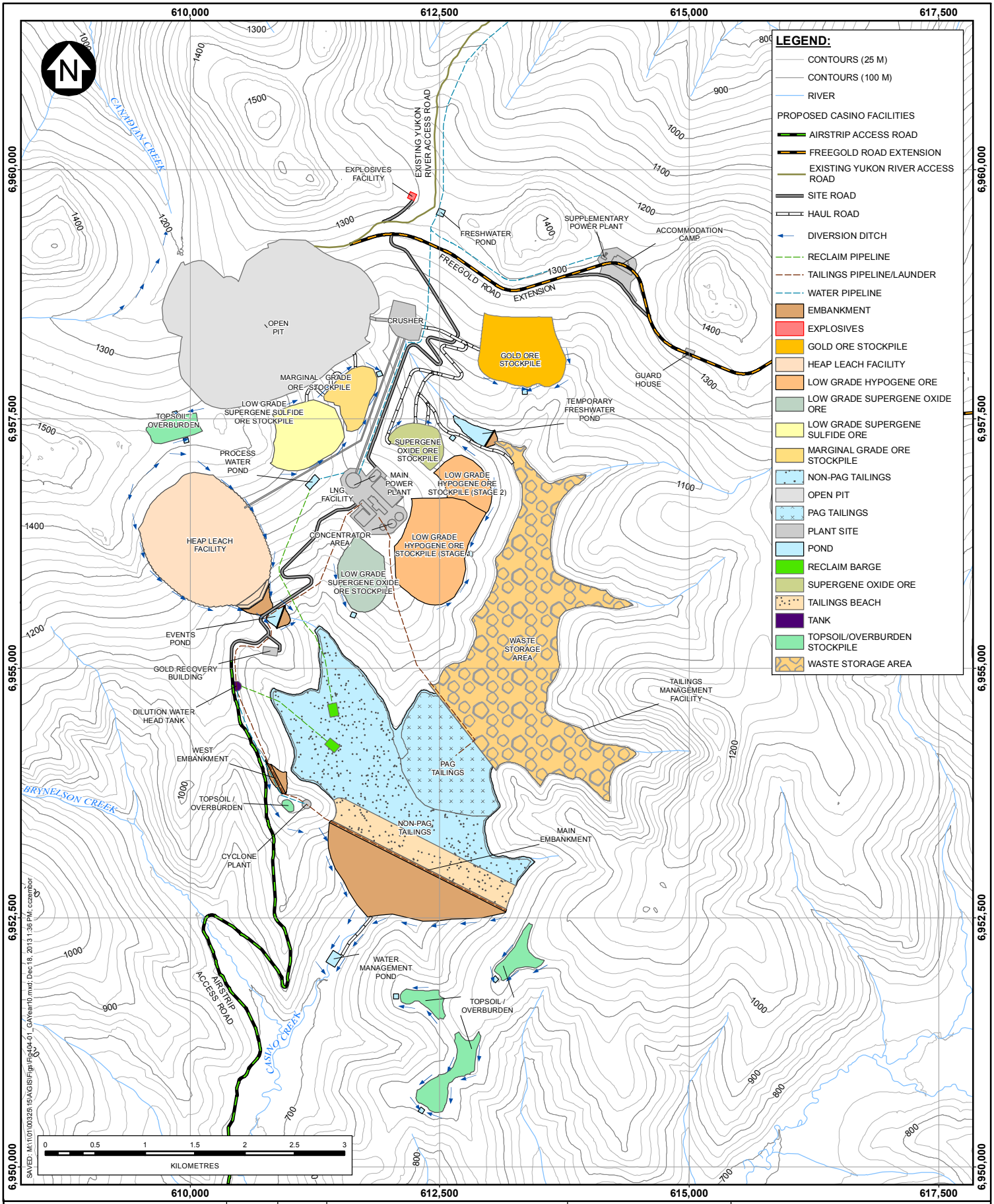
4.4.1.3 Water Management

During operations, the primary objective for water management at the Casino mine site will be to continue to minimize contact water while maximizing the amount of water collected in the TMF, and subsequently used in the milling process. The Water Management Plan for the Casino Project contains detailed information on the overall Casino mine site water management approach.

Like the construction phase, sedimentation and erosion control structures and best management practices will continue to be implemented in the operations phase to mitigate sediment transport. All contact water from the site will be collected and directed to the TMF. The majority of seepage from the TMF is predicted to occur at the Main Embankment, with a minor amount from the West Embankment in the final stages of the operation phase. Seepage will be collected in the water management pond and will be returned to the TMF via pumps.

Process water from sulphide ore processing will also be discharged into the TMF along with the tailings. Water required for the mill process will be primarily sourced from TMF supernatant pond via the reclamation barge pumping system; however, when the TMF pond reaches it's minimum volume of 15,000,000 m3, the reclaim system will temporarily cease operations and process water requirements will be sourced from the Yukon River groundwater reservoir via the make-up water pumping system described in Section 4.3.4.

All runoff from areas upslope of the Open Pit will be allowed to flow into the Open Pit. Pit dewatering and pumping systems will collect water in the pit and will be pumped to the plant site for use in the milling process. In Year 10 when the Open Pit footprint intercects Canadian Creek, an engineered diversion channel will be constructed to divert the creek around the Open Pit.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:

1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

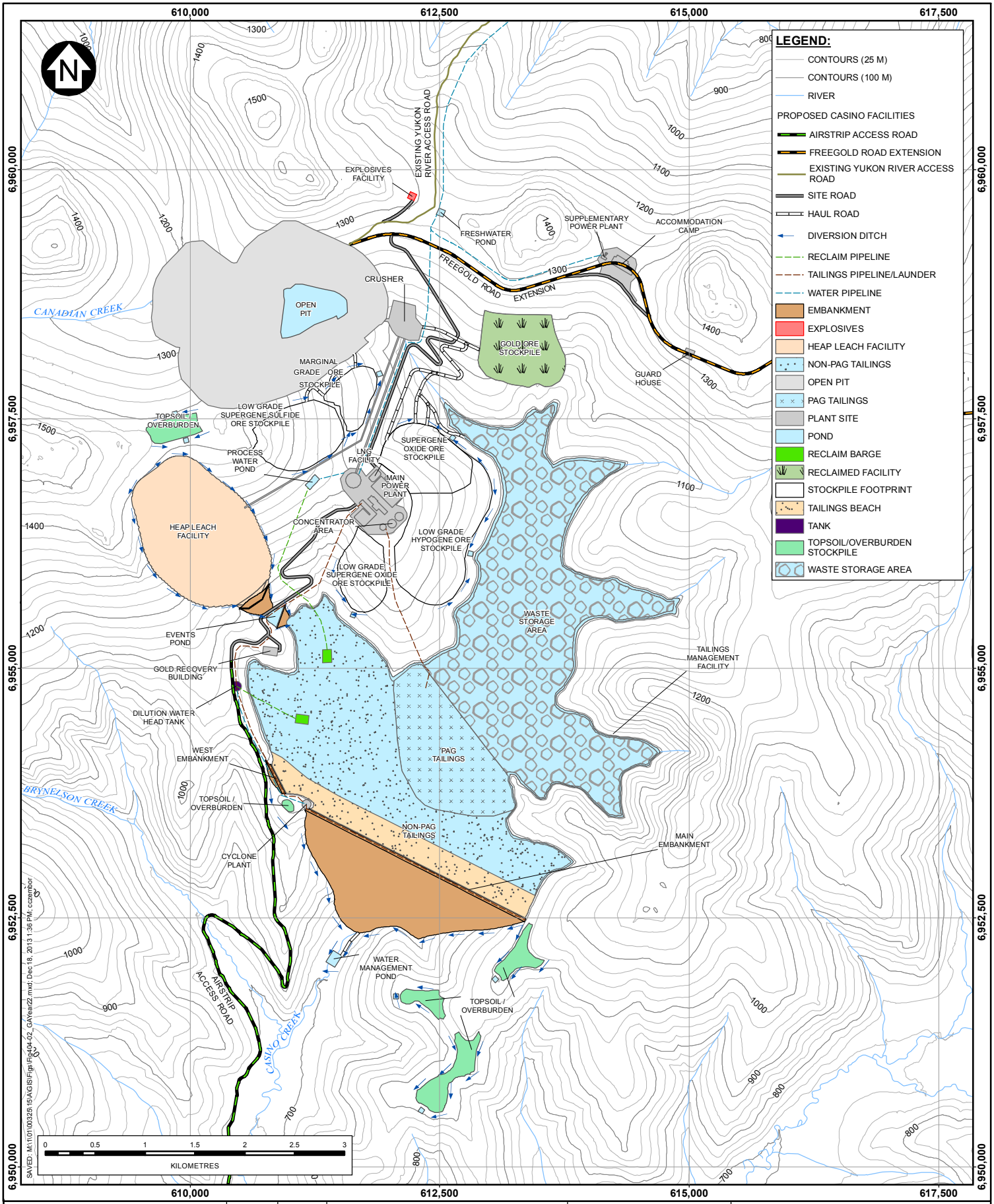
CASINO PROJECT

GENERAL ARRANGEMENT YEAR 10

FIGURE 4.4-1

REF 1

P/A VA101-325/15



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REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

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CASINO PROJECT

GENERAL ARRANGEMENT YEAR 22

FIGURE 4.4-2

REF 1

P/A VA101-325/15

4.4.1.4 Waste Management

There are several types of waste generated during the operations phase of the Casino Project. The waste types, handling and disposal methods are the same in the operations phase as those summarized in Table 4.3-3 for the construction waste management plan.

4.4.1.5 Fuel, Hazardous Materials and Explosives Management

Fuel, hazardous material and explosives facility details are provided in Section 4.3.1.6 of the Proposal. This section provides further details specific to the operation phase for fuel, hazardous materials and explosives use.

Fuel Delivery and Usage

Both LNG and diesel will be delivered to the Casino mine site throughout the operation phase of the Casino Project based on the anticipated consumption and delivery schedule in Table 4.4-2. Delivery of LNG will be completed using 95,000L tanker trucks from an LNG facility in Fort Nelson, British Columbia. Diesel fuel will be delivered to the Casino mine site by 43,000L tanker trucks. The table below summarizes the fuel volume and the average daily number of fuel truck deliveries that are expected in each phase of the Casino Project (Table 4.4-2).

Table 4.4-2 Projected Fuel Consumption and Delivery Schedule

Fuel Consumption and Deliveries	Project Phase		
	Construction	Operations	Closure and Decommissioning
LNG Consumption (‘000 litres per year)	33,000	360,000	10,000
LNG Deliveries (trips per day)	2	11	0
Diesel Consumption (‘000 litres per year)	26,000	32,000	2,000
Diesel Deliveries (trips per day)	2	2	1

Note:
This scenario is based on using diesel for the mining fleet.

Explosives Products Delivery and Usage

The following table summarizes the anticipated annual requirements for explosives use by the Casino Project (Table 4.4-3). See Section 4.3.1.6 for additional information regarding explosives manufacturing, storage and use. During operations, blasting will only occur during daylight hours at specific designated times (i.e. during a shift change or at lunch hour) in order to minimize risk. Blasting times will be posted at the Casino mine site and response measures are put in place in case of an emergency according to the Explosives Management Plan that will be developed for the Casino Project.

Table 4.4-3 Explosives Consumption Schedule

Explosives	Project Phase		
	Construction	Operations	Closure and Decommissioning
Explosives Consumption (tonnes of ANFO per year)	0 to 7500	19,000	0

[1] **Note:**
Consumption is based on an average production capacity of 25,000 tpd during construction and 120,000 tpd during operations, assuming a powder factor of 0.25 Kg ANFO/tonnes ore.

Processing Reagents

Reagent storage, mixing, and distribution will be conducted for the reagents used in the sulphide ore and oxide ore processing circuits listed in Table 4.3-5. The reagent storage and mixing facilities for the flotation circuits will be located within a structurally independent building adjacent to the flotation building. An 8,000 t pebble lime silo will be located apart from the flotation building.

Table 4.3-4 Reagents Used for Sulphide Ore and Oxide Ore Circuits

Sulphide Ore (Flotation Circuits) Process	Oxide Ore (Heap Leach) Process
Sodium-diisobutyl dithiophosphinate (Aerophine 3418A Promoter) Sodium diethyl dithiophosphate/sodium di-secondary butyl dithiophosphate (Aerofloat 208 Promoter) Methyl Isobutyl Carbinol (MIBC, frother) Pebble Lime (CaO, pH modifier) Fuel Oil (#2 Diesel fuel, moly collector) Sodium Hydrosulfide (NaHS, copper mineral depressant) Flomin D-910 (copper mineral depressant) Flocculant Potassium amyl xanthate (PAX – pyrite flotation)	Sodium Cyanide (NaCN) Caustic (sodium hydroxide, NaOH) Pebble Lime (CaO) Hydrochloric Acid (HCl) Sodium Hydro-Sulphide (NaHS) Sulphuric acid (H_2SO_4) Activated Carbon Antiscalant Flocculant

4.4.1.6 Access and Transportation Management

Throughout the operations phase of the Casino Project, trucking will be the primary inbound and outbound transport from the Casino mine site complemented by aircraft for transporting personnel. Workers starting or finishing their on-site rotations will be shuttled over the airstrip access road to and from the Casino airstrip. During the operations phase, concentrate trucks are anticipated to travel round trip between the Casino mine site and the Port of Skagway daily on a year round basis by utilizing the Freegold Road. This main all-weather access road will also be used to resupply the Casino mine site and remove wastes, and for the occasional transport of oversized equipment during operations. CMC anticipates that trucking will be utilized during the operations phase for the following activities:

- Copper concentrate from the Casino mine site to the Port of Skagway;
- Molybdenum concentrate from the Casino mine site to the Port of Skagway;
- Copper sulphide precipitate from the Casino mine site to the Port of Skagway;

- Supplies and equipment inbound to the Casino mine site; and
- Special Waste removal from the Casino mine site to appropriate disposal facilities.

Several types of trucks are considered capable of hauling concentrate to the Port of Skagway. For the purpose of the Feasibility Study completed in 2013, outbound vehicles will be double-trailer trucks, and the inbound vehicles will be standard Tridem trucks. A truck shop and maintenance facility will be located at the Open Pit's eastern exit on the Casino mine site and will provide truck repair and maintenance for haul trucks and other mobile equipment.

Access and transportation management during the operations phase will be similar to that of the construction phase, described in Section 4.3.1.7, including materials management procedures, regular maintenance and inspections for safe operation, snow clearing, and the application of dust suppressants. Ore handling and spills response will be included in the Casino Project's Emergency and Spill Response Plan that will be developed for the Project.

The final Road Use Plan that will be developed for the Project specifies rules for the Freegold Road Extension (a conceptual Road Use Plan is presented in Appendix 22A). The final Road Use Plan will include:

- Ensuring safe access to the Casino mine site;
- Potential use of the access road by the public, including hunters;
- Speed limits and enforcement;
- Yielding the right-of-way to wildlife and reporting wildlife observations;
- Travelling in convoys for safety;
- Emergency and spill response procedures;
- Truck traffic communications; and
- Community notification and update processes for the Village of Carmacks**.**

Anticipated Traffic Volume during Operations

The Casino Project will operate year-round with associated year-round traffic on the Freegold Road Extension. Road use data are not available for the existing proposed Freegold Road Upgrade segment to determine the exact increase of traffic volume. However, there are currently relatively few users of the Freegold Road Upgrade segment. Table 4.4-4 presents the projected traffic volumes by vehicle type and year for the operations phase of the Casino Project.

Table 4.4-5 Projected Traffic Volumes for the Operations Phase

Vehicle Type	Inbound (loads per day)	Outbound (loads per day)
LNG Fuel	11	11
Diesel and Lubricants etc.	4	4
Lime (as backhaul)	6	0
Grinding Media (as backhaul)	3	0
Camp and Catering Supplies	2	2
Copper Concentrate	0	17
Molybdenum Concentrate	0	4
Other	10	10
Buses, vans, light vehicles	20	20
TOTAL	**56**	**68**

NOTES:
Daily and seasonal variations will occur. Peak outbound results can arise from years of higher than life of mine average copper concentrate production. For example, Copper concentrate outbound loads can reach 24 loads per day in some years.

Freegold Road Extension Maintenance

The Freegold Road Extension will be maintained to provide year-round access to and from the Casino Project. Regular road maintenance, including snow clearing in the winter, will be carried out to ensure user safety, preserve the condition of the access road, and ensure access to the Casino mine site.

Activities associated with the regular maintenance of the Freegold Road Extension from the Casino mine site up to the proposed Freegold Road Upgrade will be carried out by a CMC contracted service provider. CMC is engaged in discussions with the Yukon Government to develop an agreed upon maintenance plan for all sections of the Freegold Road, including the proposed Freegold Road Upgrade, to meet Project needs for year-round operations.

4.4.2 Open Pit Operations

The Open Pit will be excavated by using a conventional bench configuration with access via ramps, using conventional open pit mining equipment and will be designed to extend to a maximum depth of approximately 600 m. A summary of the total ore and waste quantities of materials mined from the Open Pit is presented in Table 4.4-6.

Table 4.4-6 Casino Project Ore and Waste Quantities

Material Mined	Quantities (000' Tonnes)
Supergene Oxide Ore	60,010
Supergene Sulphide Ore	255,864
Hypogene Ore	649,332
Gold Ore	157,454
Waste	657,867
Total Material Mined	1,780,527

Slope Design

The slope design for the Open Pit is based on kinematic and rock mass stability analysis and site-specific geotechnical and hydrogeological information collected from site investigations which occurred from 1994 to 2011 (Knight Piésold Ltd. 2012d). Operational considerations have been factored into the recommended slope angles as are experiences encountered at other large open pit operations in Canada. Many design factors have been considered in selecting the final open pit wall angle, including slope height, rock mass strength, groundwater pressure, blasting, and the inter-ramp angles. The open pit design will be made up of three parts: bench geometries, inter-ramp slopes, and overall slopes. These parts have been designed as:

- Overburden is cleared at the Open Pit edge at a 2H:1V slope;
- Benches of 8 m in width and 15 m tall, with a face angle of 65º will be used for the majority of the Open Pit;
- Inter-ramp angle of 45º will be used for the majority of the Open Pit;
- the M-North and W-North sectors have an inter-ramp angle of 42º to minimize wedge failures from occurring; and
- the overall angles to be utilized in pit sections will be 40º in the main pit and 42º in the west pit.

The recommended bench geometries and pit slope angles developed for the Casino Project Open Pit are summarized in Table 4.4-5.

Table 4.4-7 Recommended Bench Geometries and Pit Slope Angles

Design Sector	Slope Height	Wall Geology	Bench Face Angle	Bench Height	Bench Width	Inter-ramp Angle	Max Inter-ramp Slope Height	Overall Slope Angle
	m		degrees	m	m	degrees	m	degrees
M-North	30	Overburden	40	5	4	27	200	39
	610	DRB	60	15	8	42		
M-Northeast	30	Overburden	40	5	4	27	100[(1)]/200	40
	610	DRB	65	15	8	45		
M-South	540	PMS, DRB	65	15	8	45	200	42
Central	210	PMS	65	15	8	45	200	N/A
W-North	285	DRB	60	15	8	42	200	39
W-South	480	DRB	65	15	8	45	200	42
W-Southwest	345	PMS	65	15	8	45	200	42
W-West	210	DRB	65	15	8	45	200	42

Note:

A 100-m high inter-ramp slope is recommended for slopes developed in weathered bedrock. The maximum height for the inter-ramp slopes in fresh rock is 200 m.

Controlled blasting and slope monitoring will be conducted as part of the Open Pit operations because controlled blasting is important for overall pit wall stability. Incorrect blasting activities may lead the progressive deterioration of the wall face and instability. Blasting trials will be implemented when there are observed changes in the characteristics of the rock during excavation. Slope monitoring will be conducted during all stages of open pit development including geotechnical analysis of the pit walls, geotechnical mapping of pit walls, tension crack mapping, surface prism monitoring, piezometer installation, and automated monitoring systems.

Mining Equipment

Electric-cable face shovels, backed up by front-end loaders, will be used to load mine haul trucks to transport ore to either the crushers or to the appropriate stockpile depending on the mine production schedule. During open pit mining, waste rock will be hauled to the waste storage area of the TMF for subaqueous disposal. Backhoe excavators will be utilized for general earthworks, snow removal, and limited mining activity where larger equipment may have restricted access. Wheel and track bulldozers will be used for cleanup around mining activities and for control of rock on the benches. Graders and water trucks will be used for main haul road maintenance. All movement of vehicles within the Open Pit will be monitored by a central dispatching system to ensure worker health and safety and efficiency in operation.

Drilling and Blasting

Blast holes will be drilled and an explosives truck will deliver and dispense explosives into the blast holes. Blast sequences will be established and the Open Pit is cleared of all personnel, and the blasts detonated. Blasting at the Open Pit will be carried out by a licensed explosives contractor using ammonium nitrate and fuel oil emulsion (ANFO) manufactured on site.

Hauling

Ore materials will be transported from the pit using haul trucks and are intended for either the crusher for processing or a temporary ore stockpile to be milled over the later years of the Casino Project. Waste rock materials excavated from the Open Pit will be hauled to the waste storage area of the TMF. During operations, all movement of vehicles within the Open Pit will be monitored by a central dispatching system to ensure worker health and safety and operational efficiency.

Water Management

Development of the Open Pit will create a large depression in the local groundwater table, which will result in the pit becoming a groundwater discharge area. The majority of pit inflows will likely be from the West where the higher topography results in higher groundwater gradients towards the pit.

The water management system for the Open Pit will be comprised of surface water diversion ditches, vertical pumping wells, horizontal wall drains and water collection systems. These measures will be implemented as a staged approach during open pit development. A Water Management Plan (Appendix 4C) has been developed the controlled removal of both groundwater inflows and precipitation runoff from within the Open Pit. The main features of the water management system for the Open Pit will include:

- An engineered channel to divert Canadian Creek around the Open Pit during operations;
- Horizontal drains installed in both interim and final pit walls to drain groundwater;
- Vertical wells are installed in the north walls to reduce water pressure in the pit walls, and to remove water from faults;

- A series of pumps and collection systems which transfer water from the pit excavation to a surface sump located near the primary crusher for recycle to the milling process; and
- Modifications to the depressurization systems to account for the extreme cold during winter months and the high inflows during the freshet period.

4.4.3 Tailings Management Facility Operations

At each stage in embankment construction the previous lift will be stripped and cleared for approximately 1 m for placement of the next layer of fill and any unsuitable or frost-susceptible material is removed. Embankment raises will be constructed by a centerline raise construction method. Additionally, an upstream and downstream shell will be constructed from dozer compacted cyclone sand. Drainage piping is to be added to the embankments in Years 1, 4, 10, and 22 of the Casino Project. At the end of Year 22 the final Main Embankment height is 286 m with an elevation of 998 masl.

To the northwest of the Main Embankment will be the West Embankment (Figure 4.3-2). This embankment will be constructed with approximately 0.36 million m^3 of total fill comprised of mostly local borrow materials and as much non-PAG waste material as possible. While the West Embankment will not be required for containment of the TMF until Year 18, it will be constructed by the start of Year 1 and will function as a pipeline corridor for tailings. The low permeability core of the West Embankment will be 10 m in width. A cut-off trench will be constructed underneath the core into bedrock at an average depth of approximately 3 m.

Cyclone Sand Plant

The Project TMF has been designed to include a cyclone plant to generate sand from the bulk non-PAG tailings for the construction of the embankments. The cyclone plant process and system will include the following general features:

- a pre-engineered building (including a maintenance bay and a leveled pad around the building for storage, trucks and maintenance equipment maneuvering);
- a cyclone feed system (including feed tank, pipelines and valves);
- a large diameter cyclone cluster (with twelve cyclones in total, including two spare cyclones);
- slurry process pumps (are gradually added starting in Year 5 to transfer sand and cyclone fines to the deposition points); and
- a sand sampling process (including pumps, compressed air, pipelines and valves).

Thickened non-PAG tailings flow by a gravity concrete chute (launder) from the mill to the cyclone plant for approximately 9 months a year when climatic conditions allow placement of cyclone sands in the Main Embankment. At the cyclone plant, the non-PAG tailings will be processed in a single stage of cyclones to produce sand that is recovered as cyclone underflow for the construction of the Main Embankment. The cyclone overflow (fine tailings) produced in the cyclone plant will be sent to the TMF for disposal and is used as part of the shell material in the developing embankments. In order to feed the cyclones at optimum solids concentration for solids separation, dilution water will be required at the cyclone plant. This dilution water is pumped directly from the TMF pond by barge and intermediate pumps to a water header tank located at the cyclone feed tank. A schematic of cyclone plant system showing the different plant components is presented in Figure 4.3-5.

Cyclone sand production will commence in Year 1 of the Casino Project and will be used to extend the downstream shell of the Main Embankment (Stage IB). The availability of cyclone sand needs will be matched

with the filling schedule for the TMF, to ensure adequate embankment heights are provided well in advance of the rising tailings surface. CMC anticipates that there will be sufficient cyclone sand material available to meet the fill requirements of the Main Embankment for Years 2 to 22 of the Casino Project. When the cyclone plant is unavailable due to maintenance or suspended (for approximately three months of the year when freezing climatic conditions likely preclude sand placement in the Main Embankment), all non-PAG tailings will be disposed of in the TMF through a cyclone overflow pipeline.

Waste Storage Area

Waste rock will be disposed of within the waste storage area of the TMF located in the upstream portion of the TMF impoundment in the Casino Creek valley. During construction activities, auxiliary surface stockpiles will be used for temporary storage of waste rock, but the final location of all waste rock is in the waste storage area of the TMF, which is designed to accommodate approximately 658 million tonnes of PAG waste rock and overburden subaqueously. The waste rock and overburden will be excavated from the Open Pit and transported to the waste storage area within the TMF by haul truck.

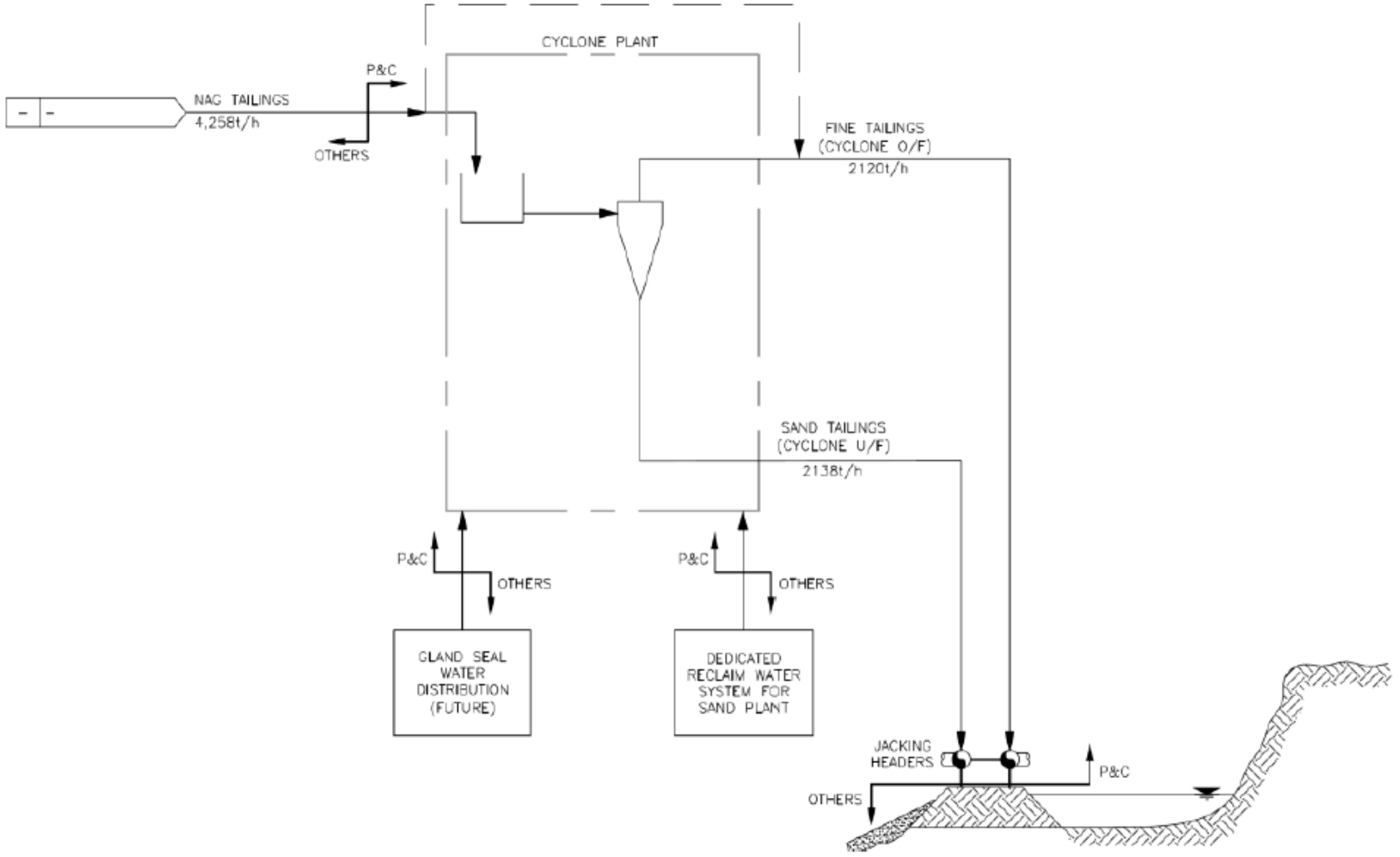
The design of the waste storage area will be based on the mine production schedule for the Casino Project. The waste rock storage area will be developed with a similar rate of rise as the tailings. The following methods may be implemented to ensure on going stability and performance of the waste storage area:

- Waste rock and overburden will be transported from the Open Pit using haul trucks. The material may be end dumped over the face or spread by dozers over the crest of the waste storage area;
- Trial sections may be constructed in the field during the initial stages of development to monitor waste pile stability and foundation performance; and
- Waste rock will be end dumped over the crest to allow for maximum segregation of the coarser material at the base of each bench. For overburden materials, end dumping short of the crest and dozing over may be required.

During operations, the maximum elevation of the waste storage area will be maintained at an elevation above the potential flood level of the TMF supernatant pond. The crest will be maintained several metres higher than the tailings and supernatant pond to provide a dry, stable surface for access and placement of material by haul trucks.

A separation of 1 km will be maintained between the waste storage area and the TMF embankments during operations. This separation will allow for the development of a non-PAG tailings beach between the TMF embankments and the waste storage area. The non-PAG tailings beach will provide a low permeability transition zone between the coarse and permeable waste rock in the waste storage area and the TMF embankments. The non-PAG tailings beach will be a low permeability zone that functions as a seepage limitation and control measure between the two areas.

The crest of the waste storage area will be covered with tailings and submerged by the supernatant pond in the later years of the Casino Project when stockpiled low grade ore will be milled after mining of the Open Pit is complete. Based on the proposed mine production schedule, approximately four years of tailings deposition will occur after placement of all waste rock into the waste storage area.



NOTES:
1. ADAPTED FROM "CASINO PROJECT TAILINGS CYCLONE AND TRANSPORT STUDY".

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	19DEC'13	ISSUED WITH REPORT	CPK	GLS	GLS

CASINO MINING CORPORATION

CASINO PROJECT

OVERALL SCHEMATIC OF CYCLONE PLANT SYSTEM

Knight Piésold CONSULTING

P/A NO. VA101-325/15

REF. NO. 1

FIGURE 4.4-3

REV 0

4.4.5 Ore Management

4.4.5.1 Ore Crushing and Conveying

Ore materials from the Open Pit or the ore stockpiles will be hauled to the crusher system to reduce ore size to required specifications. The Casino Project will have two primary crushers located next the Open Pit at approximately the elevation of the exit from the pit (Figure 4.1-5). One crusher will be used for the initial crushing of the sulphide ore for the mill and the other crusher will be used for the initial crushing of the oxide ore for the HLF.

Sulphide ore will be fed to the sulphide ore primary crusher via a dump pocket. The crushed sulphide ore will be dropped into a discharge bin equipped with an apron feeder that discharges onto a belt conveyor. The belt conveyor will discharge the primary crushed sulphide ore to a covered, conical ore stockpile which can contain approximately 75,000 t of ore storage. Sulphide ore for the single grinding line will be withdrawn from the coarse ore reclaim stockpile by apron feeders. The apron feeders will discharge to a conveyor belt which provides the primary crushed ore to the SAG mill in the primary grinding circuit located at the Plant Site.

Oxide ore will be trucked from the open pit or the ore stockpiles to the dedicated oxide ore primary crusher (alternatively, oxide ore may be stockpiled in the Gold Ore Stockpile if the primary crusher is down for maintenance). An apron feeder will provide the oxide ore to the primary crusher which discharges onto a secondary screen feed belt conveyor. The secondary screen feed conveyor will discharge onto the secondary screen. The primary crushed ore will be reduced in size to minus 50 mm through screening and a secondary cone crusher. At this point, lime will be added to the conveyor, which discharges onto the intermediate transfer conveyor and onto a series of overland transfer conveyors that transfer the crushed oxide ore and lime to the heap leach pile.

Overland transfer conveyors will be covered and equipped with wind hoods to reduce wind exposure and the potential for ore fines to be blown off the conveyors. Dust collectors will be installed at transfer points and other required areas to limit fugitive dust emissions. Additional dust suppression techniques may consist of spraying of dust suppressants to control fugitive dust in the Open Pit, mine access and haulage roads, and ore stockpiles.

4.4.5.2 Ore Stockpiles

During the operations phase, approximately 144 million tonnes of low grade ore and 32 million tonnes of supergene oxide (SOX) ore will be stored in temporary stockpiles according to the mine production schedule. The SOX ore will be stockpiled during the construction phase and in Year 1 of operations, and reports to the mill during Years 4 to 12, together with direct feed mill ore. Low Grade ore will be stockpiled up to Year 17 and milled during the last four years of mine operations (Years 19 to 22). During the construction phase, oxide ‘gold’ ore will be stored in a temporary stockpile near the crusher on the valley slope east of the Open Pit at the northern end of the TMF. The gold ore will be stacked on the heap leach over a period of 18 years, starting in the first year of construction (Year -3) three years prior to mill start-up and continuing up to Year 15.

In general, run-of-mine ore will be extracted from the Open Pit, transported to a stockpile via haul truck for storage, or directly to the crusher as described in Section 4.4.3.1. The ore material will be end dumped and spread by dozers over the crest of the stockpile. The ore stockpiles will be gradually used over the duration of mine life according to the mine production schedule. As required, the stockpiled ore will be trucked from the stockpiles to the crushers. The prepared base of the ore stockpiles will function as a working platform during the re-handling of the stockpiled ore for crushing.

A series of diversion ditches will be installed upstream of the ore stockpiles to minimize the contact of runoff water with the ore stockpiles and divert surface flow to the TMF basin. Based on the topography at the Casino mine site, the total diversion ditch widths will range between 3-4 m for the protected ditch sections and 4-5 m for the shallow-grade earth lined sections. The diversion ditching system will meet the following design criteria:

- Design storm conveyance: 1 in 100 year 24-hour duration storm event;
- Minimum freeboard = 0.3 m;
- Maximum design storm flow depth = 0.5 m;
- Minimum ditch grade = 0.01 m/m; and
- Minimum channel side slope = 2H:1V.

As well, sediment control fencing will be placed around the down-gradient perimeter sections of the ore stockpiles to prevent sediment discharge from the stockpiles. A detailed description of the surface water management strategy for ore stockpiles is presented in Appendix 4C.

4.4.6 Ore Processing

Ore processing will be conducted by two means: Sulphide Ore Processing and Oxide Ore Processing. Both of these ore processing techniques are described below and are depicted on Figure 4.1-6.

4.4.6.1 Sulphide Ore Processing

As described in Section 4.4.3.1, run-of-mine sulphide ore will be hauled to the crusher and reduced in size to minus 200 mm using a primary gyratory crusher. The primary crushed sulphide ore will be stockpiled and then reclaimed with feeders and a belt conveyor, which will provide the new feed to the SAG mill in the primary grinding circuit at the Plant Site.

Grinding

Primary crushed sulphide ore will be reduced in size in two stages: first, a primary SAG mill circuit and, second, a ball mill circuit. The SAG mill circuit will operate with a pebble trommel screen and pebble crushers, while the ball mill circuit operates with hydrocyclones. The final sulphide product has a target particle size distribution of 80% finer than 200 microns, which flow by gravity to the copper and molybdenum flotation circuit.

Copper and Molybdenum Flotation Circuit

The copper and molybdenum sulphide minerals in the sulphide product from grinding will be concentrated and separated by froth flotation to produce a bulk copper/molybdenum concentrate. The froth flotation circuit will consist of the following components:

- Two rows of mechanical rougher flotation cells;
- Two rows of mechanical first cleaner flotation cells;
- Two concentrate regrind mills operated in closed circuit with hydrocyclones;
- One row of mechanical second cleaner flotation cells; and
- Four copper-molybdenum third cleaner flotation column cells.

Concentrate from the final cleaner of the froth flotation circuit will be sent to a copper-molybdenum thickener. Thickened copper-molybdenum concentrate will be pumped to the molybdenite flotation circuit, which separates the copper-molybdenum concentrate into separate copper and molybdenum concentrates.

Copper Concentrate Dewatering

Copper concentrates will flow by gravity from the flotation circuit to a copper concentrate thickener. Thickened copper concentrate will be filtered in three tower type copper concentrate pressure filters into filter cakes. The filter cakes will be discharged onto a conveyor belt that transfers them to a covered copper concentrate stockpile until shipment.

Copper concentrate from the concentrate stockpile will be moved by front-end loaders onto highway transport trucks. The loaded highway transport trucks will proceed to a wash station and will be cleaned before exiting the concentrate load out area. This procedure will ensure against tracking of copper concentrate from the facility.

Molybdenum Concentrate Dewatering

Molybdenum concentrates from the flotation circuit will flow by gravity to an agitated filter feed tank. Molybdenum concentrate slurries will be filtered in one tower type molybdenum concentrate pressure filter to create filter cakes. Filter cakes will travel through a dryer and discharge to the molybdenum concentrate storage bin.

Molybdenum concentrate will be withdrawn from the dried molybdenum concentrate storage bin by a packaging system and will be bagged in super-sacks for shipment by highway transport trucks.

Tailings Disposal

Both pyrite concentrate and tailings from the copper first cleaner flotation circuit will be collected in a pyrite thickener. Thickened pyrite concentrates will flow by gravity through a tailings pipeline to the TMF for subaqueous deposition.

Tailings from the pyrite scavenger flotation will flow by gravity to two tailings thickeners operated in parallel. Overflow solution from the tailings thickeners will be pumped to the process water pond for reuse in the mill. Thickened tailings will flow by gravity through a launder to the cyclone plant near the TMF. Thereafter, tailings will be transported via pipeline to the TMF.

4.4.6.2 Oxide Ore Processing

As described in Section 4.4.3.1, run-of-mine oxide ore will be hauled to the crusher and reduced in size to minus 200 mm using a primary gyratory crusher. The crushed oxide ore will be further reduced in size to minus 50 mm through screening and a secondary cone crusher. The crushed ore will be transferred by overland conveyors and a stacker to a heap leach pad according to the heap leach stacking schedule described in Table 4.3-12. A detailed description of the HLF development is presented in Section 4.3.8.4, including a description of the following features and their functions:

- Confining embankment;
- Pad liner system;
- Leachate collection system;
- Leak detection and recovery system (LDRS);
- Events pond;
- Freshwater supply pond; and

- Stormwater management system, including sediment control ponds and surface runoff diversions.

Layering and Leaching

Once an oxide ore layer is stacked on the heap leach, barren process solution will be applied to the stacked ore layer with drip emitters to minimize evaporation losses. When an ore layer has completed the primary leach cycle, the application of barren solution will be stopped and another ore layer will be placed on top of the previous one and the application of barren process solution resumes. The process of layering and leaching the ore will repeat for a maximum of eight ore lifts or layers on the leach pad. When the last process leach cycle is completed on the last ore layer, the ore heaps will be rinsed.

Pregnant solution will be discharged from the ore heaps and collected in a network of pipes that direct the pregnant solution to the in-heap collection area of the HLF. Pregnant solution will be pumped from the in-heap collection area to the gold recovery building by pumps and a single pipeline.

Gold and Silver Recovery

The pipeline from the in-heap collection area of the HLF will discharge the heap leach pregnant solution to the gold recovery building. Gold and silver will be recovered from the heap leach pregnant solution by adsorption of their ions on activated carbon followed by desorption and electrowinning of a gold and silver solid product. The process steps required to recover gold and silver by the carbon adsorption method include:

- Loading gold and silver heap leach pregnant solution on activated carbon in a carbon in column (CIC) circuit;
- Acid washing of the carbon to remove water scale and acid soluble copper;
- Cold stripping of carbon (elution) to remove copper;
- Stripping gold and silver from the carbon using a hot caustic solution;
- Electrowinning gold and silver from the stripping solution in a precious metal sludge using an electrolytic cell; and
- Reactivating stripped carbon by thermal regeneration and melting the precious metal sludge in a crucible furnace to produce doré bars.

Copper Recovery

Copper will be recovered from the heap leach pregnant solution by the SART process where the copper is precipitated by the addition of sulphide to produce a copper sulphide precipitate product. The process steps to recover copper sulphide precipitate product by the SART method include:

- Bleeding a portion of the pregnant solution to the SART process;
- Adding sodium hydro-sulphide to the solution;
- Decreasing the pH of the solution with acid, thereby precipitating copper;
- Removing the copper precipitate from the solution by thickening, filtration, and drying;
- Increasing the pH of the solution with lime, thereby precipitating gypsum;
- Removing the gypsum from the solution by thickening; and
- Shipping the filtered copper sulphide product to a smelter for refining.

Fresh Water Supply

During the operation phase, water requirements will be met by using the reclaim water from the TMF which will be collected in a process water pond located near the Plant Site, and supplemented by the Yukon River freshwater pipeline (Figure 4.1-5).

4.5 CLOSURE AND DECOMMISSIONING PHASE

4.5.1 Overview

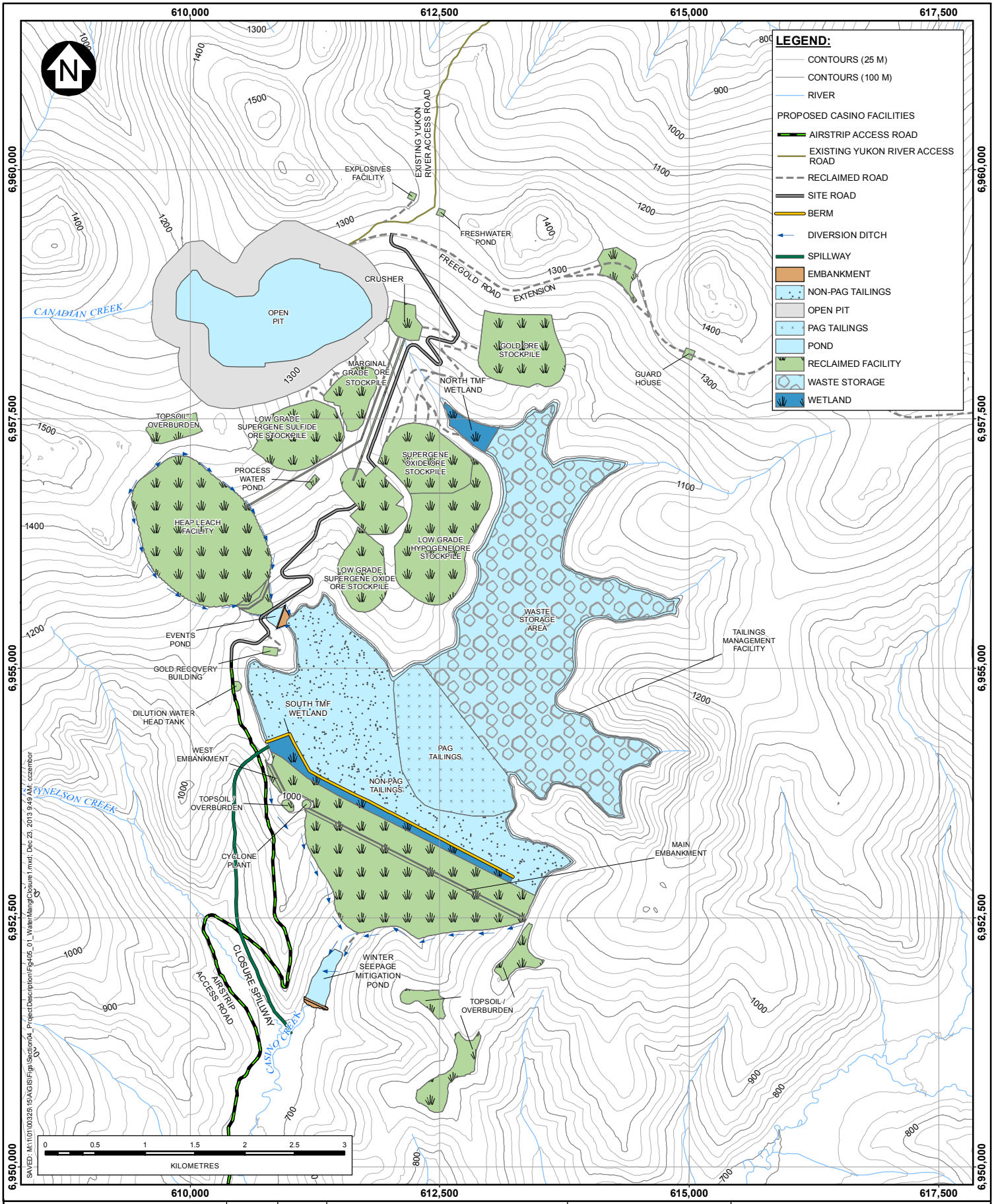
A conceptual closure and reclamation plan has been developed for the Project as part of the Proposal (Appendix 4B). The primary objectives for closure and decommissioning as outlined in this plan are to protect public health and safety, prevent or minimize adverse environmental impacts, reclaim the site to a land use state consistent with surrounding conditions, and ensure long-term physical and geochemical stability of all mine facilities. Additional key objectives include:

- Where practicable, undertake progressive reclamation;
- Address stakeholder, relevant Yukon Government departments, potentially affected First Nations, local communities and stakeholders priorities and concerns;
- Prevent the spread of invasive plant species;
- Re-establish wildlife habitat to a level comparable to baseline conditions;
- Where practicable, return altered water courses to their original alignment and cross-section; and
- Demonstrate that future risks and liabilities associated with the site have been eliminated or controlled to an acceptable level.

Further to these objectives, the closure strategy is to achieve long-term passive care, which is defined as regular or infrequent site presence for monitoring and maintenance, as necessary. There will be no requirement for year-round site presence, power, or chemical reagents for water treatment. Conceptual representations of the closure and decommissioning phase at the Casino mine site is provided on the Water Management at Closure Phases in Figure 4.5-1, Figure 4.5-2 and Figure 4.5-3.

The comprehensive closure and reclamation plan will be reviewed and revised regularly throughout operation to reflect operational changes, changes in reclamation procedures identified through on-going studies, and at least every five years (Yukon Government 2006). Prior to the start of the closure and decommissioning phase, a comprehensive closure and reclamation plan will be prepared for the Casino Project to meet all Yukon Government regulatory, licensing, and policy requirements. This plan will be developed in accordance with the Yukon Mine Site Reclamation and Closure Policy and involve the participation of relevant Yukon Government departments, potentially affected First Nations, local communities and stakeholders (Yukon Government 2006). The final closure plan will match the vision of the Policy, which is to ensure that reclamation is conducted "*in a manner that fosters sustainable development and a healthy environment*" (Yukon Government 2006).

Reclamation and closure activities have been selected based upon best practicable technology currently available to achieve the closure objectives. Future updates to the plan may incorporate new and improved technologies as they become technically and economically viable. The following sections summarize the key principals and activities proposed in the Conceptual Closure and Reclamation Plan.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

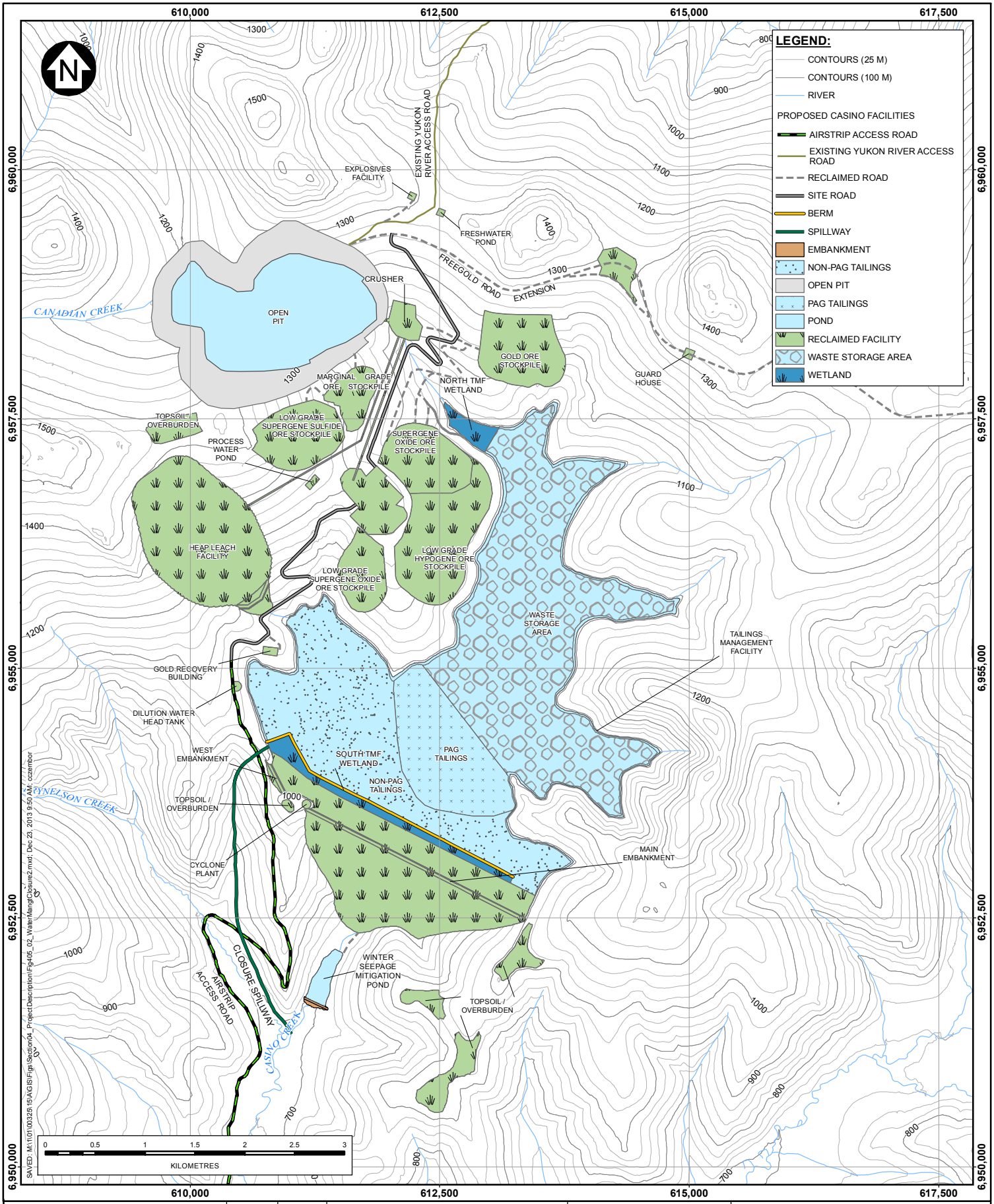
CASINO PROJECT

WATER MANAGEMENT AT CLOSURE PHASE 1

FIGURE 4.5-1

REF 1

P/A VA101-325/15



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DESIGNED	GLS/CAH
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NOTES:
1. BASE MAP: EAGLE MAPPING
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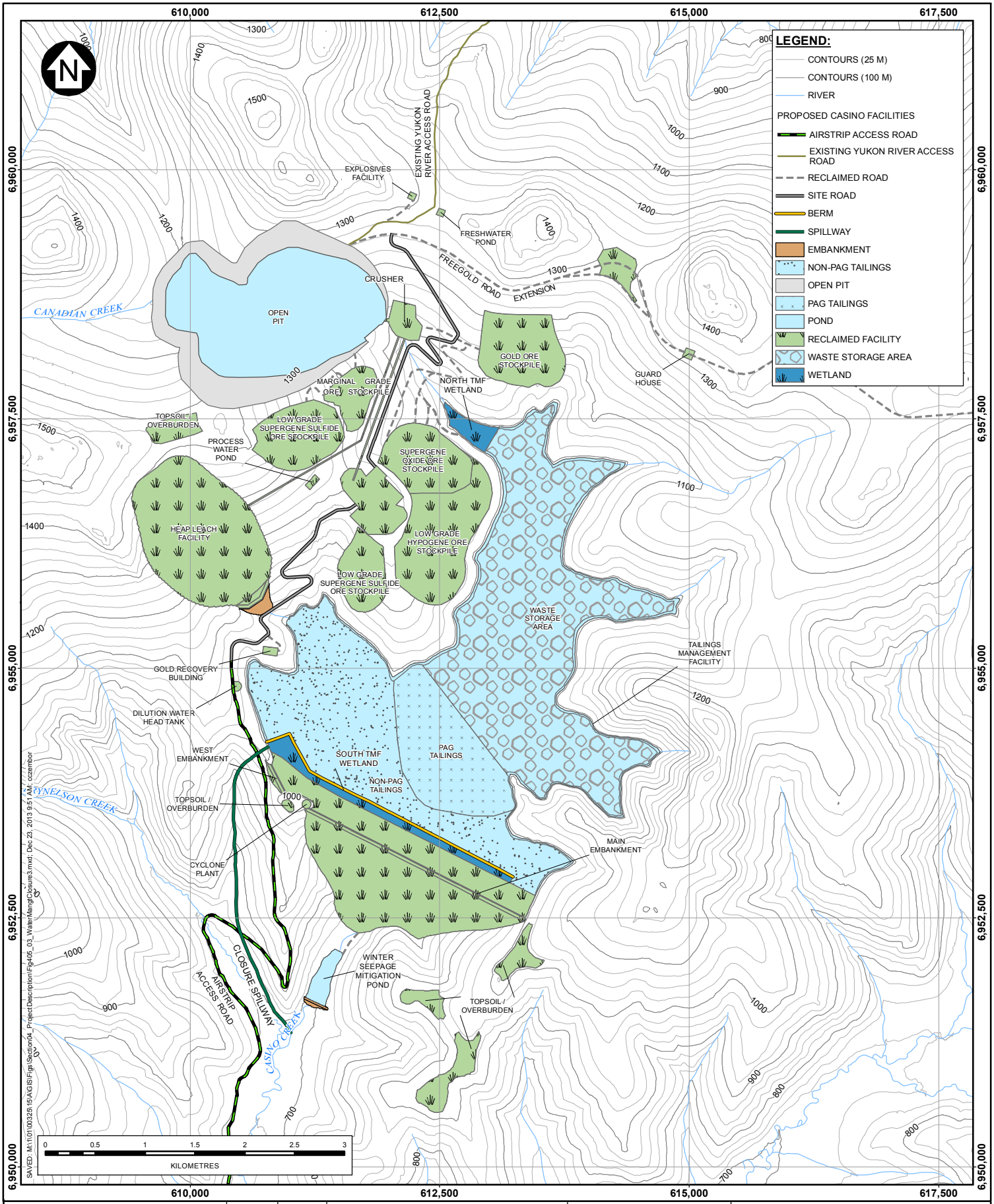
CASINO PROJECT

WATER MANAGEMENT AT CLOSURE PHASE 2

FIGURE 4.5-2

REF 1

P/A VA101-325/15



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DESIGNED	GLS/CAH
DRAWN	CC
CHK'D	CAH
APP'D	GLS
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: EAGLE MAPPING
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

WATER MANAGEMENT AT CLOSURE PHASE 3

FIGURE 4.5-3

REF 1

P/A VA101-325/15

4.5.1.1 Schedule

The Casino Project is expected to have a three year active closure and decommissioning phase, followed by a five year active post-closure monitoring phase, followed by a long-term passive post-closure monitoring. CMC intends to carry out progressive reclamation activities to the extent possible throughout the Casino Project life. In addition, CMC anticipates that closure and decommissioning activities can commence one year before the end of the operations phase.

4.5.1.2 Temporary Closure

Temporary closure measures will be initiated for both planned and unplanned closures lasting more than six months but less than five years. In accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government, 2008), in the event of a temporary closure:

- Facilities and equipment will remain on site and will be maintained in working order so that production may resume;
- All monitoring, reporting, and progressive reclamation activities will be maintained; and
- Any unanticipated risks of significant adverse effects resulting from the temporary closure not addressed in the approved reclamation and closure plan will be identified; the plan will be updated to reflect any potential adverse effects. Associated security to cover the liability associated with the temporary closure may be required.

Measures to prevent personal injury, property damage, and damage to the environment during temporary closure will be implemented, including but not limited to (Yukon Government 2008):

- Closure of all entrances and exits to prevent unauthorized access through surveillance or gating;
- Stabilization of all surface areas disturbed;
- Securing of all buildings, power transmission sources and other structures and facilities at the site;
- Securing of all machinery, equipment, and storage tanks at the site, including any storage tanks containing petroleum products, hazardous substances and chemicals; and
- Stabilization of the TMF, waste rock storage areas, heap leach piles, and landfill sites.

In addition to the generic required activities listed above, activities specific to temporary closure of the Project include:

- Open Pit dewatering will be stopped and water will be allowed to accumulate in the pit.
- Accumulation of water in the TMF will be monitored to ensure freeboard level is maintained at the dam. If necessary, surplus water will be pumped to the pit.
- TMF seepage return pumping will be maintained.
- HLF operations will continue with ongoing circulation of water onto the heap and processing of water in the recovery plant. Cyanide addition to the circulating water will be stopped. Surplus water will be processed in the Inco/SO2 plant for cyanide destruction and be pumped to the pit.
- Site power, security and personnel for the above activities will be maintained.
- The mill will remain heated, but tanks and piping will be drained to the TMF.

4.5.1.3 Early Closure

As described in the Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions (YESAB 2005), the closure plan must provide the same level of detail for early closure as is required for closure. To meet this objective, in the event of early closure the closure plan approach will be followed, as described within this document and in greater detail in Appendix 4A, along with the following early closure specific activities:

- Pit sump pumps will be turned off and water allowed to accumulate in the pit, all pit infrastructure will be removed, and the closure decant system will be installed;
- Canadian Creek will re-directed to the Open Pit;
- All LGO stockpiles will be processed as needed for TMF reclamation (minimum 1 m cover on all PAG rock) or relocated to the open pit for sub-aqueous disposal;
- A spillway invert elevation, consistent the requirements for dam freeboard, will be determined. Any PAG higher than 1 m below the invert elevation will be relocated to provide 1 m cover;
- Erosion protection will be placed on exposed sand areas of the dam;
- Water in the TMF will be pumped to the pit, followed by construction of the wetlands;
- The water retention pond for TMF seepage will be constructed;
- Heap operations will continue with ongoing circulation of water onto the heap and processing of water in the recovery plant. Cyanide addition to the circulating water will be stopped. Once gold recovery ceases, water will be processed in the Inco/SO2 plant for cyanide destruction and used to rinse the heap, drain-down water processed in the Inco/SO2 plant for cyanide destruction and through the bio-reactor for selenium removal and then pumped the pit; and
- All infrastructure will be removed as per the closure plan.

4.5.1.4 Reclamation Practices

The closure objective for the landscape of the mine site is to ensure that slopes, excavations, and other disturbed areas will be left in a physically stable condition that will promote establishment of self-sustaining native vegetation. Measures will be prescribed to limit the incidence of soil erosion and slumping that would impede re-vegetation, pose a threat to public safety, or lead to wildlife mortality; and prevent excessive sediment loads from entering nearby water bodies (Yukon Government 2008). This will be accomplished by:

- Benching, contouring and levelling;
- Placement of soil cover material containing adequate growth media (fines) to sustain re-vegetation;
- Prescribing a vegetative cover that is capable of self-regeneration without continued dependence on fertilizer or re-seeding; and
- Sediment management practices.

4.5.1.5 Workforce Requirements

Personnel requirements during the decommissioning and closure phase are a subset of the operations requirements. The expected duration of the closure phase is 3 years, during which time a small fraction of the

operation phase workforce will be retained to carry out closure and reclamation activities. Details of the size and composition of the closure and reclamation workforce will be developed during the operation phase, prior to the planned commencement of closure and reclamation activities.

4.5.1.6 Water Management

The closure objective for all water retention and sediment control structures will be to ensure that decommissioning is done in a manner that leaves drainage at and adjacent to the site stable in the long term, with minimal maintenance requirements (Yukon Government, 2008). Water management reclamation activities required by Yukon Government are described as follows (Yukon Government, 2008):

- Sediment traps, basins, silt fencing, spillways and dikes should be dismantled and materials disposed of in an approved non-hazardous solid waste dump or be removed from the site;
- Collection and diversion systems for passive treatment put into place or remaining at closure in order to recover contaminated percolation waters or runoff will be designed to require minimal maintenance;
- All engineered impoundment structures will be certified by a qualified professional engineer with respect to their long-term physical and chemical stability: any dams left in place will meet the provisions of the Canadian Dam Safety Guidelines;
- Mine dewatering ponds will be decommissioned, with sediments stabilized, pond dikes levelled and surfaces contoured and re-vegetated; and
- Water course diversions will be dismantled and either removed from the site, or disposed of on-site in an approved non-hazardous solid waste dump according to the Solid Waste Regulations in the *Environment Act.*

In addition to adhering to these guidelines, project specific closure water management activities are described as follows:

- A spillway will be constructed to facilitate discharge of the TMF pond to Casino Creek. The inlet of the spillway will be located near the West Embankment, and the spillway will discharge to Casino Creek upstream of Brynelson Creek;
- A seepage interception pond, referred to as the Winter Seepage Mitigation Pond (WSMP), will be constructed downstream of the TMF facility but upstream of the closure spillway discharge location. The WSMP will include an upstream cut-off wall keyed into bedrock, which will intercept all seepage from the dam and force it to surface where it will drain by gravity into the lined storage pond. Seepage will be stored in the pond during the low flow winter months of December through April, and will then be released via a gravity discharge pipe at a constant rate beginning in May after the onset of the spring freshet;
- A passive bioreactor will be constructed and used to mitigate elevated selenium and mercury levels in the HLF draindown water, prior to this water being pumped to the Open Pit (Project Years 24-28). The passive bioreactor will use a simple flow-through design, with a solid reactive mixture acting as a source of carbon for the bacteria and as a substrate for microbial attachment and metal sulfide precipitation. Other methods of reducing selenium and mercury in the HLF draindown water are available, such as consideration of selenium reduction by precipitation with sodium sulphide during the SART process (see Section 4.4.4.2 for more details regarding the SART process), or by adding treatment processes to the gold recovery circuit; however, for the purpose of conservatism in closure design and costing these other methods have not been considered at this time;

- Two engineered passive treatment wetlands will be constructed within the TMF to mitigate elevated levels of copper, cadmium, molybdenum, sulphate and uranium in water leaving the Open Pit, prior to discharge to the TMF pond, and in water leaving the TMF pond, prior to discharge to Casino Creek. The wetlands have been sized to treat the listed parameters to CCME Aquatic Life Guidelines prior to leaving the wetlands; and
- Water from the TMF pond will be pumped to the Open Pit for 5 years following operations. This will facilitate improvement of TMF pond water quality, as well as allow for the construction of the wetlands. Pumping of TMF seepage back to the TMF pond will also continue until the TMF pond begins discharging to Casino Creek approximately 9 years after operations.

4.5.1.7 Waste Management

All non-hazardous waste materials will be decommissioned according to the Solid Waste Regulations of the *Environment Act* and disposed of in an approved non-hazardous solid waste dump located at the uphill side of the HLF. Once landfilling is complete, waste will be buried beneath leached heap rock and covered by 0.5 m of topsoil.

No hazardous materials will remain on site unless an approved special waste site has been established and approved in accordance with the Special Waste Regulations of the *Environment Act* (Yukon Government 2008).

4.5.1.8 Fuel, Hazardous Materials, and Explosives Management

All fuel, hazardous materials and explosive will be safely shipped for off-site disposal. The comprehensive closure and reclamation plan will include objectives for soil, topsoil, and any equipment that remains onsite in the event of possible contamination, with the primary objective to prevent exposure to and mobilization of hazardous substances. In accordance with the Mine Site and Reclamation Closure Policy Technical Guidelines, a site investigation program will be conducted if contamination is suspected, to identify any contaminated material on the mine site arising from any operation, transportation, storage, handling, or processing. If contaminated materials are present, a site contamination assessment plan will characterize the type, level and horizontal and vertical extent of the contamination, and propose methods to deal with it (Yukon Government, 2008). If a site is a contaminated site, requirements of the Contaminated Sites Regulation and Special Waste Regulation of the *Environment Act*, and Occupational Health and Safety Regulations of the *Occupational Health and Safety Act* must be met (Yukon Government, 2008).

4.5.1.9 Access and Transportation Management

CMC will engage in discussions with the Yukon Government to determine the closure and decommissioning objectives for the Freegold Road Extension. CMC is committed to undertaking activities to decommission the Freegold Road Extension, if required, to ensure that future vehicular access to the mine site will not be possible. The decommissioning objectives will be to stabilize the road, restore natural drainage patterns, and reduce the risk of landslides. It is anticipated that the following activities will be conducted during decommissioning and closure of the Freegold Road Extension:

- Stream crossings will be carefully deactivated, and the stream channels will be restored to their natural dimensions and gradient;
- Cross-culverts will be removed and replaced with cross-ditches to facilitate drainage across the road corridor;

- The road surface will be scarified to a condition conducent to re-vegetation; and
- Slopes may be regarded in areas of steeper terrain to improve long-term slope stability.

4.5.2 Closure Objectives for Principal Project Components and Activities

4.5.2.1 Open Pit

The open pit will be allowed to naturally flood to create a pit lake. Prior to filling, the Marginal Low Grade Ore stockpile will be back-hauled to the Open Pit. For the purpose of ensuring conservatism in closure security, it has also been assumed that 5% of the stockpiled low-grade ore is also back-hauled to the pit rather than being processed through the mill. Following back-hauling, all water diversions will be removed. It is estimated that the open pit will take 95 years to passively fill with water from natural sources such as seepage, direct precipitation, and surface runoff, in combination with the water pumped to the Open Pit from the TMF pond and HLF during closure of these facilities. Once the open pit fills to the point of overflow, pit drainage will be controlled by a gravity decant system, which will store water during the winter months and release water during the biologically active summer months of June through September. Pit lake outflow will discharge to the North TMF wetland for passive treatment prior to discharge to the TMF pond..

4.5.2.2 Heap Leach Facility

The closure objective for the HLF will be to ensure the long-term physical and chemical stability of the decommissioned heap leach pile. The closure design will consider the consequence of failure, including the probable maximum site seismic event. Long-term stability of the HLF will be ensured by its design, which will include bench lift heights of approximately 8 m which will be constructed at repose bench face angles of 1.4H:1V. Benches approximately 9 m wide will be left at the toe of each lift to establish a final overall slope angle of approximately 2.5H:1V

Activities that will be completed during reclamation and closure of the HLF are listed as follows:

- Rinsing and drain-down of the heap and cyanide destruction (for further discussion, see Section 4.7.2);
- Treatment of drain-down water in a bioreactor (for further discussion see Section 4.5.1.4);
- Removal of the geosynthetic liners from the overflow spill way and the Events Pond, once it is determined that they are no longer needed;
- Decommissioning of the pregnant solution recovery system;
- Removal of pregnant solution, diversion ditches, Events Pond pumps and pipeworks; and
- Placement of an engineered cover that will reduce infiltration to the spent heap to 20% of mean annual net precipitation. The cover will include re-grading of the HLF surface to remove all flat surfaces and achieve slopes between 10:1 and 5:1, followed by placement of a 0.75 m cover comprised of low permeability material. The final heap slopes will then be vegetated to provide adequate erosion protection from surface runoff.

Drainage from the heap or from passive treatment will meet surface and ground water quality objectives, as well as any applicable territorial and federal legislation, including:

- *Waters Act* respecting the deposit of waste into water or into other places where the waste may enter water that may reach surface water;

- *Fisheries Act* requirements with respect to the deposit of deleterious substances; and
- *Environment Act* if the site is a contaminated site.

Monitoring of physical stability and hydrological functions will be conducted until the site is closed out.

4.5.2.3 Tailings Management Facility

The principal objectives of the Feasibility design for the TMF is to ensure protection of the regional groundwater and surface waters both during operations and post-closure, and to achieve effective reclamation at mine closure (Knight Piésold Ltd. 2012b). The TMF will be required to maintain long-term stability, protect the downstream environment, and manage surface water (Knight Piésold Ltd. 2012b). The mine site will be in a water deficit condition over the operating life of the TMF except for the last one to two years (during processing of low grade ore) and in a water surplus condition at closure. A spillway will be required at closure to facilitate control and discharge of excess water accumulated within the TMF and to provide long-term protection against overtopping of the embankment during post-closure. The closure spillway inlet will be located close to the right abutment of the West Embankment.

All impoundment structures will be certified by a qualified professional engineer; the design criteria will meet the provisions of the Dam Safety Committee Guidelines (Canadian Dam Association 2007) and the Guide to the Management of Tailings Facilities (Mining Association of Canada 1998). Tailings facility surveillance and monitoring plans will be provided for the post-closure phase; the plans will include identification of failure modes, event-driven interventions, contingency plans, and emergency response plans and activation criteria (Yukon Government 2008). For any drainage from the tailings, especially when there is potential for acid rock drainage or metal leaching, the closure objective is to have a “walk-away if possible, or a passive care solution”, that is, one that does not require long-term active treatment, to meet surface and ground water quality objectives (Yukon Government 2008). Following decommissioning, drainage from the site or from passive treatment will meet the requirements of applicable territorial and federal legislation, including:

- *Waters Act* respecting the deposit of waste into water or into other places where the waste may enter water that may reach surface water;
- *Fisheries Act* requirements with respect to the deposit of deleterious substances; and
- *Environment Act* if the site is a contaminated site.

Activities associated with closure of the TMF are designed to meet the objectives listed above, and will include:

- Selective discharge of tailings around the facility during the final years of operations to establish a tailings surface and water pond that will facilitate post closure surface water management and reclamation (including full coverage by the water pond to ensure all reactive tailings and waste rock remain fully saturated);
- Construction of a closure spillway to facilitate discharge of the TMF pond to Casino Creek. The spillway will be designed to pass 24-hr PMF event, and will terminate at an erosion protected plunge-pool in Casino Creek upstream of Brynelson Creek;
- Construction of the TMF wetlands and the WSMP, and pumping of the TMF pond to the Open Pit, as discussed previously in Section 4.5.1.4.;
- Dismantling and removal of the tailings and reclaim delivery systems, cyclone plant, pipeworks, pump stations, and surface structures;

- Removal of the seepage collection and pump-back system once the TMF pond begins discharging; and
- Decommissioning and reclamation of all non-essential access roads and diversion ditches.

4.5.2.4 Waste Rock Storage

The majority of waste material will be comprised of Potentially Acid Generating (PAG) and Metal Leaching (ML) materials, which will be placed and stored subaqueously in the waste storage area located within the TMF (Knight Piésold Ltd. 2012c.) Tailings and PAG waste rock and overburden materials will be deposited in the TMF concurrently over the mine life. Any non-Potentially Acid Generating (non-PAG) waste rock which is produced during pre-production mining will be used in the construction of the TMF Starter embankment.

Closure objectives for the waste rock storage areas will be to ensure long-term physical and chemical stability and prevent erosion, subsidence, or collapse (Yukon Government 2008).

PAG waste rock will be fully contained and submerged within the final TMF at closure. No closure activities will be required on the PAG WSA to ensure long-term geotechnical stability and integrity. The final configuration of the TMF and WSA will provide a tailings layer approximately 3 m thick over the surface of the WSA (assuming a horizontal tailings surface), plus a permanent water cover above the tailings layer.

4.5.2.5 Processing Facilities

The closure objective for the processing facilities will be to protect human safety and prevent wildlife mortality. All buildings and structures will be dismantled and disposed of in accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government 2008). Closure activities will include (Yukon Government 2008):

- All machinery, equipment, and storage tanks will be cleaned and removed from the site or disposed of on site in an approved manner;
- Fuel storage tanks will be decommissioned and removed in accordance with the Storage Tank Regulations of the Environment Act;
- All hazardous materials and wastes will be removed for off-site disposal at an approved facility;
- All non-hazardous waste materials will be decommissioned according to the Solid Waste Regulations of the Environment Act and disposed of in an approved non-hazardous solid waste dump (a location will be determined);
- All concrete structures, foundations, and slabs will be removed or covered in place, levelled to surface, and re-vegetated;
- Power supply will be disconnected in accordance with the Occupational Health and Safety Regulations of the Occupational Health and Safety Act; all transmission lines will be dismantled and removed from the site or otherwise disposed of;
- Buried support infrastructures (tanks, pipes, etc.) will be removed from the site or disposed of on site in an approved manner; any buried infrastructure that must remain will be identified on site closure maps submitted to the Yukon government; and
- Septic tanks will be emptied and either removed from site or filled with gravel, sand, earth or inert material.

No hazardous materials will remain on site unless an approved special waste site has been established and approved in accordance with the Special Waste Regulations of the Environment Act (Yukon Government 2008). All disturbed areas will be covered with topsoil as needed and re-vegetated.

4.5.3 Closure Objectives for Related Components and Activities

4.5.3.1 Accommodations

The residential camp which was operational as staff residence throughout the mine life will remain active during staffed closing operations. The camp will be dismantled and removed upon completion of mine closure staffing requirements.

The closure objective for buildings and structures will be to protect human safety and prevent wildlife mortality. All buildings and structures will be dismantled and disposed of in accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government 2008). Closure activities will include (Yukon Government 2008):

- All non-hazardous waste materials will be decommissioned according to the Solid Waste Regulations of the Environment Act and disposed of in an approved non-hazardous solid waste dump;
- All concrete structures, foundations, and slabs will be removed, levelled to surface, and re-vegetated;
- Power supply will be disconnected in accordance with the Occupational Health and Safety Regulations of the Occupational Health and Safety Act;
- Buried support infrastructures (tanks, pipes, etc.) will be removed from the site or disposed of on site in an approved manner; any buried infrastructure that must remain will be identified on site closure maps submitted to the Yukon government; and
- Septic tanks will be emptied and either removed from site or filled with gravel, sand, earth or inert material.

4.5.3.2 Power Plants

The reclamation and closure objective for the power plant will be to protect human safety and prevent wildlife mortality. All buildings and structures associated with the power plant will be dismantled and disposed of in accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government 2008). Closure activities will include (Yukon Government, 2008):

- All machinery, equipment, and storage tanks (internal combustion engines, dual fuel driven generators, gas turbine driven generators, steam generator) will be cleaned and removed from the site or disposed of on site in an approved manner;
- LNG storage tanks will be decommissioned and removed in accordance with the Storage Tank Regulations of the Environment Act;
- All non-hazardous waste materials will be decommissioned according to the Solid Waste Regulations of the Environment Act and disposed of in an approved non-hazardous solid waste dump;
- All concrete structures, foundations, and slabs will be removed, levelled to surface, and re-vegetated;
- Power supply will be disconnected in accordance with the Occupational Health and Safety Regulations of the Occupational Health and Safety Act; all transmission lines will be dismantled and removed from the site or otherwise disposed of; and
- Buried support infrastructures (tanks, pipes, etc.) will be removed from the site or disposed of on site in an approved manner; any buried infrastructure that must remain will be identified on site closure maps submitted to the Yukon Government.

No hazardous materials will remain on site unless a special waste site has been established and approved in accordance with the Special Waste Regulations of the Environment Act (Yukon Government 2008).

4.5.3.3 Fuel Storage and Distribution Facilities

The closure objective for the fuel storage and distribution facilities will be to protect human safety and prevent wildlife mortality. All buildings and equipment will be dismantled and disposed of in accordance with the Yukon Mine Site and Reclamation Closure Policy (Yukon Government 2008). Closure activities will include the objectives listed in Section 4.5.2.5 (Yukon Government 2008). No hazardous materials will remain on site unless a special waste site has been established and approved in accordance with the Special Waste Regulations of the Environment Act (Yukon Government 2008).

4.5.3.4 Explosives Storage Facility

All explosives and hazardous substances will be removed from the site or disposed of in accordance with the requirements of the Occupational Health and Safety Regulations of the Occupational Health and Safety Act.

4.5.4 Closure Objectives for Accessory Activities

4.5.4.1 Freegold Road Extension

The decommissioning objective for the Freegold Road Extension will be to “enable human and wildlife utilization in the area to revert to pre-development levels and types” in accordance with the Mine Site and Reclamation Closure Policy (Yukon Government 2008). All on-site roads, trails, and access corridors will be decommissioned unless the Minister responsible under the Highways Act provides written notification of a public interest in maintaining the road for public use (Yukon Government 2008). Decommissioning measures will include, as applicable:

- Removal of bridges, culverts, ramps, and landings;
- Stabilization of road cuts and fills;
- Installation of diversion berms on steep slopes;
- Scarification of road surfaces; and
- Re-establishment of streambeds and stabilization of banks.

Any borrow sites associated with construction of the access road will be progressively reclaimed to ensure that they present no significant hazard to people and wildlife, either through backfilling or through embankments and ditching.

4.5.4.2 Casino Airstrip

The airstrip and airstrip access road will be left in place at closure, assuming transfer of authority/liability to an appropriate party is possible, as it replaced an existing seasonal facility. Otherwise the airstrip will be decommissioned and the area re-vegetated, and the access road will be closed as per the measures outline in Section 4.5.4.1. Any fuel storage components will be addressed as per Section 4.5.3.3.

4.6 POST-CLOSURE MONITORING AND INSPECTION PROGRAMS

Monitoring and follow-up inspections will be conducted to assess the physical and chemical stability of various components after closure and reclamation of the facilities. Post closure monitoring will be conducted to ensure seepage and discharges remain compliant with water quality objectives or guidelines and protect the downstream receiving environment. Structures, such as the TMF embankment, will be monitored to ensure that they are stable

and performing as designed. Disturbed areas will be monitored for: physical and geochemical stability, cover infiltration/erosion, and re-vegetation success.

The closure strategy for the Casino Mine is to minimize the requirements for post-closure activities to the extent which is practical. No long-term active care is expected for the site; however, long-term passive care is expected (Appendix 4A). Passive care will likely consist of:

- Operation of valves to all gravity releases of water from the Open Pit, Winter Seepage Mitigation Pond, and if necessary the HLF and TMF. It is envisioned that the operation of the valves and control of flows could be done remotely, without any need for site presence;
- Periodic inspection and maintenance of:
  - Wetlands
  - TMF dam and spillway
  - Seepage mitigation pond dam and liner system; and
- A program of water quality monitoring at mine sources and in the receiving environment. This will include on-site and receiving environment water quality, metal accumulation in wetlands and plants, and other required activities as specified in the approved environmental management plans.

A final post-closure monitoring program will be compliant with the applicable guidelines and regulations will be implemented to ensure the reclamation measures remain effective and continue to provide a high level of protection for the public and the environment.

4.7 TECHNOLOGIES

This section of the Proposal for the Casino Project provides information on the degree to which the technologies being proposed as part of the Casino Project are proven to be viable in northern environments.

4.7.1 Heap Leach Technology

The Casino Project will utilize heap leach technology to process oxide ore to recover gold, silver and copper. Detailed information describing the operation of the HLF is provided in Section 4.4.4 of the Proposal.

Heap leaching is a proven technology for extracting metals from ore and the process is used all over the world in different environments (EBA 2011). In northern environments, colder temperatures and snowfall can present specific challenges that must be taken into consideration in the design and operations of a heap leach facility.

The mean annual temperature for the Casino Project area is calculated to be -3 °C, with mean minimum and mean maximum monthly temperatures of -17 °C and 12 °C occurring in January and July, respectively (Knight Piésold Ltd. 2010a). Extreme temperature events however are expected to produce temperatures significantly colder (Knight Piésold Ltd. 2012c). Based on the estimated rain/snow ratio of 0.65/0.35 for the Casino Project area, the annual snowfall is estimated to be 179 mm.

To enable year-round operation of the HLF, the Casino Project area winter conditions (cold temperatures and snowfall) and associated potential challenges have been taken into consideration as part of the design of the heap leaching process. Table 4.7-1 presents a summary of the common challenges for heap leaching technology for a northern environment and the Casino Project responses.

Table 4.7-1 Heap Leach Cold Climate Considerations

Consideration	Casino Project Response
Challenges of leaching during winter include reduced leaching efficiency due to slowed reaction rate as temperature approaches freezing.	Active leaching occurs 365 days/year for the Casino Project during the operation of the HLF. To achieve this, winter operations for the HLF will be modified during extreme cold events to include 'ripping' of the frozen ore stacks to promote improved infiltration through the ore bed.
Reduced leaching efficiency due to increased viscosity; slow solution movement due to decreased temperatures.	During periods with cooler temperatures more solution may be used to overcome the increased viscosity of the solution.
Cold temperatures can freeze leaching solution.	Leachate solution lines will be winterized and may include heat tracing and insulation.
Cold temperatures can freeze leachate collection in free-surface ponds.	All leachate collection will be conducted within the heap leach pad behind the confining embankment within the ore voids rather than in the external free-surface pond. The operational in-heap capacity has been increased to provide additional storage capacity and thermal inertia.
Cold temperatures can freeze the events ponds and cause ice damage to pond liners.	The Events Pond is designed as a dry-pond to ensure that freezing and associated ice-damage to the pond liner does not occur.
Heavy snowfall and reduced day light hours are anticipated during winter months and may cause poor visibility for ore stacking.	Seasonal ore stacking is planned at the Casino mine site where ore stacking is conducted 300 days/year. Seasonal stacking of the ore reduces the risks and challenges of stacking during winter when heavy snowfall and reduced day light hours are anticipated.

Heap leach technology has demonstrated to be viable in climates similar to those of the Casino Project area. For example, the Brewery Creek Mine successfully employed a heap leach facility in the Yukon in the late 1990s and is a good example of a viable northern heap leach operation that has undergone reclamation (EBA 2011). The case study of the Brewery Creek Mine conducted by EBA for the Yukon Government in 2011 concluded that the operational experience at the Brewery Creek Mine demonstrated that the heap leach "freeze-up" scenario is less likely for potential future operations in the Yukon under similar climatic conditions (EBA 2011). As well, the report concluded that smaller overflow pond sizes can be taken into consideration as long as the best operational practices are used to prevent the heap leach "freeze-up". Aside from the Brewery Creek Mine, other mines that have operated heap leach facilities successfully in extreme cold or high-elevation climates include the Fort Knox Mine in Alaska, USA and the Zortman Landusky Mine in Montana, USA.

4.7.2 Heap Leach Reclamation Technology

After operation of the HLF ceases, destruction of residual cyanide that remains in the heap leach either in solution, or attached to the ore surface will be required. The Casino Project will utilize a SO_2/Air cyanide destruction process for the detoxification of the heap leachate solution. The cyanide destruction plant (CDP) will be in-place during the construction phase of the Project so that it can be used in response to an emergency shutdown and/or storm event which may result in a requirement to discharge excess water from the HLF to the TMF. The CDP will be also be utilized during the closure rinsing and drain down processes following the end of the supplemental recovery phase of the facility operation.

During the closure rinsing phase of the HLF, leachate solution will be routed through the SO_2/Air process for cyanide destruction, and the detoxified solution will be recirculated back onto the HLF to continue the rinsing

process. Through a combination of cyanide destruction and dilution with incident precipitation and fresh make-up water, the cyanide concentration of the solution will gradually reduce until it meets the site specific water quality objective that has been established based on dilution and the environmental sensitivity of the receiving water body. When the leachate solution meets the site specific water quality objective, rinsing of the heap leach facility will cease and the heap will be allowed to drain down by gradually reducing the rate of recirculation of water onto the heap. Once the drain down quality and quantity reach acceptable levels the heap will be considered detoxified and the CDP will be decommissioned. It is anticipated that the rinsing (approximately 5 years) and drain down process (approximately 5 years) for the Casino Project will take a total of 10 years to complete. The actual duration of treatment will be a function of a number of factors including heap water volume, plant efficiency and cyanide solubility and will be determined based on water quality monitoring results.

4.7.3 TMF Operations

Freezing is a vital consideration for the functionality of the TMF during the operation of the Casino Project. Numerous mines have operated or currently operate tailings facilities under severe winter (freezing) conditions. In many instances a frozen layer forms over the TMF supernatant pond, which is maintained and operated under the ice. The Casino Project TMF has been designed to ensure that it has the ability to remain operational beneath ice under winter freezing conditions. Design and operating considerations, developed from mine operating experiences under freezing conditions, which have been considered in the design of the Casino Project are summarized in Table 4.7-2.

Table 4.7-2 TMF Cold Climate Considerations

Consideration	Casino Project Response
Freezing of the TMF pond during winter.	The tailings impoundment surface will be shaped during the summer months in order to provide a winter pond that can be maintained "localized" in one or more specific areas of the TMF.
Freezing of tailings discharge stream may occur and form sheet tailings over the ice.	Discharge waste and tailings in the winter will be from a single, non-mobile point under the ice cover to form a channelized flow beneath the ice. This prevents sheet tailings flow over the ice. Further, the low surface area to volume ratio created by single point discharge is an effective method in extremely cold environments where freezing of smaller discharge streams may occur. The discharge of tailings during the winter will begin at a location removed from the source/pond/recovery site and retreats step-wise towards it as the winter progresses.
Ice and pore water loss during winter.	A good water-to-ice balance will be maintained, involving the assurance of adequate water in the TMF prior to freezing to provide all anticipated ice and pore water losses during winter.
The potential for dusting can be exacerbated during cold winter conditions as a 'freeze drying' process tends to destroy capillary tensions in partially saturated sand materials, making it more susceptible to dusting.	Extra provisions to prevent the potential for exacerbated dusting of cyclone sand fill are undertaken such as capping with erosion resistant material. This may mean that the cyclone sand will need capping with erosion resistant fill material, particularly during the cold winter months, when it may be impractical to continue with active sand placement.

4.7.4 TMF Reclamation Technology

The Mining and Petroleum Environment Research Group (MPERG) of the Yukon Government published a report in 2010 evaluating the effectiveness of biological treatment options for mine waters, focusing on northern

environments (MPERG 2010). The objective of the report was to determine the effectiveness and applicability of passive treatment (or biological treatment) systems through literature review and engagement with practitioners and experts. Biological treatment systems use sulphate-reducing bacteria to reduce sulphate to insoluble metal sulphides and produce bicarbonate in the presence of an organic carbon nutrient source (MPERG 2010). Key issues discussed in the synopsis are the efficacy of the technology in cold climates, its dependability, environmental sustainability, and cost-effectiveness (MPERG 2010). Biological treatment systems can be active or passive, the classification of which depends on the degree of intervention required to maintain the system, and the amount of control that can be achieved (MPERG 2010). A passive system is one that does not require continuous mechanical-chemical input; however, even the simplest system will require some degree of intervention (MPERG 2010).

A research program investigating the use of wetlands as a passive treatment system was initiated near the United Keno Hill Mine in central Yukon in 1995 (MPERG 2000). Initial results showed that wetland treatment of mine drainage reduced concentrations of zinc, cadmium, manganese, and nickel, indicating that passive wetland biological treatment is viable (MPERG 2000). Wetlands have been used in northern Saskatchewan to treat uranium mining waste, in Alaska to treat military waste, and in the Northwest Territories to treat wastewater (Contango Strategies Ltd. et al, 2012). Other reported uses of natural and constructed wetlands for treatment of mine drainage include the Bell Copper Mine, near Babine Lake, B.C.; the Birchtree Mine in Manitoba; and the Key Lake Mine in Saskatchewan (Contango Strategies Ltd. 2012).

The MPERG (2010) review evaluating the effectiveness of biological treatment technology for treatment of mine discharge concluded that biological treatment systems can be effectively applied in the Yukon, and can overcome issues related to cold climates, are cost-effective, are long-term solutions, and can meet stringent discharge criteria.

4.7.5 Cyclone Plant

Numerous large cyclone sand embankments are utilized at mining operations in many regions of the world, including Anglo American's Los Bronces mine, Southern Peru Copper's Quebrada Honda mine, Highland Valley Mine and Gibraltar in British Columbia, and the Los Quillayes tailings impoundment operated by Minera Los Pelambres in Chile. Several large cyclone sand dams have been constructed to dam heights in the range of approximately 150 m to more than 200 m and are often located in seismically active areas.

There is ample precedent in North America for tailings dam construction using cyclone sand. There is the potential for cold winter conditions to reduce the construction period for cyclone sand placement, partly due to the potential for freezing and ice entrainment in the sand fill and partly because of snow drifting into sand cells. The Casino Project has allowed for this possibility by proposing developing the Stage 1A Starter Embankment using a combination of suitable non-PAG earth and rock fill borrow materials, thereby avoiding full dependence on cyclone sand. Examples of mine operations in British Columbia, where cyclone sand is used to construct the tailings dams include the Kemess, Gibraltar, and Highland Valley mines. To accommodate cold operating conditions in the winter months, the construction season at Gibraltar is typically from March to October. Longer cycloning operations for sand fill construction have been possible at the Kemess mine, with operations possible at temperatures as low as -25°C. The mean minimum monthly temperature recorded at the Casino Project is -17 °C occurring in January. Dam construction typically occurs 6 to 10 months of the year at the Highland Valley Mine.

The design of the Casino Project accounted for the Project area's site conditions and climate:

- Weather conditions, stringent sand quality and sand yield specifications necessitated the use of a central cyclone station instead of mobile cyclone rigs on the crest;

- Slurry pipelines will be drained for shutdowns longer than two hours to prevent freezing;
- The cyclone plant and cyclone sand placement activities are assumed to be operational for an average 9 months of the year (with a 90% sand plant availability to account for maintenance and other downtime); during the winter months, tailings bypass the cyclone plant and are deposited directly into TMF through the cyclone overflow pipeline; and
- The Stage IA Starter Embankment for the TMF will be developed using a combination of suitable non-reactive earth and rock fill borrow materials and cyclone sand.

4.8 ALTERNATIVES AND CHOSEN APPROACH

4.8.1 Overview

This section of the Proposal describes the assessment of alternatives to and alternative means of carrying out the Project. YESAB guidance to proponents defines alternatives to the project as "functionally different ways to meet the project need and achieve the project purpose" and alternative means to the project as the "various technically and economically feasible ways that the project could be implemented or carried out" (YESAB 2005).

The following key requirements of the alternatives assessment are described in detail in the following subsections:

- A description of the methodology used for the evaluating the alternatives and for selecting the preferred alternative, including the selection criteria to identify economic, environmental, socio-economic (including cultural heritage concerns), and technical, costs and benefits;
- A comparison of identified alternatives to the Project, including the basis for selection of the preferred alternative and exclusion of less preferable alternatives; and
- A comparison of alternative means of carrying out the Project, including the basis for selection of the preferred alternative means and exclusion of less preferable alternative means.

The Project described in the Proposal is the preferred means of achieving the goals and objectives of the Project in terms of minimizing adverse environmental effects, socio-economic effects and technical engineering challenges, while maximizing potential economic benefits. Alternatives to the Project and alternative means of carrying out the Project have been considered throughout the Project planning phase under the guidance of Project engineers, the Yukon Government and regulatory agencies, First Nations and the public. The selection of the preferred Project design and activities was not based solely on engineering and/or economic determinants, but considered a multitude of determinants required to promote sustainable development, operation, closure and reclamation of the Project.

4.8.2 Comparison and Selection of Preferred Alternatives

The approach used to conduct the alternatives assessment was to evaluate alternatives by a reasoned process based on comparison of anticipated costs and benefits of each alternative. The costs and benefits of each alternative were evaluated according to established selection criteria, which are attributes considered essential for Project success. Comparisons of the costs and benefits of each selection criterion are presented to rationalize the preferred alternative as well as provide any reasons for excluding particular alternatives.

The selection criteria provided a basis for distinguishing between alternatives include considerations of technical feasibility, economic viability, environmental acceptability and socio-economic acceptability. Definitions for each

selection criterion and potential factors are outlined in Table 4.8-1 along with qualitative rankings (Preferred, Acceptable, or Unacceptable). Potential factors included considerations of engineering and construction and operations costs, biophysical effects, land use, and socio-economic or cultural heritage concerns. The costs and benefits of the alternatives considered both the short term effects of each alternative through construction and operations phases, as well as the long term effects during decommissioning and closure, and post-closure phases.

In this reasoned evaluation process, all selection criteria were considered essential for the success of the Project and needed to meet a minimum ranking of Acceptable; an alternative was rejected if it attained an Unacceptable ranking for any single criterion. The alternative that received the greatest number of preferred ratings was not necessarily the preferred alternative. The relative importance of each selection criterion was also considered. It may be that one or two selection criteria were considered to be more important for any given alternative and overrode all other criteria, so long as a minimum rating of Acceptable was attained for the less important criteria.

Table 4.8-1 Selection Criteria for Alternatives Assessment

Selection Criteria	Examples of Factors Considered	Rankings		
		Preferred	Acceptable	Unacceptable
Technical Feasibility Considers applicability, system integrity and reliability as appropriate to the issue, to describe the suitability or expected technical performance of a given alternative	• Availability of construction material and volume requirements (e.g., borrow material) • Potential for increased capacity (e.g., likelihood of additional future development) • Transportation (e.g., from the mine site to the TMF) • Flexibility with regard to technical, operational and environmental uncertainties (e.g., unforeseen geotechnical conditions may require design modifications) • Proposed technologies and the advantages and disadvantages of the technologies considered, (e.g., proven technology used elsewhere or new) • Previous applications on similar projects • Post-closure risks and uncertainties (e.g., requirements for perpetual treatment or maintenance)	Predictably effective with contingencies if the alternative does not perform as expected	Appears effective based on modelling/ theoretical results; contingencies are available if the alternative fails to perform as expected	Effectiveness appears dubious or relies on unproven technologies
Economic Viability Explores if the Project is able to sustain operation on the basis of current and projected revenues versus current and planned expenditures.	• Capital, Operational, Decommissioning and Closure and Post-closure costs (e.g., treatment, fish habitat compensation and monitoring costs, bonding) • Economic risks and benefits • Regulatory review and construction timeline costs	Facilitates a competitive return on investment	Facilitates an acceptable return on investment	Cannot be financially supported by the Project
Environmental Acceptability Considers the overall environmental effects of the Project, ability to mitigate effects and amenability to reclamation.	• Overall affected land footprint size of (e.g., containment dams and access road) • Issues related to water quality, atmospheric, hydrology, hydrogeological • Considerations related to climate change adaptation (e.g., changes in water management or stability of foundations in permafrost) • Effects to valued components (e.g., fish and their habitats, aquatic/terrestrial plants and animal species and their habitat, species at risk and their habitats) • Amenability to reclamation (e.g., probability of achieving long-term reclamation goals)	Minimizes adverse effects on the environment without mitigation	Minimizes adverse effects on the environment with mitigation	Likely to cause substantial or irreversible adverse effects on the environment that cannot reasonably be mitigated
Socio-economic Acceptability Evaluates if the	• Overall perceived consequences, benefits and relative preferences from community members, First Nations, Yukon Government (e.g. contracting opportunities, building community capacity)	Minimizes negative effects on the	Minimizes negative effects on the	Likely to cause substantial negative socio-

Selection Criteria	Examples of Factors Considered	Rankings		
		Preferred	Acceptable	Unacceptable
Project will cause positive or negative changes on socio-economic factors	• Preservation of archaeological or cultural sites and heritage resources • Potential effects on Yukon First Nations • Maintenance of traditional lifestyle or spiritual well-being • Aesthetics • Uses such as recreation, tourism, industrial • Safety considerations	socio-economic environment without mitigation and provides positive benefits	socio-economic environment with mitigation	economic effects that cannot reasonably be mitigated

4.8.3 Alternatives to the Project

The Project need and purpose consist of the Project benefits described in Section 1.0 of the Proposal. In general, the Project need and purpose can be summarized as:

- Generate Yukon Territorial and Federal government taxes, revenues and royalties;
- Create direct and indirect employment opportunities in addition to training programs;
- Stimulate economic growth for local communities, First Nations and the Yukon as a whole through expenditures on goods and services;
- Help meet global demand for gold, silver, copper and molybdenum;
- Increase infrastructure for residents of local communities, First Nations and the Yukon; and
- Competitive return on investment.

Potential alternatives to the Project, needed to take into consideration the need for and purpose of the Project. It is generally acknowledged that mines are unlike other types of projects, such as a highway corridor development, for which a number of alternatives to the project exist that meet the need and purpose of the project. As a whole, the Project had limited alternatives due to the fixed location of the ore body and economic sensitivity of mining projects. A summary of the assessment of alternatives to the Project is presented in Table 4.8-2 along with rationales describing why alternatives were screened out at this stage and excluded from further assessment.

Table 4.8-2 Candidates for Alternatives to the Project

Alternatives to the Project (As A Whole)	Carry Forward into the Alternatives Assessment	Rationale
Delay the Project until economic conditions are equally or more favourable than the proposed Project development schedule.	Yes	Delaying the Project can meet the need and purpose of the Project, only if future economic conditions equally or more strongly favour the Project than predicted to exist according to the proposed Project development schedule.
Abandon the Project, considered as the "no development" scenario.	No	Abandoning the Project does not meet the Project need or purpose. Any benefits of the Project will be limited to those that have already occurred during the exploration phase of the Project.
Proceed with the Project in the near term, as planned.	Yes	Proceeding with the Project as planned and supported by the Feasibility Report in the near future can meet the need and purpose of the Project.
Changing the location of the Project.	No	An alternative location for the Project in its entirety is not an alternative to the Project. Mining projects are unique because ore bodies have a fixed location, and the only way to proceed with a mining venture is to mine the ore body in its place.

Table 4.8-2 shows that only two alternatives to the Project that were potentially able to meet the need and purpose of the Project are: to proceed with the Project as proposed in the near term, or to delay the Project until economic conditions are equally or more favourable than proceeding as planned in the near term. These two alternatives to the Project were carried forward into the assessment of alternatives to the Project.

Economic Viability

It has been demonstrated that the Project can be successfully and economically completed under the conditions and assumptions outlined in the Feasibility Report; this favourable economic conclusion assumes that the Project is constructed within the development schedule planned by CMC (M3 2013). The primary risks and key considerations for economic viability of the Project were metal prices (M3 2013). The Feasibility Report completed for the Project was based on conservative metal prices and was economically favourable (M3 2013). Proceeding with the Project as planned in the near term is the Preferred alternative in terms of economic viability.

The alternative of delaying the Project until economic conditions are more favourable is a potentially Unacceptable alternative as there is no guarantee that future economic conditions would equally or more strongly support a decision to proceed than currently exist.

Socio-economic Acceptability

In terms of socio-economic acceptability, proceeding with the Project in the near-term as planned is the Preferred alternative because, with the implementation of proposed mitigation measures, potential negative socio-economic effects were not anticipated to be significant. A detailed assessment of the anticipated socio-economic adverse and positive effects of the Project is presented in Volume 3 – Socio-Economic Valued Components of the Proposal. As part of the proposal to proceed with the Project as planned, CMC intends to employ as many workers from the Yukon as practical and the positive socio-economic effects are anticipated to outweigh any negative short term socio-economic effects that may occur. Delaying the Project until economic conditions are more favourable is an Acceptable alternative, though potential positive socio-economic effects will be delayed and

may not be as large as anticipated under the current Project development schedule because future socio-economic conditions are difficult to predict.

Technical Feasibility and Environmental Acceptability

Technical feasibility and environmental acceptability were not applicable to the evaluation of the alternatives to the Project, because the expected technical and environmental costs and benefits of all alternatives to the Project that were carried forward into the assessment were expected to be equal. All alternatives to the Project were assumed to be based on the same mine plan and Proposal and employ the same technical and environmental considerations regardless of whether the Project is delayed or proceeds in the near term as planned.

Preferred Alternative

A summary of the assessment of alternatives to the Project is presented in Table 4.8-3.

Table 4.8-3 Alternatives to the Project

Performance Criteria	Alternatives to the Project	
	Proceed with the Project in the near term, as planned	**Delay the Project until economic conditions are equal or more favourable**
Economic Viability	The Project, as planned, demonstrates financial feasibility and facilitates a competitive return on investment.	Economic risks are uncertain in the future and long-term metal prices are unpredictable. The alternative may not meet the Project goal of a competitive return on investment.
	Preferred	Unacceptable
Socio-economic Acceptability	Provides substantial positive benefits including direct and indirect employment, and tax and royalty revenues. Negative effects can be addressed with appropriate mitigation measures.	Positive benefits and negative effects are both delayed. Existing (negative and positive) conditions would continue until Project development.
	Preferred	Acceptable
Technical Feasibility	This performance criterion is not applicable to the evaluation of alternatives to the Project, because the expected technical costs and benefits are equal between alternatives.	
	Not Applicable	
Environmental Acceptability	This performance criterion is not applicable to the evaluation of alternatives to the Project, because the expected environmental costs and benefits are equal between alternatives.	
	Not Applicable	
Summary Ratings	**Preferred**	**Unacceptable**

Proceeding with the Project as planned in the near term (under the proposed Project development schedule) is the only alternative to the Project that meets the need and purpose of the Project in terms of both economic viability and socio-economic acceptability. Delaying the Project is a potentially Unacceptable alternative in terms of economic viability because there is no assurance that future economic conditions would equally or more strongly support a decision to proceed with the Project than currently exists and supported by the Feasibility Report (M3 2013). Delaying the Project is rejected as potential alternative because it received an Unacceptable

rating in terms of economic viability. The performance objectives of technical feasibility and environmental acceptability are not applicable to the evaluation of the alternatives to the Project because they are the same between alternatives. The Preferred alternative is to proceed with the Project, on the proposed Project development schedule as planned.

4.8.4 Alternative Means of Carrying Out the Project

Alternative means are defined as the "various technically and economically feasible ways that the Project could be implemented or carried out" (YESAB 2005). For example, this may include alternative locations, routes and methods of development, implementation and mitigation. During the course of evaluating the Project from the prefeasibility to the feasibility phase, alternative means of carrying out the Project were considered. Table 4.8-4 lists the identified candidates for alternative means of carrying out the Project and rationales for carrying forward the alternative into the assessment or excluding the alternative from further consideration.

Table 4.8-4 Candidates for Alternative Means of Carrying out the Project

Alternative Means of Carrying Out the Project	Carry Forward into the Assessment	Rationale
Methods of Transporting Concentrate to Market	Yes	Five methods and various concepts of possible routes for transporting concentrate from the mine site to a sea port were examined.
Points of Export for Commodities in the Yukon	No	A comparison of the five potential ports and their relative distances indicates that the Port of Skagway in Alaska, approximately 177km from Whitehorse, is the only logical port of export for the Project.
Access Road Routes	Yes	Once trucking by road was established as the preferred alternative for transporting concentrate, the cost and benefits of different access road routes were examined.
Employee Accommodations	No	Given the remote location of the Project all staff and contractors will reside at a permanent accommodations camp established at the mine site.
Power Supply	Yes	Given the distance of the Project from existing transmission network and the power requirements of the Project, multiple studies have evaluated alternative power supply options for the Project.
Open Pit Size, Area, and Location	No	The size of the Open Pit and its configuration has been optimized for economic return taking into consideration an acceptable factor of safety for the Open Pit design. Reducing the size of the Open Pit impacts production rate and effects economic return and potentially could affect the feasibility of the Project. An alternative location for the Open Pit is also not possible because ore bodies have a fixed location and the only way to proceed with a mining project is to mine the ore body in its place.
Processing Throughputs	No	The processing throughput is constrained by a number of factors including mill processing, ore crushing, conveying and waste stacking, and tailings. Determining the optimal processing throughput is a multiple-

Alternative Means of Carrying Out the Project	Carry Forward into the Assessment	Rationale
		discipline exercise involving capital and operating cost estimates, as well as resource models. This analysis was completed for the Feasibility Report to determine the processing throughput that would optimize the Project.
Tailing Management Facility Sites	Yes	Siting of the TMF during the planning phases of the Project evaluated the positive and negative effects of various site options for the storage of tailings and waste rock for the Project.

The subsections below present an assessment of the alternative means of carrying out the Project that have been carried forward into the assessment and the reasoned process that led to the selection of the Preferred alternative.

4.8.4.1 Methods of Transporting Concentrate to Market

Five full and partial methods of transport and associated preliminary concepts of routes were considered as part of the evaluation of alternative means for transporting concentrate from the mine site to a sea port. These alternative methods of transportation and preliminary route concepts are described in Table 4.8-5.

Table 4.8-5 Preliminary Concepts for Transporting Concentrate to Market

Alternatives	Route Concepts	Carry Forward into the Assessment	Rationale
Partial conventional tug-and-barge, hover barge or self-propelled barge to truck trans-shipment point	Along the Yukon River from Britannia Creek upstream to Minto (~160km), transferred to trucks for transport along Klondike Highway to Skagway.	Yes	• The Yukon River is only open to barge traffic for four months each year (June to October). • The Yukon River current is very strong and tugs would require large engines. • The Five Finger Rapids and other rapids may present an obstacle. • Sandbars and shallow channels exist especially in reaches of the Yukon River downstream from the mine site. • A concentrate shed would have to be built at the barge site to store eight months of concentrate. • Barging will always have to be undertaken in conjunction with road, pipeline or air transportation which will offset any cost advantages of barging.
	Along the Yukon River from Britannia Creek to a truck trans-shipment point at Carmacks or Whitehorse, highway to Skagway.		
Concentrate Pipeline and Trans-shipment Point	From the mine site due to north to a barge port on the Yukon River at Britannia Creek (~ 20km)	Yes	• Problems are reported with pipelines operating in extremely cold conditions, but this can be overcome by heating the slurry
	From the mine site to		• This could be a year-round operation.

Alternatives	Route Concepts	Carry Forward into the Assessment	Rationale
	Minto or Carmacks (~200 or 300 km) and then trans-ship to a truck for transportation to Skagway along the Klondike Highway.		• It would be susceptible to freezing, and would require a holding shed and a pipe bridge across the Yukon River.
Rail	If the Alaska-Canada Rail Link is built between Fairbanks and the North American rail network in northern BC. Potential corridor for this rail link is the Nisling River between Beaver Creek and Carmacks.	No	• Rail transportation costs for concentrate are relatively low compared to trucking, though rail line construction and maintenance costs are five to ten times more expensive than trucking. • The Link is a potential project in the early pre-feasibility planning stage and cannot yet be justified commercially. If the Link was to begin construction immediately, it would take eight to ten years to complete. It is not likely to be ready for use during the first half of the mine life.
Heavy Duty Transport Aircraft	Concentrate can be shipped by air in containers or sacks to Haines port or to an alternative port in Alaska or BC.	No	• Heavy-duty cargo aircraft can carry ~50 tonnes (same as a highway truck), though a large fleet would be required. • A Hercules transport plane costs ~$9,000/hr, a round trip for a plane is ~4 hours. • Still a need for an access road to transport supplies into the mine site. • This is untested technology that has not yet been applied successfully to support a commercial operation.
Truck	By truck along a specially prepared gravel mining road and paved Yukon highways. Multiple routes are possible.	Yes	• A truck costs ~$100/hr to operate, a round trip is ~36 hours. • Trucks can operate throughout most weather conditions. • The Yukon is well served with existing surfaced roads and provides access to ports in Southeast Alaska.

The two threshold criteria applied to reduce the number of preliminary concepts to plausible alternatives included exclusion of:

- Concepts that will not be operational by the commencement of the Project; and
- Concepts that would not provide sufficient transport capacity.

Any preliminary concepts that met any of the two threshold criteria were eliminated from further consideration and not carried forward into the alternatives assessment because they were considered fatally flawed. The results of the screening exercise are shown in Table 4.8-5 and the remaining three alternatives have been structured into the potential alternatives described below.

Table 4.8-6 Summary Evaluation – Alternative Methods of Transporting Concentrate

Performance Criteria	Barging	Pipeline	Trucking
Economic Viability	Construction costs include a concentrate pipeline or a truck haul fleet and a new concentrate shed at the barge port.	Construction costs are ~2x the cost of a haul road, pipeline cost is ~$1M/km and the return water pipeline cost is ~$0.5M/km	Construction cost includes a new all-season access road; Operating cost is ~$100/hr, a round trip is ~36 hours
	Acceptable	Acceptable	Preferred
Socio-economic Acceptability	Yukon River was used as a transportation route in the past. Unknown level of effects to First Nations and recreationalists from increase barging activity on the Yukon River.	Perceived safety concerns around loading and unloading of concentrate and additional requirement for water to transport concentrate as slurry.	Generate benefits through spending and employment. Perceived interest from community members and the Yukon Government to establish both the Casino Trail and Freegold Road into all season roads.
	Acceptable	Acceptable	Acceptable
Technical Feasibility	Limited barging season of 4 months, difficulties of operating on the Yukon River, stored concentrate could become susceptible to contamination. A large fleet of barges and trucks would be required for short transport season.	Technically conceivable, operating in extremely cold conditions will require heating	Transport can be undertaken year-round on an all-season road; variety of truck, container and trailer combinations can be used for standard highway as well as mining roads.
	Unacceptable	Acceptable	Preferred
Environmental Acceptability	Potential accidents related to barging could impact the Yukon River from spills of fuel and concentrate.	Fewest points at which concentrate is handled in its raw state, though this water will most likely require treatment before discharge or be returned to the mill.	Potential impacts from spills of fuel and concentrate avoided or minimized with implementation of standard measures.
	Acceptable	Acceptable	Preferred
Summary Ratings	**Unacceptable**	**Acceptable**	**Preferred**

Alternative A: Barging

Transporting concentrate by barge would also require either the construction of a concentrate pipeline or trucking from the mine site to a barge port on Britannia Creek. It is likely that a pipeline would be a preferred means of transportation for concentrate since a winter road along Britannia Creek would be extremely steep, with grades in excess of 15%. A new concentrate shed would have to be built at the barge port to store concentrate for at least eight months of the year as barging would only be operational for four months of the year due to ice on the Yukon River.

Alternative B: Pipeline

Construction of a concentrate pipeline also requires the construction of a road along the pipeline route for purposes of pipe and pump station supply, pipe assembly and regular maintenance. Concentrate pipelines usually require an additional water pipeline for the return of slurry water to the mill. Storage tanks would be required at both the mill and the end of the pipeline, and a de-watering tank would be required at the end of the pipeline.

Alternative C: Trucking

Trucking also requires the construction of an all-season road from the mine site to the existing Yukon Highway network. A number of route options were investigated for the location of an all-weather road from the mine site to the existing Yukon Highway network that would permit truck transportation to either the ports of Skagway or Haines (additional information on alternative route options is discussed in Section 4.8.4.2).

Economic Viability

In terms of economic viability, the Preferred alternative for transporting concentrate to and from the mine site to a sea port is by trucks utilizing the existing Yukon highways for the majority of the way and constructing a new all-season access road to the mine site for a smaller portion of the road. A truck costs approximately $100/hr to operate and a round trip from the mine site to the Port of Skagway is approximately 36 hours; additional costs will include maintenance of the truck haul fleet. As a rule of thumb, the capital cost of a concentrate pipeline is twice the cost of a mine haul road. For this exercise, it was assumed that a typical concentrate pipeline costs about $1 million/km and the return water pipeline about $0.5 million/km; however, the operation of a pipeline is half the cost of maintaining a truck haul fleet. Based on these cost estimates, a pipeline is an Acceptable alternative from an economic viability perspective. The costs associated with barging include the cost of constructing a concentrate pipeline or operating a truck haul fleet and a new concentrate shed at the barge port to store concentrate for 8 months of the year which will offset any cost advantages of barging. Barging is considered to be an Acceptable alternative in terms of economic viability.

Socio-economic Acceptability

All alternative methods of transporting concentrate will generate socio-economic benefits through Project–related contracting opportunities, as well as building community capacity through local employment and increase local purchasing and spending. Barging is an Acceptable alternative from a socio-economic perspective because the Yukon River was used as a transportation route in the past; however, it is challenging to predict the level of potential effects to First Nations and recreationalists from increase barging activity on the Yukon River. Trucking is also an acceptable alternative because of the perceived interest from community members and the Yukon Government to establish both the Casino Trail and Freegold Road into all season roads. Of the three alternatives, a concentrate pipeline is the least acceptable alternative due to the perceived safety concerns around loading and unloading of concentrate and additional requirement for water to transport concentrate as slurry.

Technical Feasibility

Concentrate pipelines are becoming more common in the mining industry, and their operating characteristics are becoming better understood; however, most slurry pipelines operate using gravity with emergency pump stations. Problems have been reported with slurry pipelines operating in extremely cold conditions, which can be overcome by heating the slurry which can be technically challenging. It is technically conceivable that a slurry pipeline could be built from the mine site due north to a barge port on the Yukon River at Britannia Creek, a distance of about 20 km.

Barging is an Unacceptable alternative from a technical feasibility perspective for the Project, primarily due to the limited barging season, of approximately four months, and the anticipated difficulties of operating barges on the Yukon River. Furthermore, the purpose-built concentrate shed will have to store up to 250,000 m^3 of concentrate and could become susceptible to contamination. Furthermore, by this method, a large fleet of barges and trucks would be required but would only be operational for four months of the year.

From a technical feasibility perspective, trucking is the Preferred alternative because truck transportation can be undertaken year-round on an all-season road and concentrate can be carried by truck in a variety of containers. Different truck and trailer combinations can be used for standard highway and as well as mining roads. Road transportation can present technical challenges in the form of road construction, operation and maintenance.

Environmental Acceptability

Most potential spillage and contamination of concentrate occurs at the point of its loading and unloading. The fewer points where concentrate is handled in its raw state will provide better quality control and environmental compliance. If concentrate is to be transported by pipeline or a tanker trailer it can be pumped directly from the mill to the pipeline or trailer and then again pumped to a barge. Though concentrate in this form generally has high water content and has to be de-watered before transport and this water will most likely require treatment before discharge or be returned to the mill. For these reasons, any environmental advantages of transport by pipeline are negated and pipeline transport is an Acceptable alternative. Barging is also an Acceptable alternative though accidents related to barging could impact the Yukon River; these potential environmental concerns center on the potential impacts from spills of fuel and concentrate. Of the three alternatives, barging is the least acceptable method of transporting concentrate to market. Similarly, environmental concerns related to trucking are centered on potential impacts from spills of fuel and concentrate on roadways and into waterways along the transport route. Even so, trucking is the preferred alternative in terms of environmental acceptability because with the implementation of standard measures, such as dust suppression and road use priorities, the potential environmental impacts of trucking will be minimized.

Conclusion

Trucking presents the most reliable method of transporting concentrate in the Yukon and is the Preferred method of transport for concentrate to market for the Project. The other two methods, of barging and pipeline transport, present challenges for implementation and operations. Trucking would provide the Project with the flexibility, versatility and reliability required to maximize the Project benefits and minimize potential adverse effects.

4.8.4.2 Access Road Routes

Since 2008, various access road alternatives were examined for the Project to determine the preferred alternative that would balance technical, environmental, social and economic costs and benefits.

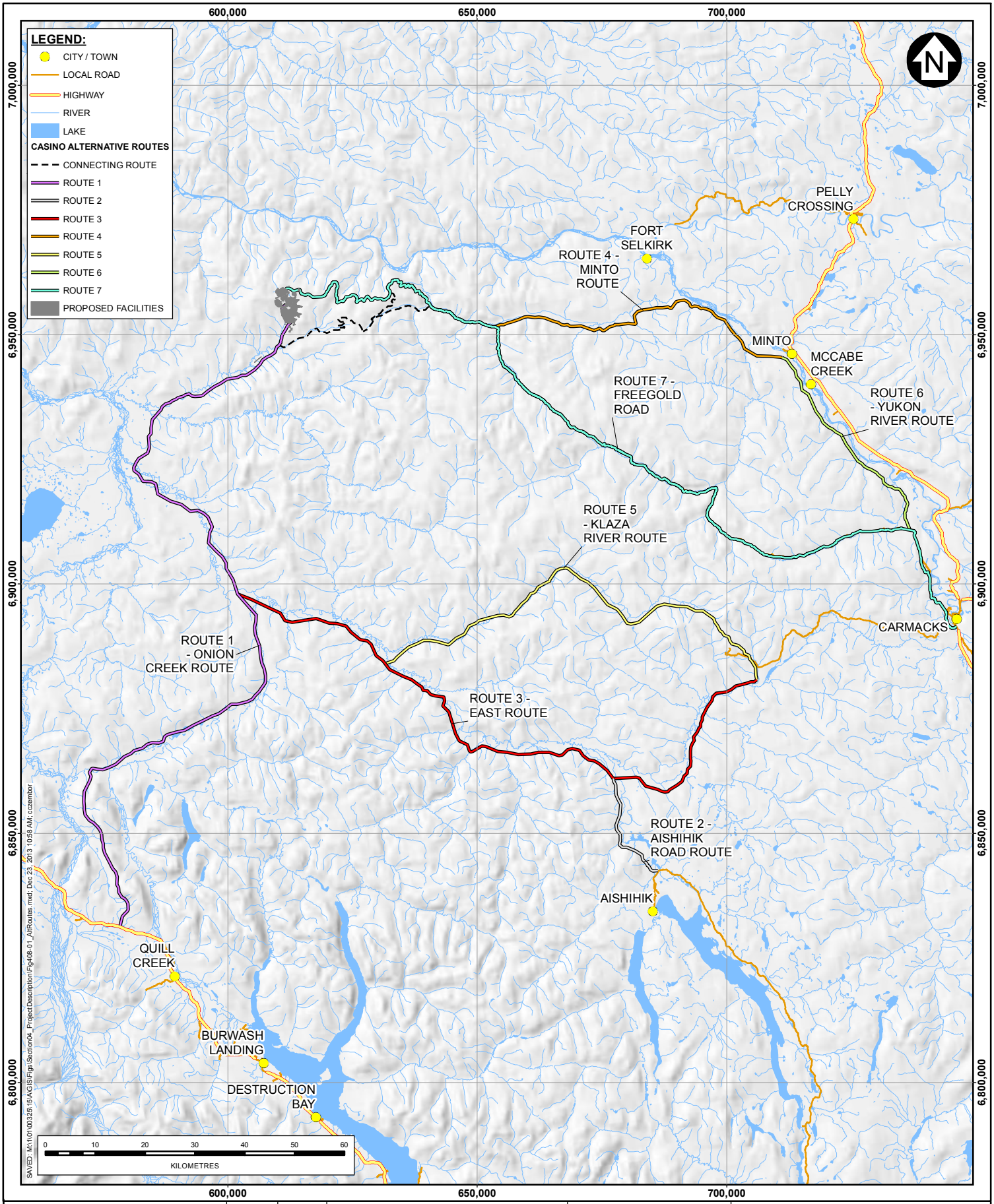
Initially, seven access route concepts were considered at a preliminary level because they may have the potential to provide year round and all weather access between the mine site and existing highways to market (Figure 4.8-1). The seven access route concepts are described in Table 4.8-7.

Of the seven access route concepts considered, three routes (Onion Creek, Minto and Freegold Road) were assessed in greater detail because they were considered to be the most feasible, likely to represent the option with the least challenges in permitting and perceived as most likely to be supported by public, First Nations and the Yukon Government. The results of the screening exercise are shown in Table 4.8-7 and the remaining three alternatives have been structured into the potential alternatives described below.

Table 4.8-7 Preliminary Access Route Concepts

Route Concept	Carry Forward into the Assessment	Rationale
Onion Creek: Casino Mine Site via Onion Creek to Alaskan Highway	Yes	This route has been used by a former owner for earlier transportation of exploration equipment to the mine site. It follows a route through the wetland north of the Nisling River Valley and the terrain is mainly flat below the mine site and crosses the large flat valleys of the Nisling and Donjek Rivers before crossing the Nisling Range and the Kluane River to reach the Alaska Highway. A crossing of the Kluane River would be required, but is potentially feasible.
Aishihik Road: Casino Mine Site via Onion Creek to Alaskan Highway to Aishihik Road Intersection	No	This route would follow the same alignment as Onion Creek from the mine site and east of the wetland to a crossing of the Nisling River close to Onion Creek. It would then follow the south slopes of the Nisling River Valley, before turning south to follow along the existing, summer-only Aishihik Lake Road to the Alaska Highway. This route was excluded from further consideration due to potential challenges with permitting because it follows the Nisling River area which is known wildlife habitat.
East Route: New Mine Access to Nisling River to East Route	No	This route would follow the same alignment as Onion Creek from the mine site and east of the wetland to a crossing of the Nisling River close to Onion Creek. It would then follow the south slopes of the Nisling River Valley, before turning south to follow along the existing Aishihik Lake Road to the Alaska Highway. This route was excluded from further consideration due to potential challenges with permitting. The Nisling River area supports a healthy population of wood bison. There is also evidence of sheep and moose in the area. Up-grading the existing Aishihik Road would require agreements from the Champagne and Aishihik First Nation.
Minto: Casino Mine site via Minto Access Road to new Yukon River Crossing to Minto	Yes	This route would follow the steep Rude Creek from Casino Creek east to a pass over the high point of the Dawson Range. It would then continue over steep and rugged mountainous terrain along Battle Creek to the headwaters of Hayes Creek. The route then follows more moderate terrain to the headwaters of Wolverine Creek which leads down to the Yukon River and the existing Minto Mine Road. A new bridge would have to be built across the Yukon River to enable all-season access. This route is considered to be feasible.
Klaza River: Mine Access to Nisling River to Klaza River Routes	No	This route is similar to the East Route but instead of following the Nisling River east to Nansen Mine Road it would follow the more mountainous route of Klaza Creek. The purpose of pursuing this route was to avoid the wetland of the Nisling River. Even though it would be a slightly shorter section of new road than the East Route, it is likely to be too costly to build and to operate and was excluded from further consideration. As well, it follows known wildlife habitat and has potential challenges with permitting.

Route Concept	Carry Forward into the Assessment	Rationale
Yukon River: Mine Access to Battle Creek to Yukon River Routes	No	This is an extension of the Minto Route, instead of crossing the Yukon River at Minto, the road would connect with the Klondike Highway at Carmacks. This route was excluded from further consideration because objections can be expected from wildlife, tourist and sport-fishing interest groups due to its proximity to the Yukon River.
Freegold Road: Mine Access to Battle Creek to Hayes Creek Routes	Yes	This route would follow a similar alignment to the existing Casino Trail from the mine site to what is known as the Freegold Road to Carmacks and the Klondike Highway. No crossing of the Yukon River is necessary for this route. This route is considered to be feasible.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	CC
DRAWN	CC
CHK'D	CAH
APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:

1. BASE MAP: YUKON GOVERNMENT SHADED RELIEF, ALTERNATIVE ROUTES FROM AE.
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

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CASINO PROJECT

PRELIMINARY ACCESS ROUTES CONCEPTS

FIGURE 4.8-1

REF 1

P/A VA101-325/15

Alternative A: Onion Creek

This route has been used in the past by previous owners for transport of exploration equipment to the Casino mine site. There is an existing 190 km winter road from the Casino mine site to the north of Kluane Lake on the Alaska Highway. It follows a route through the wetland north of the Nisling River Valley and a major river crossing at the Kluane River.

Alternative B: Minto

The Minto Route is the most northern route from the Casino mine site to the Yukon Highway system, as illustrated in Figure 4.8-1. It would follow Rude Creek from Casino Creek east to a pass over the high point of the Dawson Range. It would then continue over steep and rugged mountainous terrain along Battle Creek to the headwaters of Hayes Creek. The route then follows the headwaters of Wolverine Creek which leads down to the Yukon River and the existing Minto Mine Road. Currently, Minto Mine maintains a barge ferry crossing across the Yukon River to Minto, which is on the Klondike Highway. A new bridge would have to be built across the Yukon River to enable all-season access for the Project.

Alternative C: Freegold Road

In general, this route will follow the existing historic Casino Trail that has been used in the past to service the Casino mine site, however closer to the mine site the route will deviate from the trail in order to ensure better grades and alignment for traffic. It would then descend southward down Hayes Creek to the existing Freegold Road, which would be followed to Carmacks and the Klondike Highway.

Economic Viability

In terms of economic viability, the total cost of each alternative to construct and operate the alternative access roads was estimated, using best available information at the time of this exercise, and compared to select the preferred alternative. These cost estimates were calculated specifically for this exercise and may not be reflective of the actual costs associated with the construction and operations of the access road alternatives.

Table 4.8-9 provides estimates of the associated costs including hauling of concentrate, hauling of supplies and capital or maintenance activities for each alternative. The Onion Creek route is the preferred alternative from the economic viability perspective with an estimated construction cost of $93M and an operating cost of $591M. A major river structure is likely to be required at the crossing of Kluane River which is not included in the overall cost estimate. The Minto and Freegold Road routes are acceptable alternatives in terms of economic viability and have total anticipated costs of $967M and $1,090M.

Socio-economic Acceptability

The Onion Creek route crosses unsettled land claims and has the potential to open new access to wilderness areas. As well, outfitting concessions are known to currently exist in the area and may be effected by the development of the Onion Creek route. Approximately 100km from the Casino Mine Site are known First Nation's traditional fishing and salmon spawning grounds and further south are known First Nation's timber and quartz mine claims. This route is deemed to be an acceptable alternative from the socio-economic acceptability perspective.

The Minto route also crosses First Nations settlement land and has the potential to open new access to wilderness areas along the route. This route is an acceptable alternative in terms of socio-economic acceptability.

The Freegold Road is the preferred alternative from a socio-economic acceptability perspective. It generally follows a previously impacted corridor used to access the Casino Project area, other exploration projects and

placer mines in the Dawson Range, and has been previously identified as potential future access to the Casino Project by the Yukon Government. By managing access on the Freegold Road, any potential adverse socio-economic effects due to increase access to wilderness areas along the route will be mitigated.

Technical Feasibility

The Onion Creek and Minto routes are deemed to be acceptable from the technical feasibility perspective due to the anticipated technical challenges of the routes that have been identified to date.

The Onion Creek route is a potentially technically challenging access route to construct even though the terrain is mainly flat, much of this route is extremely swampy in the summer and fall and there is evidence of large volumes of peat underlying the surface. Construction of this route would require excavation of unsuitable material and significant quantities of gravel to create an all season road and the potential construction of embankments for sections of the route. Additionally, a major river structure is likely to be required at the crossing of the Kluane River, though overall fewer crossings are required than the other two alternatives.

A large section of the Minto route, approximately 70km, will traverse over mountainous terrain and will involve switch-backs and steep grades and this route will also require a high level of maintenance activity for operations in the winter. It is beneficial that this route uses some existing road and trails for a portion of the route.

From the technical feasibility perspective, the Freegold Road route has the longest history of engineering studies and planning by the Yukon Government dating back approximately 45 years. The technical challenges with this route are well understood and can be managed through implementation of construction and operation measures. As well, the alignment of the route will follow the existing Casino Trail and Freegold Road for the majority of the way. For these reasons, the Freegold Road route is the preferred alternative, technically.

Environmental Acceptability

All alternative access road routes have the potential to adversely affect wildlife habitat and fish habitat, if not appropriately mitigated. Based on the preliminary understanding of potential adverse environmental effects, all alternatives are deemed acceptable, if mitigation is implemented to avoid or minimize potential adverse effects.

The Onion Creek alignment appears to cross the winter range of the Kluane caribou herd, as well as grizzly bear habitat and moose habitat. Additional studies will be required to determine their importance and mitigation will be required during construction and operations to avoid or minimize adverse effects.

The major portion of the Minto route is on the edge of key wildlife areas; though construction of a bridge over the Yukon River at Minto could have environmental impacts to fish habitat.

Even though the Freegold Road route minimizes new disturbance by following the alignment of an existing trail and road, the Freegold Road route crosses the Klaza caribou herd winter range based on the winter distribution studies of 1987-90 and 2011-12 and has the potential to impact wintering caribou if not appropriately mitigated. The Klaza caribou herd is estimated at 1179 animals (Hegel 2013) that tend to use higher elevation habitats during winter. It is generally understood that the Klaza caribou herd has experienced relatively minimal harvest pressure.

Conclusion

All alternatives appear to be acceptable; however, Alternative C, the Freegold Road access route appears to have the least technical challenges and is perceived to have the greatest stakeholder support and socio-economic benefits. For these reasons, the Freegold Road access route is the preferred alternative.

Table 4.8-8 Summary Evaluation – Alternative Access Road Routes

Performance Criteria	Alternative A - Onion Creek	Alternative B- Minto	Alternative C – Freegold Road
Economic Viability	Construction ~$93M Operations ~$591M	Construction ~$129M Operations ~$838M	Construction ~$99M Operations ~$897M
	Preferred	Acceptable	Acceptable
Socio-economic Acceptability	Crosses unsettled land claims and has the potential to open new access to wilderness areas. Known outfitting concessions, and traditional fishing and spawning grounds.	Crosses First Nations settlement land and has the potential to open new access to wilderness areas along the route.	Crosses First Nations settlement land. It generally follows a previously impacted corridor used to access the Casino Project area and other projects and has been previously identified as potential future access to the Casino mine site by the Yukon Government. Adverse effects can be mitigated through access management.
	Acceptable	Acceptable	Acceptable
Technical Feasibility	Fewest crossings required. Swampy conditions with large volumes of peat underlying the surface would require excavation of unsuitable materials and potential embankments.	Mountainous terrain involving switch-backs and steep grades (of approximately 10% to 14%), requires a high level of maintenance activity during winter.	Longest history of engineering studies and planning by the Yukon Government ~45 years. Technical challenges of this route are well understood and can be managed.
	Acceptable	Acceptable	Preferred
Environmental Acceptability	Crosses winter range of Kluane caribou herd, as well as grizzly bear habitat and moose habitat if not mitigated.	On the edge of key wildlife areas; though construction of a bridge over the Yukon River at Minto could have environmental impacts to fish habitat if not mitigated.	Minimizes new disturbance by generally following the alignment of an existing trail. Potential effects on the Klaza caribou herd winter range if not mitigated.
	Acceptable	Acceptable	Acceptable
Summary Ratings	**Acceptable**	**Acceptable**	**Preferred**

4.8.4.3 Power Supply

The Project will require a reliable power supply of sufficient capacity to service mining, crushing and milling operations. During the construction phase approximately 20 MW are required and during operations approximately 130 MW are required. Multiple studies evaluating alternative power supply options were completed

for the Project between 2006 and 2013; the preliminary concepts considered in these studies are listed in Table 4.8-10. The preliminarily power supply concepts were reduced based on two threshold criteria:

- Sufficient capacity for the Project's anticipated requirement; and
- Certain implementation timeline.

Table 4.8-9 Preliminary Power Supply Concepts

Power Supply Concept	Carry Forward into the Assessment	Rationale
Coal	Yes	A historically reliable source with potential supply options including a new Yukon coal mine or coal imported from the Port of Skagway.
Natural Gas Pipeline	No	This option was found not to be feasible due to the cost associated with the construction of the natural gas pipeline and the uncertainty of the implementation timeline.
Diesel	Yes	A historically reliable source for operating mines.
Wind	No	The Project's energy requirement could not be met by using wind alone and would need to be combined with another power supply option such as diesel. A potential site for wind generation is Leslie Ridge, located approximately 10km from the Project site.
Hydroelectric	No	The Project's energy requirement could not be met using hydro. Land tenure and permitting challenges for suitable off-site hydro sites, including a requirement for a long transmission line, makes this alternative cost-prohibitive and would not meet the project schedule.
Transmission Connection	No	Connecting to the existing Yukon, British Columbia or Alaska transmission system would require constructing a new transmission line and permitting a very large distance would be difficult.
Solar	No	Large scale solar power is not cost competitive and it is unlikely that the Project's energy requirement could be met using solar alone.
Biomass	No	No continuous reliable supply of wood waste exists near the Project.
Geothermal	No	Known geothermal resources in the Yukon are too low in temperature; this option is not considered to be viable.
Liquefied Natural Gas (LNG)	Yes	Liquefied natural gas is available and potential supply options include BC or Alaska.

Preliminary concepts that did not meet either threshold criteria were considered fatally flawed and were not carried forward into the alternatives assessment. The majority of preliminary power supply concepts were removed from further consideration and three potential alternative power supply options were evaluated in greater detail for the Project: Diesel Genset, Coal Power Plant and LNG Power Plant.

An overview of each alternative power supply option for the Project is described below followed by an evaluation of the economic, environmental, technical and socio-economic costs and benefits of each alternative and the selection of the preferred power supply alternative for the Project.

Diesel Power Plant

A diesel power plant could be developed at the mine site for use during construction and operations, supplying all necessary power for the Project. Diesel could be transported to the mine site from a reliable source in BC or Alaska.

Coal Power Plant

The option to power the Project using coal could be implemented by utilizing Circulating Fluidized Bed (CFB) boiler technology. The CFB boilers use a variety fuels, including wood waste, bituminous and sub-bituminous coals, and coal waste.

Liquefied Natural Gas Plant

LNG could be used for the Project's power supply with the appropriate infrastructure. LNG could be transported to the Casino mine site and used in a power plant. Sources of LNG include Northern BC and through Skagway, Alaska.

Economic Viability

The costs associated for the power supply alternatives include the estimated capital costs, annual operating cost and the Total Unit Energy Cost. The Total Unit Energy Cost includes the predicted fuel consumption, operation and maintenance costs, and amortization of each power supply alternative.

From the economic viability perspective, diesel is an Acceptable alternative because it has the lowest capital costs; however, with a Total Unit Cost of $0.25/kWh, the cost of diesel is substantially higher than the other two alternatives. LNG is an Acceptable alternative as the Total Unit Cost is approximately $0.18/kWh and annual operating cost are comparable to diesel.

Coal is the Preferred alternative because it has the lowest Total Unit Energy Cost (at approximately $0.16/kWh, though this very similar to the cost for LNG) and the lowest annual operating cost of all alternatives. However, the cost estimates do not account for possible future CO_2 emissions tariffs, which may be imposed on the coal industry in the future.

Socio-economic Acceptability

All alternative power supplies would be subject to a formal government review and permitting process. Any power plant proposed at the mine site would be assessed as part of the Project infrastructure to support the mining operation. Based on the fuel required for the power plant, transportation of the fuel to site would also be included in the assessment.

The coal plant alternative is perceived to face negative public perception due to the relatively high rate of emissions which could lead to public resistance to developing this alternative. While technologies would be implemented to meet established guidelines, this alternative is considered to be the most difficult to successfully implement given the social context and the least acceptable alternative. The alternatives of diesel and LNG are perceived to be more positive in the context of socio-economic acceptability and the preferred alternatives from a socio-economic acceptability perspective.

Technical Feasibility

The implementation timelines for each alternative and transportation of fuel and materials to the mine site are key technical considerations of each alternative.

A coal power plant is anticipated to have the longest design, permitting and construction timeline of the three alternatives and will require approximately 36 months to become operational. The permitting process for a coal power plant is anticipated to be more complex than the other alternatives. A coal power plant is an Acceptable alternative in terms of technical feasibility.

The permitting process for a diesel power plant is anticipated to be substantially simpler than a coal power plant. Additionally, a diesel power plant will have a comparably shorter design and construction timeline (of approximately 24 months) which fits into the overall Project timelines as it employs widely used technology. This is the Preferred alternative power supply in terms of technical feasibility.

LNG is an Acceptable alternative from the perspective of technical feasibility because there are reliable sources of LNG in British Columbia and through Alaska. The technology is well known, although is not as widely used as that of diesel power. The LNG power plant onsite will require trained technical personnel to operate the LNG power plant as well as LNG storage and a regasification plant. The implementation for a LNG power plant at the mine site is longer than the diesel power plant; however, it is anticipated to be operational prior to the operation phase of the Project.

Environmental Acceptability

It is difficult to gauge the environmental acceptability of the coal power plant alternative due to the fact that coal power plants have faced negative public perception; although western Canadian coal is noted as low-sulphur and "clean" burning. A coal power plant is predicted to have higher emissions than the alternative power supplies; however, with the addition of limestone to trap most SO_2, a lower combustion temperature to limit NO_x production, and bag houses to trap particulates, the total CO_2 emissions are only predicted to be approximately 10% higher than that of diesel. For these reasons, the coal power plant alternative is an Acceptable alternative.

The diesel power plant alternative is an Acceptable alternative and the air emissions associated will be less than those associated with coal power plants. Though, transporting diesel fuel to the mine site poses a potential environmental risk due to fuel spills on the transport route.

From the perspective of environmental acceptability, LNG is the Preferred alternative because the anticipated air emissions are predicted to be lower than that of a diesel power plant and approximately half as much as a coal power plant. The environmental risk of a fuel spill is considered to be low for LNG as the material would evaporate and disperse due to its low boiling point and low density compared to air.

Conclusion

Overall, a LNG powered plant is the Preferred power supply for the Project based on a comparison of the economic, technical, socio-economic and environmental costs and benefits of each alternative evaluated as shown in Table 4.8-11.

Table 4.8-10 Summary Evaluation – Alternative Power Supply Options

Performance Criteria	Coal Power Plant	Diesel Power Plant	LNG Power Plant
Economic Viability	• Capital Cost ~$386M • Annual Operating Cost ~$57M • Total Unit Energy Cost $0.16/kWh	• Capital Cost ~$182M • Annual Operating Cost ~$139M • Total Unit Energy Cost $0.25/kWh	• Capital Cost~ $355M • Annual Operating Cost: ~ $139M • Total Unit Energy Cost $0.18/kWh
	Preferred	Acceptable	Acceptable
Socio-economic Acceptability	Perceived negative public perception which could lead to public resistance. Most difficult to successfully permit.	Perceived positive public perception and public support.	Perceived positive public perception and public support.
	Acceptable	Preferred	Preferred
Technical Feasibility	Expected to be operational in ~ 36 months. Complex permitting process.	Expected to be operational in ~24 months. Less complex permitting process.	Expected to be operational before start of operations (within 4 years). Reliable sources of LNG in BC and through Alaska. Requires specialized personnel onsite, LNG storage and regasification plant.
	Acceptable	Preferred	Acceptable
Environmental Acceptability	CO_2 emissions approximately 1 tonne of CO_2/MWh of electricity. CO_2 emissions are predicted to be ~10% higher than that of diesel.	Less air emissions than coal, though transporting diesel fuel poses a potential environmental risk due to fuel spills along the transport route	Least air emissions of all alternatives. Environmental risk of a fuel spill is low because the material would evaporate.
	Acceptable	Acceptable	Preferred
Summary Ratings	**Acceptable**	**Acceptable**	**Preferred**

4.8.4.4 Tailings Management Facility Sites

The Project proposes to utilize a catchment area as a tailings management facility (TMF) for mine waste management. This alternatives assessment only considered subaqueous disposal of conventional slurry tailings because the anticipated production rates of the Project were determined early on in the planning phase to be in excess of what could be managed by dry stack tailings. The purpose of this alternatives assessment was to demonstrate that the selected TMF site is the most appropriate site option for mine waste disposal from economic, environmental, technical and socio-economic perspectives.

CMC has undertaken an exercise to document the development of all possible TMF locations by completing an alternatives evaluation that takes into consideration Environment Canada's guidance on alternatives assessment (Environment Canada, 2011). The evaluation was facilitated by Shannon Shaw of pHase Geochemistry Inc. and includes a relative assessment of positive and negative effects of these options with respect to technical, environmental, socio-economic and project economic accounts. The evaluation was used as an internal tool to evaluate a set of options for the siting of the Project's TMF. This section summarizes the results of the process

undertaken to evaluate the positive and negative effects of various site options for the storage of tailings and waste rock for the Project.

Siting and design of potential TMF sites was conducted over the planning phases of the Project. An initial scoping level site study identified eight preliminary TMF concepts shown on Figure 4.8-2 and summarized in Table 4.8.2.

The two threshold criteria applied to reduce the number of preliminary concepts included exclusion of:

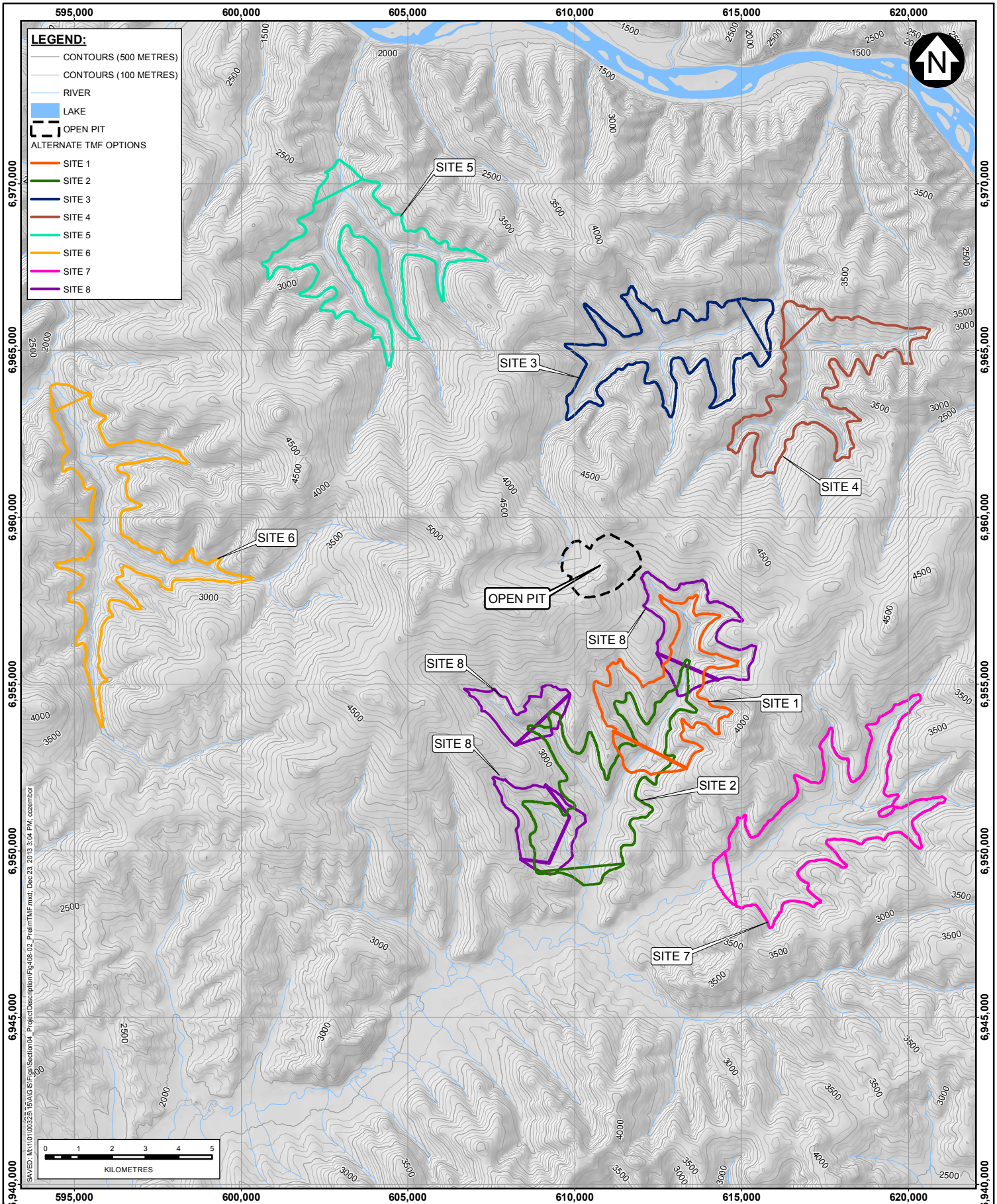
- Preliminary sites outside of 20 km radial distance from the Casino deposit; and
- Preliminary sites without sufficient capacity to store 772 MT of tailings and up to 760 MT of waste rock.

Other criteria considered included:

- Does the TMF have expansion potential?
- Does the TMF avoid sensitive fish habitat?
- If greater than ~10 km from the Casino deposit, does the TMF provide advantages that do not exist at sites closer to the deposit?

Any preliminary concepts that did not meet one of two threshold criteria were eliminated from further consideration and not carried forward into the alternatives assessment. These preliminary concepts were considered fatally flawed and were not carried forward into the alternatives assessment. The results of the screening exercise are shown in Table 4.8-12 and the remaining four sites have been structured into the potential alternatives shown on Figure 4.8-3.

Potential alternatives have been given a letter designation to differentiate them from the numbered sites from screening. Labeling effectively starts with the northern-most location and moves southward.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	CC
DRAWN	CC
CHK'D	CAH
APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: YUKON GOVERNMENT SHADED RELIEF, EAGLE MAPPING.
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

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CASINO PROJECT

SCOPING LEVEL PRELIMINARY TMF CONCEPTS

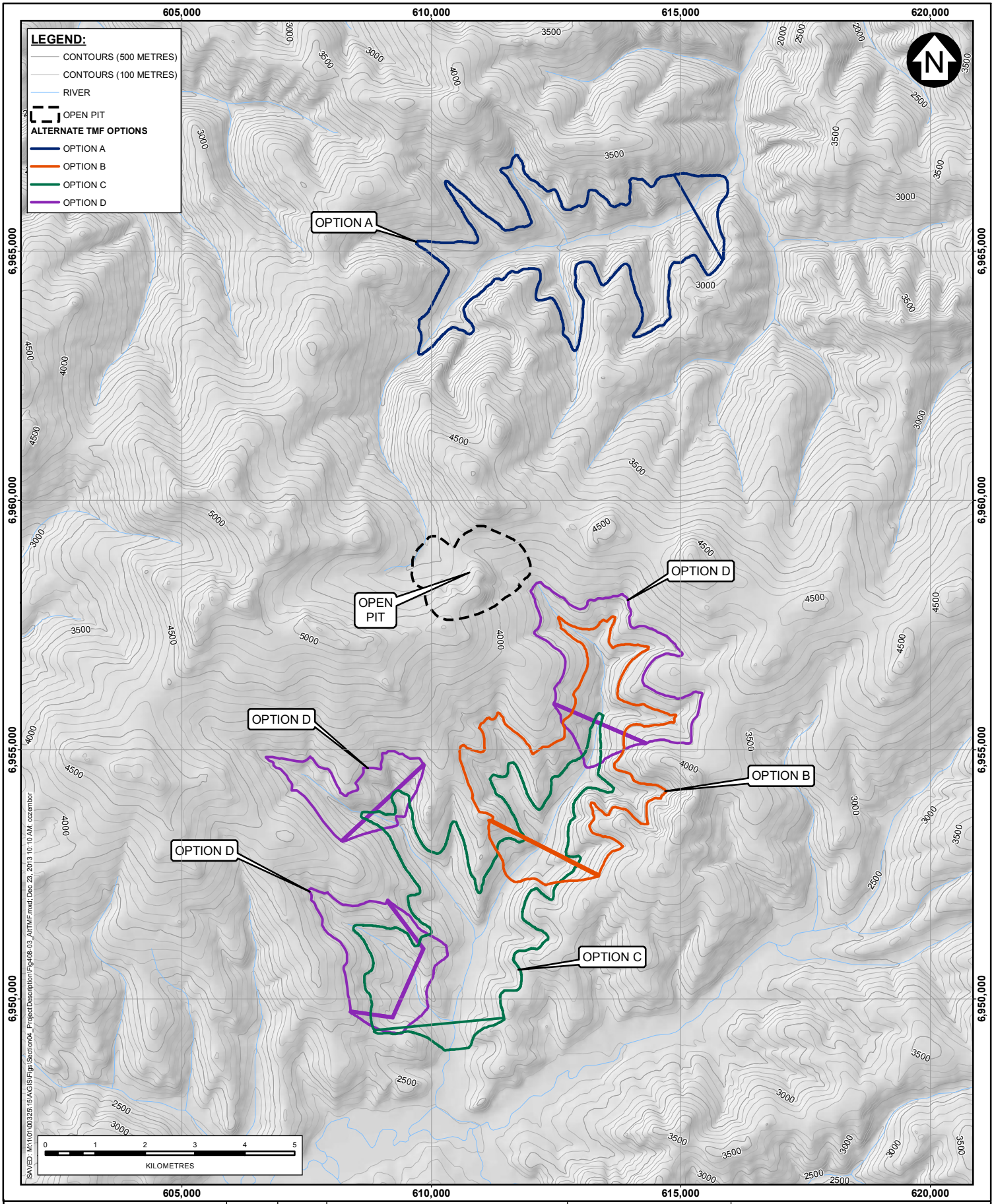
FIGURE 4.8-2

REF 1

P/A VA101-325/15

Table 4.8-11 Preliminary Concepts for TMF Locations

TMF Concepts	Carry Forward into the Assessment	Rationale
TMF Site 1	Yes, as Option B	Upper reaches of Casino Creek, within 10km of the Open Pit. Has expansion potential and does not impact on sensitive fish habitat.
TMF Site 2	Yes, as Option C	Lower Casino Creek, within 10km of the Open Pit. Has expansion potential and does not impact on sensitive fish habitat.
TMF Site 3	Yes, as Option A	Canadian Creek just above the confluence with Britannia Creek which drains to the Yukon River. Within 10km of the Open Pit. Has expansion potential and does not impact on sensitive fish habitat.
TMF Site 4	No	Potential impacts to sensitive fish habitat. Site located more than 10 km from the Casino deposit.
TMF Site 5	No	Potential impacts to sensitive fish habitat. Site located more than 10 km from the Casino deposit.
TMF Site 6	No	Potential impacts to sensitive fish habitat. Site located more than 10 km from the Casino deposit.
TMF Site 7	No	Potential impacts to sensitive fish habitat. Site located more than 10 km from the Casino deposit.
TMF Multiple Sites 8 (Casino Creek, Austin Creek and Brynelson Creek)	Yes, as Option D	Combines three sites with the objective of keeping all tailings above any areas frequented by fish. Located in Upper Casino, Upper Brynelson and Upper Meloy drainages. No expansion potential and requires the construction of three dams and water diversions.



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Knight Piésold CONSULTING

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NOTES:
1. BASE MAP: YUKON GOVERNMENT SHADED RELIEF, EAGLE MAPPING.
2. PROJECTION: NAD 1983 UTM ZONE 7N
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TMF ALTERNATIVE LOCATIONS

FIGURE 4.8-3

REF 1

P/A VA101-325/15

An overview of each alternative is described below followed by an evaluation of the economic, environmental, technical and socio-economic costs and benefits of each alternative and the selection of the preferred alternative TMF location.

Alternative A: Canadian Creek
This TMF is located within Canadian Creek just above the confluence with Britannia Creek, which drains to the Yukon River located approximately 7 km from proposed embankment. The TMF has capacity to store all tailings and waste rock in a subaqueous environment.

Alternative B: Upper Casino Creek
This TMF is located in the upper reaches of Casino Creek and represents the most compact footprint for the overall Project of all alternatives. Capacity of the TMF is sufficient to store all the tailings and waste rock in a subaqueous environment. Other proposed facilities such as the HLF would drain towards the TMF.

Alternative C: Lower Casino Creek
This TMF is in the lower reaches of Casino Creek and is located approximately 5 km further downstream from the Alternative B location. This alternative would provide for sufficient capacity for subaqueous disposal of all tailings and waste rock. As in the Alternative B configuration, other facilities such as the HLF would drain towards the TMF.

Alternative D: Multiple Sites
This alternative combines a number of smaller TMF sites with the objective of avoiding any fish habitat. Due to topographic challenges with this approach, three TMF locations are required to provide the needed storage capacity for tailings and waste rock. The three TMF locations for this alternative are located in Upper Casino, Upper Brynelson and Upper Meloy drainages. The non-acid generating tailings would be stored in the Casino Creek facility while waste rock and the potentially acid generating tailings would be stored in the Upper Brynelson and Upper Meloy drainages.

Economic Viability

The Project related costs represents the initial capital cost for construction of the TMF, sustaining and operating costs for its operation, and closure costs for decommissioning and reclamation.

The initial capital costs related to waste and water management for each alternative TMF location were estimated using the construction of the starter dam(s) in each alternative as an indicator of capital costs. Alternative A and C had similar initial capital costs at approximately $90M each, while Alternative B was estimated at $160M and Alternative D had the highest initial capital cost in excess of $300M.

Sustaining and operating costs for each TMF alternative included estimates for the dam raises, disposal of tailings and waste rock, and water management features. Alternatives A through D have estimated sustaining and operating costs of $2.98B, $2.77B, $2.72B and in excess of $4.00B respectively.

Closure costs for each alternative were also estimated on the basis of comparison to the closure cost estimates provided in the pre-feasibility study for the Project, which was a value of approximately $100M. In the assessment, Alternatives A and B were considered to have closure costs similar to that estimated in the PFS of $100M. Due to the positive water balance in Alternative C there would be some additional costs to provide for water diversions through closure and it was therefore evaluated at a higher cost of $100M + 25%. For Alternative D, with three large embankments, additional costs associated with seepage and water management were also assumed and it was there evaluated at a higher cost of $100M + 100%.

Post closure costs were included to consider the longer term costs for on-going site maintenance and monitoring of each TMF alternative. Estimates were qualitative and were based primarily on the need or potential need for water capture and potentially treatment during post closure. Alternative A, with assumed discharge to the Yukon River was the favored option in terms of post closure costs. Alternative B was slightly less favored, followed by Alternative C with a higher amount of water to manage. Alternative D with three embankments and potentially worse seepage quality associated with the two of these being used to store waste rock had the highest anticipated post closure costs.

In summary, from the economic viability perspective, Alternatives A and C are Preferred alternatives because of their overall low capital, operating and closure costs. Alternative B is an Acceptable alternative because it has slightly higher capital and operating costs than Alternatives A and C. Due to the very high costs associated with Alternative D, it was determined to be an Unacceptable alternative in terms of cost.

Socio-economic Acceptability

Socio-economic acceptability evaluates if the Project will cause positive or negative changes on socio-economic factors. This included issues that were often more difficult to quantify and dealt with issues such as other land uses, permitting, care and maintenance, perception, safety, job opportunities etc.

Traditional Land Use

The evaluation of these options considered differences in land use in the Canadian Creek and Britannia Creek system versus the Casino Creek drainage. It was determined that the traditional land usage in the area included the presence of an old fishing village in Britannia and artefacts identified in Canadian Creek. No traditional use conflicts were identified in Casino Creek drainage. Alternative A was considered less favorable with respect to this indicator than Alternatives B, C and D.

Community Perception

Expectations of community perception considered the proximity and palatability of discharge locations (e.g. Yukon River versus Dip Creek), the height and number of dams and the potential influence of the option on areas frequented by fish. Based on these considerations, Alternative B was evaluated as being the most favorable option, followed by Alternative C and then equally by Alternative A and D.

Consequence of Dam Failure

The consequence of a dam breach was evaluated on the basis of the potential of people, fish, wildlife etc. to exist down gradient of the facility in the drainages considered and the value of habitat that could be affected. This consideration differentiated Alternative A located in Canadian Creek, which feeds into the Yukon River from Options B, C and D located in Casino Creek drainage, which feeds into Dip Creek. It was determined that in this regard, Alternative A would have a significantly higher consequence than Alternatives B, C or D.

Long Term Care and Maintenance

Winter can pose difficulty with respect to long term care of mine sites with respect to access, ice build-up (glaciation), and equipment operations. The winter operating requirements reflect the difficulty of options that include a pump back during the winter as opposed to those that do not. Specifically, it was assumed that Alternatives A and C would require winter pump back components, which would involve a greater involvement and degree of oversight, maintenance and monitoring than those that do not (Alternatives B and D).

Archaeological Risk

Fewer sites of archaeological importance were identified in the Casino Creek drainage compared to sites identified within the Canadian Creek/Britannia Creek system. Alternatives B, C, and D were considered negligible risk to sites of importance, while Alternative A is considered to pose a very high risk.

Potential Economic Benefits

All alternatives have been estimated to provide the same levels of tax contribution and potential for job creation.

Permitting Process

Alternatives B and C are expected to pose a typical degree of permitting complexity as opposed to Alternative A with a very high expected complexity, due to an expectation of negative perception relating to discharge into the Yukon River, and Alternative D with an extremely high complexity, due to a complex configuration of three large dams and large total embankment volume.

Technical Feasibility

Technical feasibility considerations encompassed those aspects that are commonly included in the engineering assessments completed to select tailings facility locations. Comparisons are made in an effort to differentiate between the fundamental engineering considerations for the various alternatives (e.g. capacity of the facility) and the geotechnical considerations that may be alternative-specific (e.g. foundation conditions).

Dam Design

Alternative C is the Preferred alternative in terms of technical design with a lower embankment volume (48 Mm^3) than Alternatives A (87 Mm^3) and B (136 Mm^3), only requiring one large dam and also having a lower dam height (192 m) than Alternatives A (284 m) and B (287 m). Alternative D was the least acceptable of the four Alternatives assessed with the highest dam height (a combined height of 960 m from three large dams [460 m, 345 m and 155 m combined]) and highest total embankment volume (256 Mm^3).

Operational Management

Alternative B was the Preferred alternative from an operational management standpoint, with the lowest impoundment footprint (9.8 km^2) and not requiring greater than average operational oversight and scheduling requirements for both tailings management and PAG waste rock disposal. Alternatives A, C and D were all considered to be more difficult to operate, with Alternative D requiring the greatest operational oversight and scheduling requirements for both tailings management and PAG Waste Rock disposal, and have larger impoundment footprints (10.2 km^2, 13.0 km^2 and 11.1 km^2 respectively).

Construction of Tailing Management Facility

When considering the construction aspects of the Alternatives, the main aspect is that of the dam construction itself. This has been defined further into two main components; geotechnical complexity and scheduling of construction materials.

On the basis of geotechnical complexity, Alternative B was considered to have the most favorable conditions and be the least complex amongst the alternatives. It would drain to the south and therefore would not be anticipated to have as much permafrost (anticipated to be more prevalent on northern slopes). Alternatives A and C had less information available on which to base an assessment, but have the potential for some permafrost on northern slopes (Alternative A in particular) and unconsolidated soils (both Alternatives A and C). Alternative D would involve three dams for consideration, two that have relatively little information available related to foundation conditions but all of which would be located in fairly steep valleys.

Alternative C, with the smallest dam and volume needs was considered the preferred alternative in terms of scheduling construction materials. Alternatives A and B located at higher elevations in the valley were slightly less desirable with higher volume needs and higher required rates of rise. Alternative D was considered to be the least favorable alternative by this measure with a very large volume demand and three structures with the expectation that two of them would be constructed concurrently.

Structural Stability

Considerations of structure stability both during operational phase and afterwards was assessed on the basis of the number of dams, the terrain and abutment conditions, expectations of the colluvial aprons and permafrost conditions, dam height and anticipated tailings beach width.

With these considerations in mind, Alternatives A, B and C with only one main dam were assessed to be preferable over Alternative D with three large structures. Further, the lower dam in Alternative C with the wider tailings beach was considered to be favored over Alternatives A and B, and ground conditions in Alternative B would be expected to be slightly better than that for Alternative A.

Capacity

The ability of each alternative to handle potential expansion was included not only to assess the potential effects of increased production from the project, but also the potential effects of increased volumes of PAG rock, should it occur. The expansion potential was evaluated qualitatively and was largely dictated by the expected size of the alternative, the location of each and the ability to increase the size of the dam(s) if required.

With the most favorable volume to height relationship, Alternative C in the Lower Casino location would have the greatest expansion potential, Alternatives A and B would have similar and lower expansion potential by comparison with less favorable volume to height relationships and Alternative D with three facilities in the upper reaches of three drainages would have the least favorable conditions for expansion potential.

Environmental Acceptability

Environmental acceptability considers the overall environmental effects of the Project, ability to mitigate effects and amenability to reclamation.

Water Management, Water Quality and Groundwater

Alternative B was the Preferred alternative in terms of water management, water quality and groundwater impact. Alternative B is expected to have negligible impact to groundwater quality and groundwater baseline conditions, with the lowest degree of operational water management complexity, no additional long-term maintenance and oversight requirements over typical conditions required, and having the smallest catchment area (37 km^2) and only a low degree of seepage from the TMF expected. Alternatives A and C were slightly less desirable due to slightly higher potential impact to groundwater quality (Alternative A), larger catchment areas (62 km^2 and 77 km^2 respectively), higher degree of seepage (Alternative A), more complex operational water management (Alternatives A and C) and some additional long-term maintenance and oversight requirements (Alternative C). Alternative D was the least favourable of the Alternatives considered with the poorest water quality, the highest required degree of long-term maintenance and oversight expected, a high degree of operational water management complexity and a very high degree of seepage expected.

Flora, Fish and Wildlife Habitat

Alternatives B and D were the most preferable in terms of fish and wildlife habitat. While all four alternatives were considered to have negligible expected impact to flora and wildlife habitat in the TMF footprint area, Alternatives B and D are expected to pose the least risk to fish habitat, having the smallest removal to fish habitat by footprint (< 40 km^2) and having marginal quality of fish habitat under the TMF footprint, at first tributary downstream of the dam during operations and 10 km downstream of the dam during operations. Alternative C was less desirable due to a moderate to high quality of existing fish habitat both under the TMF footprint and at the first tributary downstream of the TMF dam (although a marginal quality 10 km downstream of the dam) and a larger removal of fish habitat by footprint (60 km^2 to 70 km^2). Alternative A poses the greatest risk to fish habitat due to a higher removal of fish habitat by footprint than Alternatives B and D (50 km^2 to 60 km^2), moderate quality of existing habitat both under the TMF footprint and at the first tributary downstream of the dam, and a very high quality of existing fish habitat and a lot of fish 10 km downstream of the dam.

Closure Measures

Alternatives A and B were considered to be the most favoured, with Alternative B requiring the least complex system of expected closure measures and a moderate long-term level and intensity of site activity, and Alternative A requiring a moderately complex system of closure measures with a very low level and intensity of site activities. Alternative C is slightly less desirable with a low degree of complexity and a moderate level/intensity of site activities, and Alternative D slightly less desirable again, with a moderately complex system of closure measures and a moderate level and intensity of site activities at closure.

Conclusion

Alternative B, located in upper Casino Creek is the Preferred TMF location for the Project because it is the most appropriate site for mine waste disposal from economic, environmental, technical and socio-economic perspectives (Table 4.8-13). Alternative C presents increased challenges for implementation and operations, as well as increased potential adverse environmental effects to water quality and fish habitat. Alternative D, utilizing three multiple TMF sites, is an Unacceptable alternative in terms of economic viability and technical feasibility. Similarly, Alternative A, located in Canadian Creek is an Unacceptable alternative in terms of environmental acceptability due to its potential for groundwater quality impacts and relatively high impact to fish habitats.

Table 4.8-12 Summary Evaluation – Tailings Management Facility Alternatives

Performance Criteria	Tailings Management Facility Locations			
	Alternative A – Canadian Creek	**Alternative B – Upper Casino Creek**	**Alternative C – Lower Casino Creek**	**Alternative D – Multiple Sites**
Economic Viability	• Capital ~$90M • Operating ~$3.0B • Closure ~$100M • Post Closure Cost - very low	• Capital ~$160M • Operating ~$2.8B • Closure ~$100M • Post Closure Cost –low	• Capital ~$90M • Operating ~$2.7B • Closure ~$100M +25% • Post Closure Cost – moderate	• Capital >$300M • Operating>$4.00B • Closure ~$100M +100% • Post Closure Cost – very high
	Preferred	Acceptable	Preferred	Unacceptable

Performance Criteria	Tailings Management Facility Locations			
	Alternative A – Canadian Creek	**Alternative B – Upper Casino Creek**	**Alternative C – Lower Casino Creek**	**Alternative D – Multiple Sites**
Socio-economic Acceptability	Evidence of traditional land use; High consequence of dam breach; and Very high complexity of permitting.	Lesser consequence of dam breach; and Most preferable from permitting standpoint.	Lesser consequence of dam breach; and requires winter pump-back components.	Least favourable community perception due to greater degree of involvement, oversight, maintenance and monitoring.
	Acceptable	Preferred	Acceptable	Acceptable
Technical Feasibility	Volume ~87 Mm^3 Footprint ~10 km^2 Dam Height ~284 m	Volume~136 Mm^3 Footprint~9 km^2 Dam Height~287 m Greatest ease of operational management	Volume ~ 48 Mm^3 Footprint ~13 km^2 Dam Height ~192 m Greatest expansion capacity	Volume~ 256 Mm^3 Footprint~11.1km^2 Dam Height ~ 960m (for three dams) Lowest expansion capacity; and most difficult operational management
	Acceptable	Preferred	Preferred	Unacceptable
Environmental Acceptability	Potential for groundwater quality impacts; Higher degree of seepage; and Highest impact to Fish Habitats.	Most favourable water quality conditions; and Least complex system of closure measures.	Some additional long-term maintenance and oversights for water management and water quality required; and Moderate impact to fish habitats.	Least favourable water quality conditions; Least impact to fish habitats anticipated; and Most complex system of closure measures.
	Unacceptable	Preferred	Acceptable	Acceptable
Summary Ratings	**Unacceptable**	**Preferred**	**Acceptable**	**Unacceptable**

4.9 CAPACITY OF RENEWABLE RESOURCES

According to YESAA, when assessing a project, one must consider "the capacity of any renewable resources that is likely to be significantly affected by the project or existing project to meet present and future needs." Although the term is not explicitly defined by YESAA, this Proposal defines "renewable resources" as any natural resource (such as timber) that can be replenished naturally with the passage of time.

The potential Project-specific and cumulative effects of the Casino Project on renewable resources are assessed in detail in Section 6 through Section 12. The biophysical resources assessed are Terrain Features, Water Quality, Air Quality, Noise, Fish and Aquatic Resources, Rare Plants and Vegetation Health, and Wildlife. Additionally, the socio-economic implications of the Project are assessed in detail in Section 13 through Section 19. These sections discuss activities that rely upon renewable resources such as fishing, hunting, trapping, gathering, and public recreation.

No significant adverse residual or cumulative effects to renewable resources are anticipated after the implementation of mitigation measures. Therefore, the effects of the Casino Project on the capacity of renewable resources are not significant. This conclusion is supported by assessment details presented in Section 6 through Section 19.

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5 – ASSESSMENT METHODS AND FRAMEWORKS

5.1 INTRODUCTION

The assessment methods and framework for the Casino Project Proposal have been developed in accordance with the Proponent's Guide for Information Requirements for Executive Committee Project Proposal Submissions (YESAB 2005a). The purpose of the assessment is to provide information requirements necessary for review by the Executive Committee under YESAA.

Five key steps are involved in the effects assessment of the Project:

1. Characterize environmental values and socio-economic values to identify Valued Components (VCs) relevant to the Project and the assessment. The VCs are identified through consultation with First Nations, governmental organizations, regulatory authorities, the public, as well as the professional knowledge of CMC and the assessment team. VCs are selected based on environmental, scientific, social, aesthetic, or cultural reasons. The purposes of identifying VCs are to improve the effectiveness and efficiency of the assessment, facilitate the selection of appropriate study methods and focus the analysis on potential key project-environment interactions; components not identified as VCs may be assessed as intermediate components in the effect pathways for VCs.
2. Set spatial and temporal assessment boundaries. Spatial boundaries are delineated to encompass the physical and socio-economic environment that could reasonably be expected to be directly or indirectly affected by the Project. Temporal boundaries are set to define the time frame over which the assessment will occur.
3. Characterize effects. The effects are characterized by determining the current conditions in which the VC exists; identifying how, when, and where the Project is anticipated to interact with the VC; and identifying how the interactions could affect the VC. Effects are characterized against baseline (or pre-Project) conditions.
4. Identify mitigation measures for the elimination, reduction, or control of adverse environmental or socio-economic effects on the VC. Mitigation measures as outlined by YESAB include restitution, restoration, replacement, compensation, or other appropriate means. For beneficial environmental or socio-economic effects of the Project, where possible, opportunities to enhance the beneficial effects are identified as enhancement measures (Canadian Environmental Assessment Agency 2010).
5. Determine significance of residual effects, those that remain after the implementation of mitigation measures, and provide a discussion of the level of confidence in the prediction.

Residual effects of the Project that remain after the implementation of mitigation measures are carried forward into the Cumulative Effects Assessment (CEA). Cumulative effects are defined by YESAB as incremental changes to VCs as a result of the combined influences of the proposed project in conjunction with other projects or activities. The CEA follows similar steps as the effects assessment of the Project (YESAB 2005a):

1. Identification of VCs chosen for the CEA. For the Project, the VCs chosen for the CEA are the same as those used in the effects assessment of the Project.
2. Setting spatial and temporal assessment boundaries. For the CEA, the spatial scope will consider regional pressures on the VC and encompass known or likely effects originating from other projects and activities on the VC with the RSA. The temporal boundary includes other projects and activities occurring in the past or present, and those with a reasonable likelihood to occur in the future that will potentially

overlap temporally with the life of the Casino Project. A master list of projects and activities that could have an interaction with the residual effects of the Project is provided in Appendix 5B of this Proposal.

3. Characterization of other assumed residual effects and identification of the other assumed residual effects that have the potential to spatially and temporally overlap with the residual effects of the Project. Identification and characterization of the potential cumulative effects that may occur.
4. Identification of additional mitigation measures that CMC or other parties can implement to address cumulative effects and discussion of the anticipated effectiveness of additional mitigation measures and the potential for residual cumulative effects.
5. Determine the significance of residual cumulative effects, those that remain after the implementation of mitigation measures, and provide a discussion of the level of confidence in the prediction.

5.2 SCOPE OF THE ASSESSMENT

5.2.1 Valued Components Selection and Rationale

For this Proposal, VCs are defined as environmental and socio-economic components of the environment that are considered by CMC, public, First Nations, technical specialists, YESAB or other government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance.

The selection of VCs for the Project was informed by professional judgement and the experience of CMC and its consultants and through discussions with YESAB, First Nations, and local community representatives. All VCs selected for the Proposal shared common attributes:

- The VC was considered to have importance;
- The VC is relevant to YESAA requirements;
- A potential Project-VC interaction exists because the VC is potentially affected by Project components and/or activities and is the receptor component; and
- Assessing the Project-VC interaction is feasible because the resulting effect pathways can be clearly understood.

Components that were not selected as VCs were:

- Intermediate components along an effect pathway between the Project and the receptor VC;
- Not responsive to the Project components or activities;
- Management plans and actions, such as Cyanide Management or Emergency Response;
- Better represented by another VC to avoid redundant analysis; and
- Legally binding government requirements exist to protect the component which is intended to avoid potential adverse effects and additional detailed analysis within the context of the Proposal is not needed.

The Proposal is structured and driven by the selected VCs and components not identified as a VC are not explicitly assessed as its own section; these components may be assessed as intermediate components in the effect pathways for VCs or considered in the context of other requirements of the Proposal. The VCs selected for the Proposal are intended to be comprehensive, so that when they are collectively considered, they enable full understanding of the important environmental and socio-economic potential effects of the Project.

The environmental and socio-economic VCs selected and the rationale for their inclusion are presented in Table 5.2-1 along with a sample of components that were not selected as VCs and the rationale for their exclusion. Selected VCs are assessed in detail in Sections 6 through 19 of this Proposal.

Table 5.2-1 Selection of Environmental and Socio-economic Valued Components

Valued Component	Definition	Rationale
Selected Valued Components		
Terrain Features	The geological surface features, topography, and layers of mineral and organic materials covering the underlying bedrock geology.	Terrain features were selected as VCs because of their importance to regional and localized ecological processes. Potential effects of the Project include loss of Beringian features that could be unique to this landscape; fugitive dust deposition or spills as a result of operational incidents affecting soil quality. The quality of soils affects vegetation health and growth, potentially changing vegetation communities. Erosion can affect the health of vegetation and aquatic ecosystems. Increased sedimentation in watercourses as a result of erosion can have detrimental impacts to fish, fish habitat and aquatic resources.
Water Quality	Water quality refers to key parameters such as total suspended solids, acidity, alkalinity, metals, sulphate, cyanide and nutrients.	Water quality was selected as a VC as it forms one of the vital links between the abiotic and biotic aquatic systems and is the foundation to supporting and maintaining healthy ecological processes fish, wildlife, and humans.
Air Quality	Air quality is the composition of outdoor air. Major air pollutants that will be assessed are sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter, as well as Greenhouse Gases (GHG).	Air quality was selected as a VC because mining activities such as fuel consumption, vehicle movement, and material transfer generate air emissions that could cause deterioration of ambient air quality. Clean air in the Yukon is valued unto itself, but additionally fugitive dust and particulate matter may affect receptors such as rare vegetation, wildlife, surface water quality, and soil.
Noise	Noise is commonly defined as a disagreeable sound; sound is the result of pressure vibrations.	Use of heavy equipment and machinery and increased human presence in the area will increase existing sound levels. In the Yukon, the tranquility of the landscape and lack of intrusion from anthropogenic sources holds an intrinsic value; increased noise levels could affect humans and wildlife.
Fish and Aquatic Resources	Fish and aquatic resources include habitat quality, habitat connectivity, water temperature, benthic invertebrate and periphyton population parameters, fish relative abundance, fish condition factor, fish tissue metal concentrations, and sedimentation in spawning areas.	The Proposal will assess the potential effects of the proposed Project on aquatic habitat loss and alteration, and lethal and sub-lethal effects on fish and other aquatic organisms. Primary and secondary producers such as periphyton and benthic invertebrates provide food sources for higher trophic levels (e.g., fish and birds), and are useful as indicators of overall aquatic health due to their relatively long-lived and sedentary life histories. Fish have ecological, cultural, recreational and commercial value as they support various fisheries, and constitute a fundamental role in aquatic ecosystem functioning.

Valued Component	Definition	Rationale
Rare Plants and Vegetation Health	Rare plants are defined as plant species identified as rare, and on the Yukon's Conservation Data Centre's watch or track list. Vegetation includes vascular plants and lichens. Part of the Project area falls within beringia, an area that may have some unique plants and plant ecosystem associations.	Rare Plants and Vegetation Health were selected as VCs due to the potential change in plant abundance because of direct loss of individual plants within the Project footprint, and the effect on plant health from fugitive dust Sensitive ecosystems such as wetlands and lichen-producing habitats are considered an indicator of Project effects on vegetation health.
Wildlife	Wildlife is defined within this assessment as terrestrial mammals, songbirds, raptors and waterfowl.	Wildlife was selected a VC because the Project will interact with wildlife through potential effects to individuals and populations, and their habitats. Wildlife are important because of their value to local people who rely on wildlife as a subsistence and economic resource, and for their intrinsic value as a symbol wilderness and a healthy ecosystem. Potential effects of the proposed Project on wildlife are primarily loss of available habitat due to the Project footprint; sensory disturbance from mine related activities; and mortality due to increased hunter access, collisions with vehicles, and destroying animals as a result of human-wildlife conflict. The assessment of the proposed Project's potential effect is focussed on a number of Key Indicators (KI). Particular species or species groups are selected as KIs to represent potential Project effects on wildlife. KI's for this project include the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, bird species at risk, and waterfowl.
Community Vitality	Demographic conditions and well-being of individuals, families, and communities.	Community Vitality was selected as a VC since the potential change in community demographics, and new project-related income and work schedules could affect social and behavioural and therefore affect the well-being of individuals, families, and communities. The key indicators selected to assess community vitality are Population and Demographics and Community Well-being.
Community Infrastructure and Services	Community Infrastructure and Services will be defined by Municipal infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities); Housing; Transportation; Educational services; Health and Social Services; and Protective Services.	Community Infrastructure and Services were selected as VCs to capture concerns expressed by First Nations and communities in the study area. The potential effects of the proposed project on community's infrastructure and services in the study region will ultimately depend on the extent to which proposed Project activities and Project-related population growth will result in increased demands on regional infrastructure and services, and the ability of the local infrastructure to cope with increasing demands. This VC also evaluates the potential for some regional infrastructure development as a result of the proposed Project.

Valued Component	Definition	Rationale
Employability	Ability of local and regional residents to gain from Project-related employment opportunities.	Employability was selected as a VC to assess the qualifications and experience of local and regional residents. The Employability VC discusses the potential effects of the Project on educational level and experience of study area residents, and discusses training opportunities that maybe driven by the proposed Project.
Employment and Income	Labour availability and their ability to meet potential labour demands during the lifetime of the proposed Project.	Construction and operations of the proposed Project will create employment and income opportunities for residents. Employment and Income were selected as VCs to examine labour availability in the study communities, as well as direct, indirect and induced local employment and employment income derived from the proposed Project.
Economic Development and Business Sector	Economic Growth; Government Revenues; and Business Opportunities in the broader territorial economy.	Construction, operations, and decommissioning, and closure of the proposed Project would generate employment, income and business opportunities throughout Yukon. Economic Development and the Business Sector were chosen as VCs, since Project development would result in increased activity within the territorial economy.
Cultural Continuity	Defined by Traditional Language; Places of Historical and Archaeological Value; Traditional Knowledge; Social, Community and Cultural Activities; and Subsistence and Recreational Harvesting	Cultural continuity was selected as a VC to address the potential of the proposed Project to affect traditional activities and culture and existing heritage resources.
Land Use and Tenure	Land use refers to the human use of the land; land tenure refers to the legal regime governing land ownership.	Land Use and Tenure was selected as a VC due to the potential interactions of the Project with other land users in the area. The various land uses include: Parks and Protected Areas, Trapping and Guide Outfitting, Hunting and Fishing, Recreation and Tourism, Permits and Licenses, Mining and Mineral Claims, Forest Uses (firewood collection and gathering), Transportation and Access, Energy and Utilities, and Traditional Land Use.
Components Not Selected as Valued Components		
Hydrology	Surface water quantity (annual streamflow including peak and low flows)	Hydrology was not selected as a VC but is assessed as an intermediate component in the effect pathways for the Water Quality VC and Fish and Aquatic Resources VC. The baseline hydrology report and hydrology assessment are included as appendices of this Proposal.

Valued Component	Definition	Rationale
Hydrogeology	Groundwater flow rate and gradient.	Hydrogeology was not selected as a VC but is assessed as an intermediate component in the effect pathway for the Water Quality VC. A technical report is appended to the Proposal that provides detailed information on boundary conditions and aquifer properties; a conceptual model provides a generalized view of boundaries and hydrostratigraphic units potentially affected by the Project components and activities. Hydrogeological conditions such as hydraulic conductivity, porosity, average gradient, velocity, and travel time are described in the technical report.
Climate	Prevailing weather conditions in an area over a long period.	Climate was not selected as a VC but measured climate parameters (temperature, precipitation, wind direction, etc.) is integrated into the assessment of VCs such as Air Quality and Noise and are relevant to the calculation of hydrologic data.
Climate Change	A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties that persists for an extended period, typically decades or longer	Climate change was not selected as a VC because quantitative methods are not available to assess the Project's actual contribution or effects on climate change. The Proposal includes an assessment of the potential effects of Climate Change on the Project and predictions of the Project's contribution to greenhouse gases.
Health and Safety	Worker and public health and safety	Worker and public health and safety was not selected as a VC but is assessed as part of the assessment of other VCs, additional information requirements of YESAB (i.e. accidents and malfunctions) and through mandatory compliance with regulations. Worker Health and Safety: CMC will comply with the *Worker's Compensation Act and Regulations*, the *Occupational Health and Safety Act*, and the *Public Health and Safety Act*. Mine operations will be conducted in a manner to minimize risk through training, awareness, and continuous improvement. Worker health and safety will form a component of the detailed Occupational Health and Safety Plan developed as part of the Quartz Mining License application after the YESAB review. Human Health and Safety: Human health and safety is addressed as part of the water quality VC, air quality VC, noise VC, community vitality VC, community infrastructure and services VC, accidents and malfunctions and conceptual environmental management plans.

5.2.2 Assessment Boundaries

Assessment boundaries delineate the spatial and temporal scope of the Project assessment; the spatial boundary is known as the "study area", (YESAB 2006b). The temporal boundary is the time frame, or the period over which the effects are assessed (YESAB 2006b).

Spatial Bounding

Spatial boundaries are the geographical limits to which potential effects to a VC are expected to extend and beyond which effects are expected to become insignificant (YESAB 2006b). Spatial boundaries for each VC encompass areas that can be reasonably expected to be affected by the Project and beyond which potential effects are expected to be non-detectable. Study areas take into account the spatial range of the VC and any relevant ecological, technical, and social or political considerations (YESAB 2005a). Spatial boundaries for the effects assessment are determined on a VC-specific basis and are described in the relevant sections of the Proposal, as well as illustrated on maps of appropriate scale. Two spatial boundaries are delineated: the Local Study Area (LSA) and the Regional Study Area (RSA), which are defined as follows:

- LSA is the spatial area within close proximity to the project under review where direct effects are anticipated. The LSA is generally the Project footprint.
- RSA is the spatial area within which cumulative effects are assessed; it extends a distance from the project footprint in which both direct and indirect effects are expected to occur (Hegmann et. al. 1999). The RSA encompasses an area large enough to consider most regional pressures (YESAB 2006a).

Project effects on socio-economic VCs inherently assess cumulative effects issues because of the use of VCs or indicators that are representative of regional conditions (YESAB 2006b). Therefore, for socio-economic VCs such as Economic Development only one study area may be defined. Alternatively, study areas may be defined in relation to direct and indirect effects or induced effects (YESAB 2006b).

Temporal Bounding

Temporal boundaries are the periods of time examined in the effects assessment and account for the different phases of the Project (YESAB 2006b). A life of project schedule for the phases that make up the Casino Project is presented in Table 5.2-2. Some Project components and activities will span more than one Project phase.

Table 5.2-2 Casino Project Phases

Project Phase	Period
Construction (C)	4 years
Operation (O)	22 years
Closure and Decommissioning (CD)	3 years
Post-Closure (PC)	5 years

Life history characteristics for environmental VCs (e.g., winter or summer habitat use, migration periods) or in reference to any cyclical or seasonal aspects of socio-economic VCs (e.g., hunting seasons) are assessed in relation to the Project phases and discussed in detail in Sections 6 to 19 of this Proposal.

5.2.3 Traditional Knowledge Integration

CMC considers traditional knowledge and community knowledge integral to the assessment and has endeavoured to develop a sound understanding of First Nations and community issues and expectations for

incorporation into the assessment. Traditional Knowledge includes traditional ecological knowledge (knowledge about the environment) as well as "knowledge about cultural, economic, political and spiritual interrelationships" (CEA Agency 2013). First Nations and community knowledge elicited through consultation activities is incorporated where available into the baseline information for each VC and is given equal weight as all scientific information and other information, as required under YESAA.

5.2.4 Baseline Information

Baseline (pre-Project) information is presented for each VC. Baseline information includes information on the setting and condition in which the VC is found. Baseline information presented for each VC includes:

- Relative qualitative or quantitative data for regional and local study areas; and
- Relevant standards and guidelines followed in collecting and analysing data.

All sources of baseline information used to characterize the VC condition and setting will be presented, including any available traditional knowledge. Limitations or uncertainties associated with baseline information and analysis, including assumptions, and the reliability, variability, and confidence in the results are discussed for each VC in each section. An overview of the information and data are provided in the body of the Proposal; detailed data are provided in technical reports in the Appendices.

5.3 ANALYSIS OF PROJECT-SPECIFIC EFFECTS

5.3.1 Project Interactions and Potential Effects

The next step in the effects assessment is to identify all potential interactions between Project components and activities (for all Project phases) and the identified VC. The Project Components and Activities List used in the effects assessment is included in Appendix 5A. For VCs where there is predicted to be an intangible or value-based rather than physical interaction (e.g., Economic Development), or where an interaction is best understood by considering the Project as a whole, "Mine Development/Presence" is used as the Project component. Table 5.3-1 is a representative table summarizing the potential interactions between the Project components and activities and VCs. For each VC the cause-effect pathway, or mechanism of interaction, indicating how the Project component interacts with the VC is identified. Where the Project and VC is not anticipated to have an interaction, a rationale is provided. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Table 5.3-1 Potential Interactions between the Project and Valued Component

Project Components and Activities	**Project Phase**[1] (C, O, DC, PC)	**Potential Interaction** (Yes/No)	**Mechanism of Interaction/ Rationale for No Interaction**

Note:

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Where an interaction is anticipated to occur between the Project and VC, the potential effect of the Project on the VC is described and characterized. This step includes identification of key indicators, also known as measureable

parameters or attributes, and an assessment of the direction of the potential effect (either adverse or beneficial). Potential effects of the Project are described and measured in terms of changes to VCs from baseline conditions, or existing guidelines or standards. Potential effects are summarized in tables as shown in Table 5.3-2. A detailed explanation as to how potential effects were predicted, such as predictive modelling and professional judgement, is provided in the text. Any underlying assumptions, data, or calculations leading to the results shown in the table will be discussed.

Table 5.3-2 Potential Effects of the Project

Mechanism of Interaction	Key Indicator(s)[1]	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction (Adverse/Beneficial)

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

Based on the VC, the discussion of potential adverse and beneficial effects of the Project may include:

- Consideration of spatial boundaries of the potential effect associated with the VC;
- The temporal phases and specific Project components and activities associated with the potential effect;
- Measurable parameters to quantitatively or qualitatively evaluate the potential effect;
- Traditional and community knowledge;
- Land use planning information; and
- Socio-economic data and trends.

All potential effects of the Project on VCs are carried forward into the effects assessment. For adverse potential effects, mitigation measures will be proposed by CMC to eliminate, reduce or control the adverse environmental or socio-economic effects on VCs. For beneficial potential effects, where possible, CMC will consider opportunities to enhance the beneficial effects.

5.3.2 Identification of Mitigation Measures and Residual Effects

Where an adverse environmental or socio-economic effect on a VC is anticipated, mitigation measures are proposed to eliminate, reduce, or control the potential effect and include restitution measures such as replacement, restoration, compensation or other means (YESAB 2005a). Where a beneficial environmental and socio-economic effect on a VC is anticipated, where possible, opportunities to enhance the beneficial effect will be considered and are identified as enhancement measures. All mitigation and enhancement measures that are recommended for implementation will be technically, environmentally, and economically feasible. Mitigation and enhancement measures can include the following types:

- Project design and considerations;
- Revised Project design or alternate approaches;
- Management practices, worker training, pollution prevention technologies;

- Compensation or restoration activities; and
- Monitoring and management plans.

For each potential environmental and socio-economic effect, proposed mitigation and enhancement measures are identified in a table of the format shown in Table 5.3-3. A description of the proposed mitigation or enhancement measures, including implementation methodologies, proposed schedules and monitoring or management plans during the life of the Project will be provided in text.

Table 5.3-3 Proposed Mitigation Measures and Residual Effects

Potential Effect	**Project Phase**[1] (C, O, CD, PC)	**Direction** (Adverse/Beneficial)	**Proposed Mitigation Measure**[2] (or Enhancement Measure)	**Predicted Effectiveness** (Low, Moderate, High, Unknown)	**Residual Effect** (Yes/No)

Notes

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

For adverse potential effects, Table 5.3-3 will include a description (e.g., Low, Moderate, High, or Unknown) of the predicted effectiveness of the proposed mitigation measure to manage adverse environmental or socio-economic effects based on the criteria proposed in Table 5.3-4. The predicted effectiveness of the mitigation measures is a combination of the implementation experience of the proposed measure and the predicted response of the key indicator, measureable parameter or attribute after implementation. Where mitigation measures are proposed to be implemented for which there is little experience or for which there is some question as to their effectiveness, the potential risks and effects will be described. For beneficial potential effects, mitigation measures are not required because the beneficial effect is desirable and enhancement measures are proposed, if possible.

Table 5.3-4 Level of Predicted Effectiveness of Mitigation Measures

Predicted Effectiveness	Implementation Experience	Response of the Key Indicator, Measurable Parameter or Attribute
Low	The proposed mitigation measure has been implemented in a different circumstance (e.g., different industry with dissimilar settings) and there is low level of experience with implementation.	After implementation, there is still a major measurable change in the key indicator, measurable parameter or attribute from the baseline and a permanent effect.
Moderate	The proposed measure has been implemented in similar circumstances (e.g., different industry with similar settings) and there is moderate level of experience with implementation.	After implementation, there is still a measurable change in the key indicator, measurable parameter, or attribute from the baseline but the effect is not permanent.
High	The proposed measure has been implemented in the same circumstances (e.g., same industry with similar settings) and there is a high level of experience with implementation.	After implementation, there is no measurable change in the key indicator, measurable parameter or attribute from the baseline (e.g., there is no effect, or the effect returns to its baseline condition) or an enhancement is evident.
Unknown	The mitigation measure has not been tried elsewhere and there is an unknown level of experience with implementation.	After implementation, the response of the key indicator, measurable parameter or attribute compared to the baseline is unknown.

Effects of the Project (adverse and beneficial) that remain after the implementation of mitigation measures are referred to as residual effects and are identified in Table 5.3-3. In some cases, residual effects may be completely eliminated through mitigation measures such as compensation, particularly when compensation comprises of on-site or proximal habitat compensation. Only residual effects are carried forward into the next step of the effects assessment where the significance of each residual effect is characterized.

5.3.3 Significance of Residual Effects

The YESAA requires that both adverse and beneficial residual environmental and socio-economic effects be assessed for significance (YESAB 2006b). Residual effects are characterized against eight criteria and associated ratings, outlined in Table 5.3-5 with general definitions, and defined specifically for each VC in Sections 6 to 19 of this Proposal. These eight criteria describe both the characteristics of the residual effect (e.g., direction, magnitude) and the characteristics of the VC being considered (e.g., context) (Lawrence 2007).

Table 5.3-5 Criteria for Characterizing Residual Effects

Criteria	Rating	General Definition
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	The amount or intensity of change of the residual effect.
	Medium	
	High	
Geographic Extent	Localized	The spatial extent over which the residual effect occurs.
	Widespread	
Duration	Short Term	The period of time over which the residual effect is measurable.
	Long Term	
	Permanent	
Frequency	Infrequent	The number of times the residual effect may occur.
	Frequent	
Reversibility	Reversible	Whether baseline conditions will return following cessation of an interaction.
	Irreversible	
Context	Low resilience	The ability of the VC to accommodate change.
	High resilience	
Probability of Occurrence	Low	The likelihood that the residual effect will occur.
	High	

Where legislation, thresholds, standards, or objectives exist to define criteria rating and are relevant to the assessment they will be used rather than comparative or relative criteria (Lawrence 2007). Similarly, quantitative values, if available, are used preferentially (when available) over qualitative criteria. The relative importance of each criterion in determining the overall significance of the residual effect will vary by VC and professional judgement will be used in determining if a criterion is given more or less weight in determining significance. In addition, the significance of the residual effect on a VC can be determined with consideration of one or more of the following factors (Canter 1999):

- Guidelines or standards outlined in laws, regulations, policies, etc.;
- Pre-defined thresholds;
- Setting (e.g., is the Project in a protected habitat or sensitive zone, or land-use zone);
- The intensity of the residual effect (e.g. anticipated percentage change and whether the change is within normal variability); and
- Public concerns.

All residual environmental and socio-economic effects (adverse and beneficial) and the significance determinations are summarized as shown in Table 5.3-6.

Table 5.3-6 Significance of Residual Effects

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Residual Effect #1									
Residual Effect #2									

5.3.4 Discussion of Significance of Residual Effect

A concluding discussion is provided for each VC summarizing the residual effects. Additionally, a confidence rating is applied to the overall significance determination for residual effects as shown in Table 5.3-7. Confidence measures how well residual effects are understood including the consideration of the acceptability of the data and analysis methods used to predict and assess potential environmental and socio-economic effects. The confidence rating considers the accuracy and application of analytical tools, an understanding of the effectiveness of mitigation measures, and an understanding of known responses of the measurable parameters to potential effects. The confidence ratings are:

- Low (<50% confidence)-not confident in prediction and the prediction could vary considerably. The mechanism of interaction between the Casino Project and the VC is poorly understood and/or data or analyses are incomplete, leading to a high degree of uncertainty in the prediction.
- Moderate (50% to 80% confidence)-confident in prediction, and the prediction has moderate variability. The mechanism of interaction between the Casino Project and the VC is not fully understood, and/or data or analyses are incomplete, leading to a moderate degree of uncertainty in the prediction.
- High (>80% confidence) - confident in prediction and the prediction could have low variability. The mechanism of interaction between the Casino Project and the VC is well understood, and/or data for the analyses are complete, leading to a low degree of uncertainty in the prediction.

Table 5.3-7 Summary of Residual Effects

Residual Effect	Direction (Adverse/Beneficial)	Significance (Significant/Not Significant)	Level of Confidence (Low, Moderate, High)

5.4 CUMULATIVE EFFECTS ASSESSMENT

5.4.1 Introduction

Cumulative effects can be described as "The combined impacts that accumulate from a series of similar or related individual actions, contaminants, or projects" (YESAB 2005b). The residual effects of the Casino Project on VCs will be assessed in relation to the residual effects of other past, present or likely future projects and activities. In accordance with the YESAA, consideration must be given to (YESAB 2006a):

> "The significance of any adverse cumulative environmental or socio-economic effects that have occurred or might occur in connection with the project or existing project in combination with the effects of:
>
> (i) other projects for which proposals have been submitted under subsection 50(1), or
>
> (ii) other existing or proposed activities in or outside Yukon that are known to the designated office, executive committee or panel of the Board from information provided to it or obtained by it under this Act."

The magnitude of the combined effect can be additive (equal to the sum of individual effects from each project or activity) or synergistic (equal to an effect different than the sum) (YESAB 2006a).

5.4.2 Identification of other Projects and Activities that could lead to a Cumulative Effect

The Proposal includes a master list of all potential past, present and likely future projects and activities that could reasonably be expected to have a spatial or temporal interaction with the residual effects of the Casino Project (Appendix 5-B). These past, present and likely future projects and activities, at first glance, have the potential to lead to a cumulative effect with the residual effects of the Casino Project.

- Past projects and activities are defined as past projects and land use activities which are no longer active and have been closed.
- Present projects and activities are defined as existing and active projects and land use activities.
- Likely Future projects and activities are defined as reasonably foreseeable projects or landuse activities for which proposals have been submitted under subsection 50(1) of YESAA, or have entered into a formal project approval or permitting process.

The following information sources were reviewed or consulted to collate a preliminary list of projects or activities:

- Yukon Government department websites:
  - Yukon Environmental and Socio-economic Assessment Board Registry;
  - Yukon Land Use Planning Council;
  - Geomatics Yukon;
  - Environment Yukon; and
  - Energy, Mines and Resources.
- Mining Yukon;
- Yukon Outfitters Association website;
- First Nations websites; and
- Discussion with regulators, First Nations, and/or stakeholders.

The projects and activities identified in Appendix 5B include quartz mines, mineral and placer claims, heritage sites, and registered outfitting and trapline concessions. Appendix 5B will be used as master list for each VC to

identify other projects and activities that may spatially and temporally overlap with the residual effects of the Casino Project.

5.4.3 Residual Effects of Other Projects and Activities and Potential Cumulative Effects

Three conditions of the residual effects of past, present and likely future projects and activities must be met to warrant further assessment of cumulative effects with the Casino Project, including:

1. Adequate qualitative and/or quantitative information which is publicly available to allow for spatial and temporal characterization, and
2. Spatial overlap with the residual effects of the Casino Project, and
3. Temporal overlap with the residual effects of the Casino Project.

The assessment of potential cumulative effects is carried forward only when all three of the conditions are met.

The projects and activities identified in Appendix 5B will be reviewed for each VC to determine if there is adequate qualitative and/or quantitative information available to allow for spatial and temporal characterization of the assumed residual effect. Projects and activities that meet this condition will be summarized in a table of the format shown in Table 5.4-1. Projects and activities, identified in Appendix 5B, that don't meet this condition will not be carried forward in the CEA. Where numerous projects or activities in the same category (e.g., placer claims, quartz claims) are assumed to cause similar types of residual effects, these will be assessed collectively.

Table 5.4-1 Residual Effect Information for Other Projects or Activities

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Activity A (e.g. Forestry)				
Project B (e.g. Placer Mining)				
Project C (e.g. Quartz Claim)				

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

A CEA interaction matrix is used to indicate if there is a temporal and spatial overlap between the residual effects of the Casino Project and the assumed residual effects of other projects and activities, an example is shown in Table 5.4-2. If there is a potential for an interaction spatially and temporally, the cell is marked YES, and the interaction is analyzed. A cell marked YES does not presume there to be cumulative effect; rather, it is an indication that there is a potential for a cumulative effect. A detailed explanation will be provided in the text as to how the interactions were derived, by discussing any baseline information, the source of the information, and any underlying assumptions. If the cell is marked as NO, a rationale describing why there is no predicted interaction is provided in the text, and those residual effects are no longer carried forward in the assessment.

Table 5.4-2 Cumulative Effects Assessment Interaction Matrix

Casino Project Residual Effect	Potential Spatial and Temporal Overlap		
	Activity A (e.g. Forestry)	**Project B** (e.g. Placer Mining)	**Project C** (e.g. Quartz Claim)
	Assumed Residual Effect #1	Assumed Residual Effect #2	Assumed Residual Effect #3
Casino Project Residual Effect #1	YES	YES	NO
Casino Project Residual Effect #2	NO	NO	YES
Casino Project Residual Effect #3	NO	NO	NO

Note

1 YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

Only assumed residual effects of other projects and activities that meet all three conditions are carried forward into the CEA as potential cumulative effects and summarized in a table as shown in Table 5.4-3.

Table 5.4-3 Potential Cumulative Effects

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Casino Project Residual Effect #1	Activity A (e.g. Forestry) Project B (e.g. Placer Mining)	Cumulative Effect #1
Casino Project Residual Effect #2	Project C (e.g. Quartz Claim)	Cumulative Effect #2

5.4.4 Proposed Mitigation Measures and Residual Cumulative Effects

Mitigating a local effect (i.e., a Project-specific effect) as much as possible is the best way to reduce potential cumulative effects (Hegmann et al. 1999, YESAB 2006a). The possibility of implementing additional mitigation measures by CMC or other parties responsible for the residual effects will be considered in the CEA. All potential cumulative effects on a VC are summarized in tabular format as shown in Table 5.4-4.

Mitigation measures applied or recommended for potential cumulative effects may be considerably different than those applied to Project-specific effects; often these additional mitigation measures will require regional stakeholder involvement, since recommendations for regional initiatives may be the only method to address complex regional cumulative effects (Hegmann et al. 1999). Additional Project-specific mitigation could include: recommending more effective primary control measures that are technically and economically feasible; compensation; or contribution of Project data and input for any regional planning initiatives (Hegmann et al. 1999). For socio-economic residual cumulative effects YESAB (2006a) recommends mitigation measures in the form of reparation such as the establishment of additional social infrastructure.

Table 5.4-4 Additional Mitigation Measures and Residual Cumulative Effects

Potential Cumulative Effect	Mitigation Measures for Project-Specific Effects[1]	Additional Mitigation[2] (if possible)	Effectiveness of Additional Mitigation Measure (Low, Moderate, High, Unknown)	Residual Cumulative Effect (Yes/No)
Potential Cumulative Effect #1				
Potential Cumulative Effect #2				

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

5.4.5 Significance of Residual Cumulative Effect

The significance of cumulative effects is assessed following the same methodology and criteria used for determining the significance of residual Project-specific effects, as outlined in Section 5.3.3.

Table 5.4-5 Significance of Residual Cumulative Effects

Residual Cumulative Effect	Predicted Degree of Effect After Additional Mitigation Measures								Significance of Residual Cumulative Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Residual Cumulative Effect #1									
Residual Cumulative Effect #2									

5.4.6 Discussion of Significance of Residual Cumulative Effect

A concluding discussion is provided for each VC summarizing the residual cumulative effects. Additionally, a confidence rating is applied to the overall significance determination for residual cumulative effects as shown in Table 5.4-6 using the same criteria applied to determining the confidence ratings for Project-specific residual effects outlined in Section 5.3.4.

Table 5.4-6 Summary of Residual Cumulative Effects

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Residual Cumulative Effect #1			
Residual Cumulative Effect #2			

5.5 SUMMARY AND CONCLUSIONS

A concluding discussion and summary is provided for the VC summarizing the residual effects and cumulative residual effects.

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6 – TERRAIN FEATURES

6.1 INTRODUCTION

This section presents the baseline information with respect to terrain features in the Casino Project and provides an assessment of potential effects and cumulative effects on terrain features from the Project. Proposed mitigation actions are identified that will minimize or reduce Project effects on terrain features. When Project effects cannot be completely mitigated, potential cumulative effects are described.

The assessment focuses on issues related to three unique landforms, or terrain features, of geological or ecological interest that occur in the Project area: thaw lakes, pingos, and tors. Clearing and earth moving for the Project footprint will potentially partially or totally remove some of these individual features. These landforms are important because they are geologically or ecologically unique and are sensitive to disturbance. Definitions of these landforms are as follows:

- A **thaw lake** is a lake found in thermokarst that develops in a depression and accumulates either permafrost melt water or meteoric (e.g., rain) water.
- A **pingo** is a mound of earth-covered ice which grows as a result of periglacial processes.
- A **tor** is a large, free-standing rock mass that is the product of mechanical and chemical weathering.

The scope of this assessment is based on various guidelines provided by YESAB, previous projects completed for an Executive Committee Level review, and environmental assessments completed for projects of a similar size in other jurisdictions. Additionally, the assessment scope and methods were informed by input from regulatory agencies and concerns raised during stakeholder engagement meetings.

6.1.1 Regional Setting

The Project is located near the centre of the Klondike Plateau and Yukon Plateau-Central ecoregions (Smith et al. 2004) and the Klondike Plateau Physiographic Area (Matthews 1986). The area also lies within Beringia, a region of the Yukon that remained un-glaciated during the most recent glacial advance and is hypothesized to be one of the routes that allowed humans to expand our range into the Americas. This region is unique in North America.

The late Pliocene and Pleistocene glacial history of the area is important to the understanding of present day surficial geology, terrain, and soils. During these epochs, the Cordilleran glacial ice advances covered much of the Yukon landscape; thick ice sheets eroded surface sediments and sculpted the landscape leaving distinct terrain features and surficseial sediments at the ice margins and in meltwater channels. Portions of the central Yukon were arid and unglaciated during the epochs. Terrain that was not overridden by ice sheets (glacial refuges) were left exposed to the environment resulting in extensive surface weathering, erosion, and soil development. A large portion of the Project area was unglaciated; prominent landforms associated with the unglaciated terrain in this region are tors.

The Project area is a periglacial environment where the land surface is subject to freeze-thaw cycles. Permafrost is a feature of periglacial environments where the interaction of air temperature and groundwater alter the characteristics of the surficial geology by the presence of ice. Ground ice develops throughout the permafrost horizon and is formed by ice segregation during downward migration of water at the end of summer period. Growth and decay of ground ice leads to heaving of the ground surface. Permafrost is typically overlain by an active layer — an area at the surface that freezes in winter and thaws in summer and where numerous periglacial

processes (geomorphic processes that occur in cold regions) such as frost action, solifluction, sheetwash, retrogressive thaw slumps and thaw flows take place.

Permafrost-related landforms such as cryoplanation terraces (erosional steps in bedrock), felsenmeer or blockfield (surface covered by block-sized angular rock caused by freeze-thaw weathering of bedrock), pingos (ice-cored mounds), and thermokarst formations (permafrost landscapes associated with ice degradation) can persist on the landscape for long periods of time; however, these landforms are typically dynamic and transient features that respond to environmental changes (temperature) by aggrading or thawing. In some areas, thaw lakes form as pooled water collects in depressions, further accelerating the rate of localized permafrost thaw. Thermokarst landscapes are dynamic and actively developing in fine-grained, saturated deposits.

6.1.2 Rationale for VC Selection

Terrain features were selected as a Valued Component (VC) because of their uniqueness as geological and/or ecological features of interest. Potential effects of the Project on this VC include loss of features that could be unique to this landscape.

6.2 ASSESSMENT BOUNDARIES

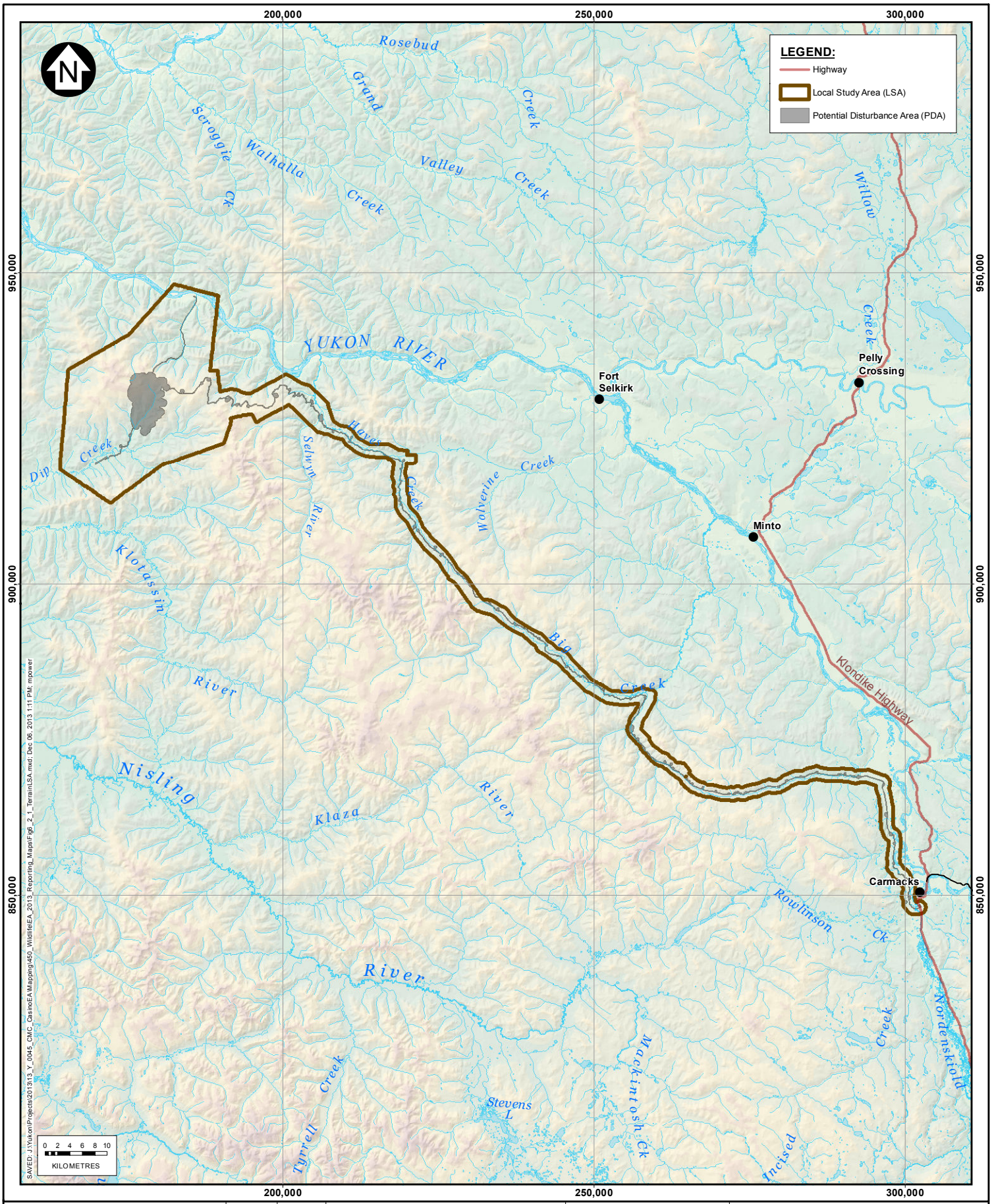
6.2.1 Spatial Boundaries

Potential Disturbance Area— The PDA is an estimate of the maximum amount of area disturbance that will occur from Project components and activities. The PDA boundaries are based on information available at the time of submission of the Proposal. For the purpose of quantifying the likely area of potential disturbance, the following assumptions are made:

- Mine site components and activities will take place within 500 m from the outermost edge of the proposed arrangement.
- Airstrip, airstrip access road, Freegold Road Extension, Freegold Road Upgrade, and the water pipeline components and activities will take place within 50 m of either side of the proposed alignment.
- Activities associated with the potential borrow areas will take place within 100 m of either side of the proposed area. Any segments of the PDA associated with borrow areas must be accessible by the proposed roads or existing roads; if not, the PDA area was extended to connect the road and borrow areas.

For the purposes of the terrain features effects assessment, the PDA is a conservative estimate used to represent the maximum potential loss of terrain features from the Project footprint. The PDA encompasses an area of 80.6 km², but the actual mine footprint is estimated to be 23.5 km².

Local Study Area — The Local Study Area is the zone where there is a reasonable potential for immediate interaction between Project components and terrain features. This area is also the maximum extent of detailed terrain mapping conducted as a baseline component of the Project. The LSA includes a boundary ranging from a 1.5 to 2.5 km buffer around the mine site, airstrip, airstrip access road, Yukon River Access Road, and the Freegold Road Extension and Upgrade, totalling 896 km². This LSA is slightly larger than the LSA used in Appendix 6A because the baseline report does not include the existing section of the Freegold Road that will be upgraded. The boundaries of the LSA and the PDA are shown in Figure 6.2–1.



PREPARED BY:

EDI

DESIGNED	MP
DRAWN	MP/LG
CHK'D	MS
APP'D	MS
REV	-
DATE	06/12/2013

SOURCES:
Potential Disturbance area: Knight Piesold, Sept. 2013.
Wildlife assessment areas developed by EDI, 2013.

1. BASE MAP: Geomatics Yukon - YG, NRCan
2. PROJECTION: NAD 1983 CSRS Yukon Albers
3. COORDINATE GRID: Metres

* Study area varies depending on measureable parameter.

CASINO COPPER AND GOLD

CASINO PROJECT

Study areas used for terrain assessments

FIGURE # 6.2-1

REF REPORT 1

P/A VA101-325/15

6.2.2 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Project. Details on activities associated with the Construction, Operations, Closure and Decommissioning and Post-Closure phases of the Project is provided in Section 4.

6.3 CRITERIA FOR ASSESSING SIGNIFICANCE

There are no known terrain features that are protected in the Project area or areas of terrain features of known cultural or scientific value. There are also no known thresholds or levels of disturbance that are published or otherwise for characterizing the significance of effects on terrain features. Therefore, a general characterization of what may be considered a significant effect on terrain is based on measureable effects and proportional loss. Magnitude (in this case proportional loss of terrain features) and the geographic extent (e.g., minor if limited to Project footprint, extensive if the effects on terrain features extend beyond the LSA) are key factors in determining significance. Permanent effects are expected to occur within the Project footprint/PDA on a high proportion of the features present within the PDA. The other criteria such as duration, frequency, reversibility and context, if they are relevant, are used to further characterize the effect. Criteria listed in Table 6.3-1 was used to determine the significance of residual effects on terrain features.

Table 6.3-1 Criteria for Significance of Residual Effects for Terrain Features

Criteria	Rating	Definition
Magnitude	Low	Loss of less than ≤5% of individual terrain features
	Medium	Loss of >5% to ≤10% terrain features
	High	Loss of >10% of individual terrain features
Geographical Extent	Localized	Effect limited to within the Potential Development Area (e.g., Project footprint)
	Widespread	Effect extends outside of the Local Study Area
Duration	Short Term	Effect occurs less than one year, terrain feature reclamation is possible
	Long Term	Effect occurs through life of Project, but reclamation is possible
	Permanent	Terrain feature is destroyed, reclamation is not possible
Frequency	Infrequent	Effect on terrain features occurs only once (e.g., during construction)
	Frequent	Effect occurs throughout the Project
Reversibility	Reversible	Terrain feature can be reclaimed following the cessation of the interaction.
	Irreversible	Terrain features cannot be reclaimed following the cessation of the interaction.
Context	Low resilience	Feature cannot withstand disturbance.
	High resilience	Feature can withstand disturbance.
Probability of occurrence	Low	Low likelihood that permanent damage to a terrain feature will occur.
	Moderate	Moderate likelihood that permanent damage to a terrain feature will occur.
	High	High likelihood that permanent damage to a terrain feature will occur.

6.4 BASELINE CONDITIONS

The Project is within an area of the central Yukon Territory characterized by a unique glacial history. The landscape is comprised of glaciated and unglaciated terrain with landforms and geomorphic processes that are modified by permafrost and other periglacial processes. Appendix 6A summarizes information on the geology, terrain and soils within the LSA.

The surficial geology and terrain are summarized in a map-based inventory of the LSA. This mapping was used to develop an understanding of surface materials, geomorphic processes and terrain hazards that are important to the design of the Project. Broad terrain units were developed to describe the landscape-based recurring surficial geologic patterns found in the LSA. The terrain units are based on the terrain morphology, the presence and nature of soil or rock exposures, geomorphic processes and vegetation associations.

The 'sheltered' north-facing slopes have a shallow permafrost table. Sheetwash and solifluction occur during seasonal melting within the active layer of these slopes and result in colluvial soils intermixing with organic soils and loess deposits to form poorly-drained colluvial aprons at the toes of the slopes. The south-facing slopes have a deeper permafrost table or are free of permafrost. Permafrost-related processes are far less prevalent on these slopes and the surficial soils tend to be better drained. There is a depressed permafrost table associated with the main watercourses on the valley floor. The valley profiles are distinctly asymmetric with shallower slope angles occurring on the north-facing slopes as a result of sheetwash and solifluction.

Uncommon and sensitive landforms in the LSA generally refer to landforms associated with permafrost or unglaciated terrain. Three uncommon or sensitive landforms were identified on the LSA landscape: thaw lakes, tors, and pingos. These features are shown in Figure 2.3 in the Appendix 6A.

These landforms are of geological or ecological interest and were therefor included in the environmental assessment. These landforms meet at least one of the following criteria;

- Relatively uncommon surficial geologic landform;
- Geologic landform of ecological importance; and
- Landform sensitive to environmental change.

Thaw Lakes — A thaw lake is a thermokarst landscape feature that develops where there has been partial permafrost degradation. A thaw lake develops in a topographic depression that has accumulated either permafrost meltwater or meteoric water. Thaw lakes are dynamic features that change in size and shape due to the thermal sink caused by the pooled water. Thaw lakes exist only in the presence of permafrost and are sensitive to the regional climate. Continued permafrost thawing eventually leads to drainage and disappearance of thaw lakes. These landforms are geologically unique in that they form and disappear relatively rapidly. A total of 29 thaw lakes have been identified throughout the LSA. Six of these thaw lakes are within the PDA boundaries including one near the Open Pit and one at the proposed TMF embankment.

Tors — A tor is a large, free-standing rock mass that protrudes dramatically from gently sloping terrain. Tors are most often composed of granites or metamorphic bedrock, but can be formed from strong, volcanic rocks. Mechanical (frost-fracture) and chemical weathering, primarily through the action of precipitation and runoff, erodes softer overlying rock material leaving the harder, more resistant rock types. The weathering process occurs over a long period of time therefore tors are generally found where glacial processes have not modified the landscape significantly. Tors are present on many of the ridges throughout the LSA, both along the road and near the airstrip. Tor occurrence was identified in an area of 5.0 km² within the LSA. Within the PDA, tors occur in an area equal to approximately 0.37 km². Tor formations were identified adjacent to the non-acid generating waste rock storage area. In addition, several ridgelines and hill tops support tor formations to the north and south of the Mine Site.

Pingos — Pingos are ice-cored hills that are landforms found in permafrost landscapes. A pingo is a mound of earth-covered ice that grows as a result of periglacial processes. A hydrostatic (closed) pingo forms on the bottom of drained thaw lakes or small surface water features where permafrost rises to the surface. An ice core grows through successive freeze and thaw cycles and the action of hydrostatic pressure which forces the ice core

upwards. Hydraulic (open) pingos form where sub permafrost or intra-permafrost groundwater is frozen to permafrost and 'lifts' the ground surface as a result of increased hydrostatic pressure. These formations are dynamic and relatively uncommon, since they only persist in permafrost landscapes. Collapsed pingos can serve as unique habitat for wildlife and year-round sources of water. Within the Dawson Range, there is an abundance of pingos. Fifteen pingos have been identified within the LSA. A single pingo is located within the PDA approximately 4 km east of the proposed open pit. The periglacial process acting on the landscape adjacent to the Mine Site LSA supports pingo formations.

6.5 PROJECT-SPECIFIC EFFECTS

6.5.1 Determination of Potential Interaction(s) Between the Project and the VC

The Project includes development of a large deposit of gold, copper, and molybdenum accessed by open pit mining; construction of processing facilities adjacent to the deposit and associated camp infrastructure; construction of a TMF; construction of an airstrip and access road; construction of a pipeline connecting the mine site to a water well adjacent to the Yukon River and use of a pre-existing road accessing the pipeline; construction of a section of road that extends the current Freegold road to the mine site; and upgrading of the current Freegold Road to meet the required design standards.

Project components and activities that have the potential to interact with terrain features, including the mechanism of interaction and potential effects, are presented in Table 6.5-1. The phases of the Project considered in the assessment are construction, operation, closure and decommissioning, and post-closure. Project components and activities that have the potential to interact with terrain features are assessed for each feature; however, when one activity or component is similar in timing, location, and scale, then the component or activity with the largest potential effect is assumed to encompass the other Project components or activities.

Project components and activities will interact with and potentially affect terrain features primary through:

- Project footprint clearing may destroy or disturb unique or sensitive terrain features; and
- Topsoil stockpiles (for reclamation) cover unique or sensitive terrain features.

Mine site - The mine site will interact with terrain features through clearing the footprint area, conducting mining activities, and developing topsoil stockpiles that may cover up terrain features. The mine site is where most Project activities take place. The primary components of the mine site are the open pit, TMF, processing facilities, heap leach facility, and temporary stockpiles.

Airstrip and access road - The airstrip and access road will interact with terrain features through land clearing.

Yukon River access road and freshwater pipeline - The existing Yukon River access road will be used to access and maintain the well system adjacent to the Yukon River. The 36 inch diameter water supply pipeline with four booster stations will be 17.4 km long and follow the existing access road where practicable. Land clearing will be required during construction to install the pipeline.

Freegold Road Upgrade and Extension - The Freegold Road Extension will interact with terrain features through land clearing for the road.

Table 6.5-1 Potential Interactions between the Project and Terrain Features

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C	No	No physical disturbance to terrain features outside of clearing footprint, which is addressed in the PDA
Aggregate sources / Borrow Sites	C	Yes	Clearing Project footprint
Airstrip and Airstrip Access Road	C,O,CD	Yes	Clearing Project footprint
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C,O	Yes	Clearing Project footprint
Concentrate Transport and Loading	O	No	No physical disturbance to terrain features outside of clearing footprint, which is addressed in the PDA
Concrete Batch Plant Operation	C,O	No	No physical disturbance to terrain features outside of clearing footprint, which is addressed in the PDA
Contracted Employment	C,O,CD	No	Administrative, no interaction with terrain features
Cyclone Sand Plant	C,O	Yes	Clearing Project footprint
Dismantling of Facilities	CD	No	No physical disturbance to terrain features outside of clearing footprint, which is addressed in the PDA
Diversion of Canadian Creek	C,O	Yes	Clearing Project footprint
Drilling and Blasting	C,O	No	No physical disturbance to terrain features
Fish Habitat Compensation Construction	C,O	Yes	Clearing Project footprint
Freegold Road Extension	C,O,CD	Yes	Clearing Project footprint
Freegold Road Upgrade	C,O,CD	Yes	Clearing Project footprint
Fuel Storage and Distribution System	C,O	Yes	Clearing Project footprint
Gold Extraction Plant / Oxide Ore Processing	C,O	Yes	Clearing Project footprint
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C	Yes	Clearing Project footprint
Hazardous Materials Storage, Transport, and Disposal	C,O	No	Disturbance occurred during construction, no additional footprint clearing required
Heap Leach Facility	C,O	No	Disturbance occurred during construction, no additional footprint clearing required
Heap Leach Pad	C,O	Yes	Clearing Project footprint
Laydown Areas	C,O	Yes	Clearing Project footprint
LNG Transport to site	C,O	No	No physical disturbance to terrain features
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C,O	No	No physical disturbance to terrain features
Mine Development	C,O,CD	No	No physical disturbance to terrain features

Project Components and Activities	Project Phase	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Mine Staffing	C,O,CD	No	Administrative, no terrain interaction
On-site equipment and vehicle use	C,O,CD	No	No physical disturbance to terrain features
Open Pit Mining	C,O	Yes	Clearing Project footprint
Ore Conveyors	C,O	Yes	Clearing Project footprint
Ore Crushing	C,O	No	No physical disturbance to terrain features
Ore Hauling	C,O	No	No physical disturbance to terrain features
Ore Stockpiles	C,O	Yes	Clearing Project footprint
Potential Disturbance Area	C,O	Yes	Clearing Project footprint
Processing Facilities for Sulphide Ore	O	No	No physical disturbance to terrain features
Reagent Storage and Distribution	C,O	No	No physical disturbance to terrain features
Site Reclamation / Re-Vegetation	O, CD	Yes	Soil cover used for reclamation works
Site Security and Fencing	C,O,CD	No	Clearing Project footprint
Surface Water Management (Contact Water)	C,O,CD	No	No physical disturbance to terrain features
Surface Water Management (Non-Contact Water)	C,O,CD	No	No physical disturbance to terrain features
Tailings Management Facility	C,O,CD	Yes	Clearing Project footprint
Topsoil Stockpiles	C,O	Yes	Conservation of soil for reclamation
Traffic (Equipment and Materials to Site)	C,O,CD	No	No physical disturbance to terrain features
Waste management: garbage and sewage waste facilities	C,O	No	No physical disturbance to terrain features
Waste rock and Overburden Disposal	C,O	No	No physical disturbance to terrain features
Water Supply	C,O,CD, PC	Yes	Clearing Project footprint

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Terrain features within the Project footprint maybe be removed or covered during the construction phase of the Project. The most substantive and permanent effect of the Project to terrain features is the land clearing required for construction of the mine site and Freegold Road Extension. The removal of terrain features during construction will be permanent. Direct area loss from land clearing within the Project footprint is estimated to be 23.5 km² (Project footprint) but may be up 80.6 km² (total PDA). Table 6.5-2 summarizes the potential effect on terrain features. The estimated loss of each of the three unique terrain features within the LSA is summarized in Table 6.5-3.

Mapping completed during the baseline work (Figure 2.3; Appendix 6A) indicated that there are a total of six thaw lakes, 0.37 km² of tor area, and one pingo within the PDA. No terrain features located outside the PDA will be affected by the Project.

Table 6.5-2 Potential Effects on Terrain Features

Mechanism of Interaction	Key Indicator(s)	Project Phase	Potential Effect	Direction
Clearing Project footprint	Loss of terrain feature(s)	C and O	Loss of or damage to terrain features	Adverse
Conservation of soil for reclamation	Loss of terrain feature(s)	C, O, CD	Covering terrain features	Adverse

Note:
1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

Table 6.5-3 Estimated Loss of Terrain Features within the Local Study Area

Terrain Feature	Number/Area of Terrain Features in LSA	Number/Area of Terrain Features in PDA (that may be removed)	Percent Loss of Terrain Features in the LSA
Thaw Lakes	29	6	21%
Tors	5 km²	0.4 km²	7%
Pingos	15	1	7%

6.5.2 Identification of Mitigation Measures and Potential Residual Effects

Within the PDA, construction and land clearing associated with the Project will remove some of the identified thaw lakes, tors and pingos from the landscape. Within the PDA, six thaw lakes, 0.37 km² of tor area and one pingo have been identified. Table 6.5-4 summarizes the proposed mitigation to reduce or eliminate effects on terrain features. Some terrain features that are within the Project footprint will be removed to accommodate the Project. Where possible, the footprint, including road, may be relocated/realigned to avoid removing/destroying these unique terrain features.

Table 6.5-4 Proposed Mitigation Measures and Residual Effects - Terrain Features

Potential Effect	Project Phase	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Loss of or damage to terrain features	C, O, CD	Adverse	Avoidance, realignment, minimize footprint	High	Yes
Covering terrain features	C, O, CD	Adverse	Avoidance, minimize footprint	High	Yes

Notes
1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

6.5.3 Significance of Residual Effects

The significance of residual effects on terrain features is summarized in Table 6.5-5. Within the Project footprint, the removal or burial of thaw lakes, tors, and pingos will occur during the construction and reclamation phases. The effects from the removing these features are permanent. Project effects on terrain features are considered to be adverse, local in extent, and are irreversible with a high probability of occurrence. The residual effect of the Project on terrain features is considered not significant (Table 6.5-6) and although the effect will be permanent, it will be effects on individual features, localized to the Project footprint. Confidence in this prediction is high.

Table 6.5-5 Significance of Residual Effects - Terrain Features

Residual Effect	Predicted Degree of Effect after Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Loss of or damage to terrain features	Adverse	High	Localized	Permanent	Infrequent	Irreversible	Low Resilience	High	Not significant
Covering terrain features	Adverse	Medium	Localized	Permanent	Infrequent	Irreversible	Low Resilience	High	Not significant

Table 6.5-6 Summary of Residual Effects - Terrain Features

Potential Residual Effect	Direction	Significance	Level of Confidence
Loss of or damage to unique or sensitive terrain features	Adverse	Not significant	High
Covering unique or sensitive terrain features	Adverse	Not significant	High

6.6 CUMULATIVE EFFECTS ASSESSMENT

Based on available information summarized in the terrain baseline report, thaw lakes, tors and pingos appear to be relatively common features in the Dawson Range landscape. There is no indication that these features are limited to the extent of the Project's LSA. Additionally, there is no indication that there are any particular concerns with the conservation and protection of these unique terrain features as a whole, nor protection of individual features.

The assessment of cumulative effects on terrain is qualitative because analyses is limited by the availability of detailed terrain mapping in the region, making it difficult to quantify combined project effects in the region. The Casino Project's mapping area for terrain features was limited to a relatively small area surrounding the PDA to address to inform the Project's engineering components and terrain hazard assessment. That level of mapping is not available region-wide, so it is difficult to determine if other projects will have an equivalent effect that may, when combined with the Casino Project, have a cumulative effect on terrain features in the Dawson Range.

6.6.1 Identification of Other Projects or Activities

For past, present or likely future projects/activities to be included in the cumulative effects assessment, three conditions were required to warrant further assessment:

1. Adequate qualitative and/or quantitative information on a project or activity is publicly available to allow for spatial and temporal characterization;
2. The project spatially overlaps with the residual effects of the Casino Project; and
3. The project temporally overlaps with the residual effects of the Casino Project.

Mineral exploration and placer mining projects have occurred in, and are likely to continue to occur in, the Project region. There are no known areas that are excluded from mineral exploration, and there are a number of placer claims that will likely exist and be active either continuously or intermittently into the foreseeable future. Although the claim blocks can be very extensive and numerous (e.g., as illustrated in the White Gold Cumulative Effects Report; EDI 2013), actual works are likely to be limited to a few focal areas for either a short period of time, or seasonally for many years, as is the case for several quartz claims in the area. Projects and/or activities that meet the conditions described above are summarized in Table 6.6-1. Projects/activities in the same category (e.g., placer mining, quartz claims) are assumed to cause similar types of residual effects and are therefore assessed collectively.

Table 6.6-1 Residual Effect Information for Other Projects or Activities - Terrain Features

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Minto Mine	Present operating mine	Terrain feature loss	Current footprint: 12.92 km², including mine site and access road.	Minto mine is expected to operate through the construction and initial operating years of the Casino Project.
Carmacks Copper	Likely future project	Terrain feature loss of project goes through to construction and operation.	Current footprint: 1.36 km², and if developed assumed equivalent to disturbance observed at Casino mine site. Current activities are likely very sporadic and site-specific.	No indication of development or operation period.
Mt. Nansen (reclamation project)	Past mine development, Present care and maintenance, future reclamation activities	Loss of terrain features from original development.	Current footprint: 1.85 km². Activities likely to be limited to extent of existing disturbance footprint.	Likely to occur over a two to three year period within the next decade.
WS Total (exploration project)	Present	No effect on terrain features	Current footprint: 0.08 km². Likely includes some individual seasonal drill locations	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
				development or operation period.
Nucleus (exploration project)	Present	No effect on terrain features	Current footprint: 0.08 km². Likely includes some individual seasonal drill locations.	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Prospector Mountain (exploration project)	Present	No effect on terrain features	Assumed equivalent to disturbance observed at Casino mine site during exploration phase. Likely includes some individual seasonal drill locations.	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Sonora Gulch (exploration project)	Present	No effect on terrain features	Current footprint: 0.27 km². Activities likely to be limited to extent of existing disturbance footprint.	Exploration likely to continue intermittently through life of the Casino Project. No indication of development or operation period.
Numerous quartz exploration permits	Past, present and future	No effect on terrain features	Localized effects, but distributed across the landscape.	Exploration likely to continue intermittently and seasonally through life of the Casino Project.
Numerous placer mining permits	Past, present and future	Some localized effects on individual terrain features, particularly thaw lakes and tors	Localized effects in areas accessible to heavy equipment.	Placer mining likely to continue intermittently and seasonally through life of the Casino. Project.
Canadian Creek, Upper Canadian Creek (Placer mine)	Present	Some localized effects on individual terrain features, particularly thaw lakes and tors	Current footprint: 0.52 km². Footprint likely increases with successive placer mining operations, but older areas will naturally re-vegetate.	Mining likely to continue intermittently and seasonally through life of the Casino Project. No indication of operation period.

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for terrain, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

6.6.2 Interactions and Potential Cumulative Effects

The interaction matrix shown in Table 6.6-2 was used to determine whether any spatial or temporal overlap exists between the residual effects of the Project and the noted projects. The word “YES” is used to indicate where a residual effect of the Project has the potential to overlap spatially and temporally with the predicted residual effects.

Table 6.6-2 Cumulative Effects Assessment Interactions Matrix – Terrain Features

Casino Project Residual Effect	Potential Spatial and Temporal Overlap				
	Minto Copper Mine	**Carmacks Copper Mine**	**Mt. Nansen (reclamation project)**	**Numerous placer mining permits**	**Canadian Creek, Upper Canadian Creek (Placer mine)**
	Terrain feature loss	Terrain feature loss of project goes through to construction and operation.	Loss of terrain features from original development.	Some localized effects on individual terrain features, particularly thaw lakes and tors	Some localized effects on individual terrain features, particularly thaw lakes and tors
Loss of or damage to unique or sensitive terrain features	YES	YES	YES	YES	YES
Covering unique or sensitive terrain features	NO	NO	NO	NO	NO

Note

1 YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

The spatial overlap may lead to the potential cumulative effects described in Table 6.6-3. These effects are the same as the residual effects from the Project except that they would be seen beyond the Project area.

Active or historic quartz mines such as the Minto Mine and Mt Nansen Mine can have residual effects on terrain features within their project footprint, but the presence of terrain features like tors, thaw lakes and pingos within those project footprints is undocumented. It is unlikely that the small footprints required for quartz exploration projects would have effects on terrain features because those footprints are likely limited to camp and drill locations, trenching in accessible terrain and access trails. Only the assumed residual effects of other projects and activities that meet all three conditions and overlap spatially and temporally with the Casino Project were carried forward into the CEA as potential cumulative effects and summarized in Table 6.6-2.

Table 6.6-3 Potential Cumulative Effects - Terrain Features

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Loss of or damage to terrain features	Combined active/historic quartz mines and placer mining operations	Cumulative loss of terrain features in the Dawson Range within an additional 17.08 km² of footprint disturbance

6.6.3 Proposed Mitigation Measures and Potential Residual Cumulative Effects

There are no additional mitigation actions proposed beyond what CMC has already committed to at the Project-specific level; the mitigation measures that are proposed are included in Table 6.6-3.

Table 6.6-4 Mitigation Measures and Residual Cumulative Effects – Terrain Features

Potential Residual Cumulative Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Loss of or damage to terrain features	Adverse	Avoidance, realignment, minimize footprint	High	Yes

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

6.6.4 Significance of Residual Cumulative Effects

Residual cumulative effects are those that remain after mitigation measures have been applied. In accordance with Section 5, the residual cumulative effects on terrain features were assessed based on eight rating criteria to determine the likelihood for a significant negative effect (Table 6.6-4).

Table 6.6-5 Significance of Residual Cumulative Effects – Terrain Features

Residual Effect	Predicted Degree of Effect after Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Loss of or damage to terrain features	Adverse	High	Localized	Permanent	Infrequent	Irreversible	Low Resilience	High	Not significant

6.6.5 Discussion of Significance of Residual Cumulative Effects

Based on the cumulative effects assessment, the Casino Project is not likely to have any significant adverse effects on terrain features after the implementation of mitigation measures. This is summarized in Table 6.6-6. The level of confidence in these predictions is high.

Table 6.6-6 Summary of Residual Cumulative Effects – Terrain Features

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Loss of terrain features	Adverse	Not Significant	High

6.7 SUMMARY AND CONCLUSIONS REGARDING CUMULATIVE EFFECTS

The largest portion of the footprint associated with the Casino Project, the Freegold Road Extension, is likely the largest disturbance footprint that the region will experience in the foreseeable future. Even with that footprint, there is very limited disturbance to unique terrain features. It is unlikely that there are significant cumulative effects on terrain features in the Dawson Range as a result of industry in the Dawson Range.

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7 – WATER QUALITY

7.1 INTRODUCTION

7.1.1 Regional Setting

The proposed Casino Project will be an open pit mine and concentrator extracting the porphyry copper-molybdenum-gold deposit in the Dawson Range, approximately 300 km northwest from Whitehorse in the Yukon Territory. The project is located at about 1300 m elevation on the catchment divide between the Casino Creek and Canadian Creek watersheds. Casino Creek drains southwest into Dip Creek and eventually into the White River, a tributary of the Yukon River. Canadian Creek drains north into Britannia Creek and then into the Yukon River.

The Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern British Columbia. The Boreal Cordillera ecozone is characterized by the presence of several mountain ranges, including the Dawson Range, that trend in the north-westerly direction and include extensive plateau regions. The climate is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect. Average annual precipitation is generally quite low, with values in the range of 300 mm to 450 mm (Smith, Meikle, and Roots 2004).

The current open pit layout is mostly located in the Casino Creek watershed with the northwestern footprint of the pit intercepting the headwaters of Canadian Creek at Year 10 of operations. The proposed major mine infrastructure including the mill and concentrator, gold heap leach facility, tailings/waste rock facility, power station, workshops and accommodation are all located in the Casino Creek watershed. Only the airstrip, located in the Dip Creek watershed, is located outside of the Casino Creek watershed. Gold will be extracted from the deep oxidised cap via a conventional cyanide heap leach operation which will cease stacking in Year 15. Copper, silver and molybdenum concentrates will be produced from a conventional grinding mill and flotation circuit capable of processing around 120,000 tonnes of ore per day. Access for the transport of equipment, fuel and supplies to site and transport of concentrate from site will be by a proposed upgrade and extension of the existing Freegold Road from Carmacks.

All waste rock, tailings and supernatant water will be stored in a valley-fill type tailings management facility (TMF) located in the headwaters of Casino Creek. The TMF has been sized to store sub-aqueously all of the tailings and waste rock, which are capable of leaching metals and are potentially acid generating (PAG). During operations the TMF will store all water originating from upstream of the TMF embankment, including decant from the concentrator, seepage from the ore stockpiles and runoff from its undisturbed catchment. Furthermore, seepage water losses from the TMF and runoff from the TFM embankment shell will be collected and pumped back into the TMF.

The area of the ore deposit, referred to as Patton Hill, has been greatly disturbed by exploration activity over the past several decades, which has had an effect on baseline water quality in Casino Creek. Numerous baseline studies have been conducted in the proposed Project area, including surface water and sediment quality (Appendix 7A), hydrology (Appendix 7B), and hydrogeology and groundwater quality (Appendix 7C), with the overall goal of assembling a comprehensive understanding of baseline conditions for the Project. This information then provides a basis for the quantitative assessment of effects of mine development, operations and closure on water quality.

The assessment of Project related effects on water quality relies upon the characterization of water quality related parameters and activities during all phases of the project. This information is presented in the YESAB Water Balance Report (Appendix 7E), Water Quality Predictions Report (Appendix 7F), Air Quality Effects Assessment (Section 8), Project Description (Section 4) and Water Management Plan (Appendix 4D). Set guidelines (i.e. Canadian Water Quality Guidelines for Protection of Aquatic Life from the Canadian Council of Ministers of the Environment (CCME 2013)) are used as key indicators during the assessment to determine whether or not an effect is likely to occur.

7.1.2 Rationale for VC Selection

Water quality was selected as a VC in order to assess the potential effects of the proposed Project on the health of aquatic ecosystems. Water quality forms one of the vital links between the abiotic and biotic environments, and is the foundation for supporting and maintaining healthy ecological processes for a rich and varied community of users (e.g., fish, wildlife, humans). Discharge of effluent from metal mines to surface waters is regulated under the *Fisheries Act* through the *Metal Mine Effluent Regulation* (MMER, 2002). Canadian Council of Ministers of the Environment (CCME) (1987; 1999a, b; 2001; 2002; 2003, 2011, 2012) and British Columbia Ministry of Environment (BC MOE) (1986, 1998, 2001a, b, 2011, 2013) have guidelines for the protection of freshwater aquatic life at a point downstream of a dilution zone. Guidelines are not regulatory instruments but are triggers for action if not met. Site-specific water quality objectives are alternative guidelines that may be set.

Changes in groundwater quality that may affect aquatic life water use is regulated under Yukon Contaminated Sites Regulation. It is important to note that a groundwater VC was not identified for the proposed Project (as described in Section 5). Results of the Hydrogeology Baseline Assessment (Section 7C) did not identify any groundwater users or significant groundwater resources in the Project area, and concluded that all groundwater flow would ultimately discharge to surface water or to the TMF. Therefore, potential effects from changes in groundwater quality will be captured in the surface water VC and addressed through the overall water quality effects assessment.

Sediment has been considered, and will be an important monitoring component, but is also not assessed as a VC. It is predicted that there will be limited potential for interaction between the Project discharges and sediment quality as the receiving water bodies for the Casino Project are streams with moderate or high flows. Flowing streams are not susceptible to changes in sediment quality as regular freshets flush fine-grained sediment from the stream bed. In addition, any discharge to the receiving environment would have metals in the dissolved phase and would therefore not settle out in receiving environment streams. While effects on sediment quality are unlikely, any potential effects would be covered through the assessment of surface water quality.

Results of the assessment of effects on water quality will be used to support the assessment of potential effects on fish and aquatic resources, wildlife, and human health. The indicators selected to assess changes in water quality are acidity, alkalinity, metals, sulphate, cyanide and nutrients.

7.2 ASSESSMENT BOUNDARIES

7.2.1 Spatial Boundaries

7.2.1.1 Local Study Area (LSA)

The LSA is the spatial area within close proximity to the project under review where direct effects are anticipated. For the Casino Project, the water quality LSA is defined by the boundaries of the two watersheds surrounding the Project deposit (also known as Patton Hill): the Britannia Creek watershed to the north and the Casino Creek

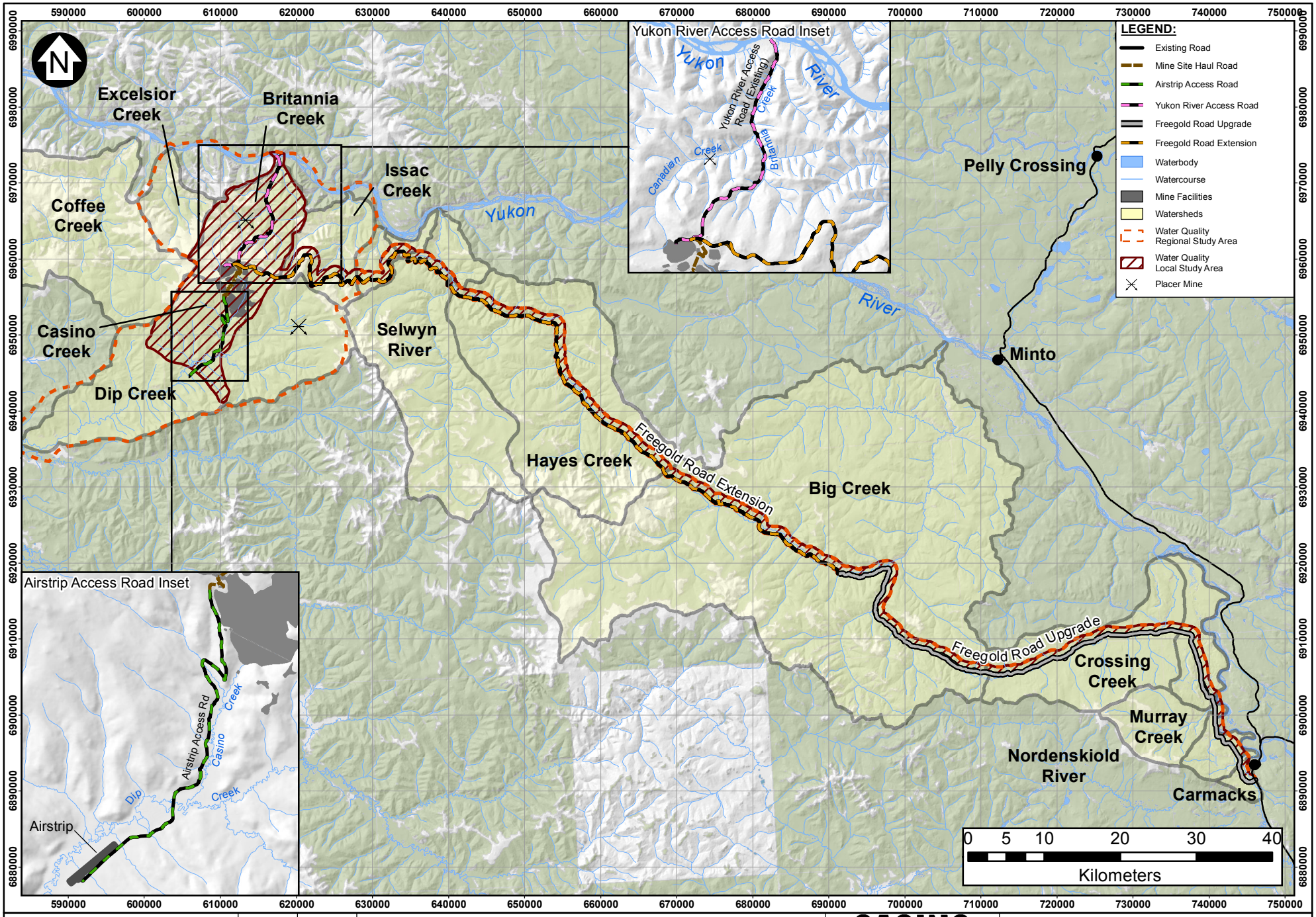
watershed to the south. The LSA also includes a 5 km-long reach of Dip Creek downstream of its confluence with Casino Creek, several Dip Creek tributaries within the airstrip and airstrip access road footprint, and several watersheds along the Freegold Road corridor which extends from the Village of Carmacks to the Casino Project. The LSA surrounding the airstrip, airstrip access road, and Freegold access road is defined as 100 m upstream and 1000 m downstream of any stream crossing. The boundaries of the LSA are shown as the brown shaded area on Figure 7.2-1.

Most of the proposed mine infrastructure will be in the Casino Creek watershed, with some (e.g., the northern corner of the open pit) found within the Canadian Creek watershed. The northern part of the LSA is drained by Britannia Creek and its main tributary, Canadian Creek, which flow northward into the Yukon River. The southern part of the property is drained by Casino Creek which flows south to Dip Creek and thence to the Yukon River via the Klotassin, Donjek and White rivers. The Freegold Road corridor crosses several major and minor watersheds, beginning with the Nordenskoild River just west of Carmacks, followed by Crossing Creek, Big Creek, Selwyn River and Hayes Creek, and Sunshine Creek.

7.2.1.2 Regional Study Area (RSA)

The RSA is the spatial area within which cumulative effects are assessed; it extends a distance from the project footprint in which both direct and indirect effects are expected to occur (Hegmann et al. 1999). The RSA encompasses an area large enough to consider most regional pressures (YESAB 2006a).

The water quality RSA was defined as the LSA plus adjacent areas that have the potential to experience either indirect (mid-to-far field), or cumulative effects due to interactions with other projects. The boundaries of the RSA are delineated by the orange dashed line on Figure 7.2-1.



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	M. Quach
APP'D	-
REV	-
DATE	7Oct'13

NOTES:

1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:650,000

CASINO COPPER AND GOLD

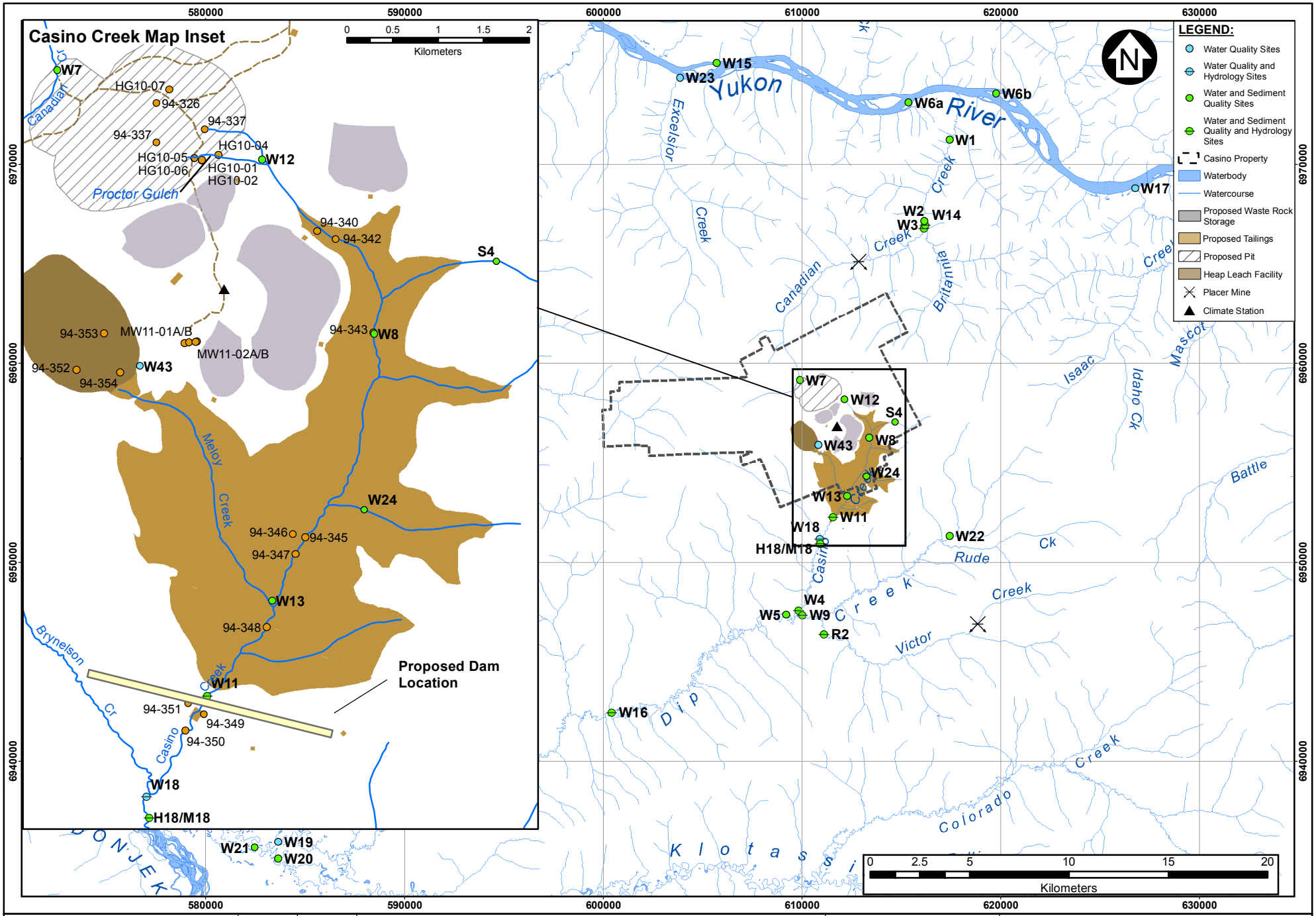
CASINO PROJECT

Water Quality Regional and Local Study Area

FIGURE 7.2-1

REF

P/A VA101-325/15



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	M. Quach
APP'D	M. Quach
REV	R. Palmer
DATE	25Nov'13

NOTES:

1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:250,000

CASINO COPPER AND GOLD

CASINO PROJECT

Surface Water Quality, Sediment Quality, Hydrology and Groundwater Quality Baseline Monitoring Sites

FIGURE 7.2-2

REF REPORT 1

P/A VA101-325/15

7.2.2 Temporal Boundaries

The temporal boundaries for the water quality effects assessment are the same as those defined in Section 5.2 of the Proposal as the life of the Casino Project. In addition, there are sub-phases to the Closure and Decommissioning and Post-Closure periods specific to water management and directly relevant to the water quality effects assessment (Appendix 4D). The overall temporal boundaries are:

- Construction (C): Years -4 to -1
- Operations (O): Years 1 to 22
- Closure and Decommissioning (CD): Years 23-25
- Post-Closure (PC): Years 26-30+
  - Water Management Plan (WMP) Closure Phase I (Years 23 to 30 – prior to TMF Discharge);
  - WMP Closure Phase II (Years 31 to 114+ - prior to Open Pit discharge); and
  - WMP Closure Phase III (Years 114 to 200).

Details on activities associated with these phases can be found in Section 4 and Appendix 4D.

7.3 BASELINE CONDITIONS

A complete understanding of baseline water quality conditions requires background information on climate, hydrology, hydrogeology, and surface water and sediment quality.

7.3.1 Climate

Climate data were collected on-site at the Casino Climate Station located in the upper Casino Creek watershed at an elevation of 1,200 m. The period of site record extends from 1993 to 1994, and from 2008 to present. The site temperature and precipitation data were compared to the long-term record from the Meteorology Service Canada (MSC) climate station at Pelly Ranch, located 80 km to the east at an elevation of 454 m, to develop long-term synthetic climate records for the Project. The long-term synthetic precipitation series was then refined using the Casino Watershed Model (Appendix 7E), and summary statistics were finally computed from the resultant data series.

Mean annual temperatures for the long-term regional stations range from -6°C to -3°C, while mean monthly temperature are warmest in July and coldest in January, with values ranging from 14°C to 16°C and -25°C to -28°C, respectively. The long-term mean annual temperature at the Casino climate station estimated from the synthetic temperature series is -3.2°C, which is at the upper end of the regional range. The mean July temperature at the Project site is 11.4°C, which is 3°C to 5°C cooler than the regional stations. The mean January temperature at the Project site is -18.0°C, which is 8°C to 11°C warmer than the regional stations. These differences between the Casino and regional temperature series are consistent with the much higher elevation of the Project site, compared to the regional stations. The maximum and minimum temperatures recorded at the Casino climate station between 2008 and 2012 are 26°C and -40°C, respectively. Based on the site data and the Pelly Ranch estimates, the estimated long-term extreme temperatures for the Casino climate station are 30°C and -50°C.

Mean monthly precipitation at all long-term regional stations is greatest during the summer months of June through August and lowest during the late winter months of February through April. Most of the precipitation falls in the form of snow during the months of November through March, and in the form of rain during the months of May through September. During the shoulder months of April and October, mixed rain and snow conditions occur,

although typically snow is more common. The long-term estimated mean annual precipitation at the Casino climate station is estimated to be approximately 460 mm, of which 305 mm (66%) falls as rain and 155 mm (34%) falls as snow. Estimates of long-term mean monthly precipitation for the Project site range from 13 mm in April to 91 mm in July.

Mean annual wind speed at the Casino climate station is 2.3 m/s (8.3 km/hr). The mean monthly wind speeds are higher in the spring, summer and autumn and lower in the winter, with values ranging from 1.7 m/s in November to 2.7 m/s in May. The maximum hourly wind speed recorded between 2008 and 2012 was 14.9 m/s (53.6 km/hr). The predominant wind direction was northerly, followed by south-westerly.

Snow Water Equivalent (SWE) measurements recorded at Yukon Environment snow course 09CD-SC01 show that the mean annual maximum SWE over the period of record is 142 mm. The estimated mean monthly snowmelt volumes for the Casino snow survey station in April and May are 22 mm and 120 mm, respectively. The site wide estimate of mean monthly snowmelt for an elevation of 1200 m predicts a mean monthly May snowmelt of 87 mm and mean annual SWE of 100 mm. The lower site-wide SWE values are consistent with the differences in vegetative cover, and their associated effects on snow accumulation and sublimation, between the snow survey location and the greater project area. Detailed baseline information is contained in the Climate Baseline Report (Appendix 8A).

7.3.2 Hydrology

Ten hydrometric monitoring stations have been operated in the Project area at various times since 2008, with three located in the Canadian and Britannia Creek watersheds and seven in the Casino and Dip Creek watersheds. Station W16, located on lower Dip Creek, has the largest monitored watershed at 384 km^2, while stations W18 and W11, located within the Casino Creek watershed, are the smallest monitored watersheds at 25 km^2 and 39 km^2, respectively.

Long-term streamflow estimates in the Casino Project area were developed by comparing the available Project data (2008-2012) with regional streamflow stations operated by Water Survey of Canada (WSC). Mean annual unit runoff in regional watersheds range between 2.8 l/s/km^2 and 9.2 l/s/km^2. Streamflow in the region is typically highest in May due to melting of the winter snowpack. Flows are usually sustained at moderate to high levels in the summer months due to the influence of rainfall combined with melting permafrost, followed by receding and low flows in the colder fall and winter months. Flows decrease throughout the winter and minimum flows typically occur in March or early April.

The resulting mean monthly and mean annual long-term synthetic flow estimates illustrate the following patterns:

- Mean annual unit runoff at the nine active Project monitoring stations ranges between 4.3 l/s/km^2 and 5.8 l/s/km^2, with an average of 5.2 l/s/km^2 (~165 mm annual runoff); and
- Maximum monthly unit runoff occurs in May, June, or July depending on the station, with maximum mean monthly values ranging between 12.0 l/s/km^2 and 16.5 l/s/km^2.

Since the vast majority of the potential effects to water quality are assessed in the Casino and Dip Creek watersheds, the baseline mean monthly discharge at stations W4 on Casino Creek, and W5 on Dip Creek, are summarized in Table 7.3-1. Monthly average discharge for station W5, which is not a hydrometric station, was calculated by combining the average discharges at stations W9 (Dip Creek, upstream of Casino Creek) and W4 (Casino Creek, upstream of the confluence with Dip Creek). Detailed baseline information is contained in the Hydrology Baseline Report (Appendix 7B).

Table 7.3-1 Mean Monthly Discharge at Stations W4 and W5

Station	Mean Monthly Discharge (m^3/s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
W4	0.05	0.03	0.03	0.18	0.99	0.79	1.05	0.80	0.74	0.41	0.20	0.10	0.45
W5	0.12	0.08	0.07	0.53	3.42	3.13	4.25	3.02	2.42	1.21	0.51	0.24	1.58

7.3.3 Surface Water Quality

Detailed baseline information is contained in the Water and Sediment Quality Baseline Report (Appendix 7A). The Casino Project aquatic study area is defined by the boundaries of the two watersheds surrounding the ore body: the Britannia Creek watershed to the north and the Dip Creek watershed to the south. Current baseline sampling stations were based on sampling stations from the 1993-1995 baseline studies. A total of 26 stations between 2008 and 2012 were chosen for water quality sampling. Stations were concentrated in the Casino Creek (a tributary to Dip Creek) and Britannia Creek watersheds as they have the potential to be directly affected by the Project. Himmelright (1994) indicated natural sources of acid rock drainage (ARD) exist near the mineral deposit and that their effects are seen most clearly in Proctor Gulch, a tributary that flows into upper Casino Creek. Elevated metal concentrations and high acidity from Proctor Gulch are major contributors to the chemistry in the surface waters of Casino Creek. Other sources of ARD include groundwater that flows directly into upper Canadian Creek (a tributary to Britannia Creek) and groundwater that discharges from a historical adit via a pipe to upper Meloy Creek and onward to Casino Creek.

Water samples were collected and analyzed for the full suite of physical parameters, anions, nutrients and total and dissolved metals. Minimum, mean, median and maximum concentrations were calculated for each parameter at all stations. Exceedances of the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life were observed for a total of ten parameters (copper, cadmium, aluminum, iron, uranium, fluoride, zinc, lead, pH and silver) throughout the project area. The number of exceedances was highest for aluminum, cadmium, copper and iron. With the exception of uranium, exceedances were most numerous in the summer season (May to October), indicating a seasonal trend likely related to hydrological factors.

Nutrient levels at all stations were below CCME guidelines, with approximately 20-70% of all ammonia, nitrite, nitrate, nitrate+nitrite-N, total phosphate and orthophosphate concentrations below analytical detection limits. Levels of many metals and anions were consistently low, with concentrations equal to or lower than analytical detection limits observed for 50% to 90% of the samples, including those for beryllium, boron, bismuth, bromide, chloride, mercury, tin, silver, titanium, thallium, vanadium and zirconium in all study areas.

The 2008-2012 water quality program confirmed the unique water chemistry of Proctor Gulch documented in Himmelright (1994). Exceedances of CCME guidelines for pH, copper, aluminum and iron were found in 100% of the 16 samples from Proctor Gulch. Fluoride, cadmium, lead and zinc were also elevated in samples from Proctor Gulch. Additionally, water quality at this station exhibited highest values for acidity (and lowest pH), hardness, conductivity, total dissolved solids and turbidity, as well as lowest values for alkalinity.

Spatially, it was observed that copper, aluminum and iron concentrations were highest at Proctor Gulch (W12) and decreased at each successive downstream station (W8, W11 and W4). This indicates that inflows from Casino Creek tributaries including Meloy Creek, Brynelson Creek and Austin Creek, effectively dilute the water from Proctor Gulch. Proctor Gulch consistently shows higher concentrations in the winter than in the summer for all the metals as groundwater is the major source of flow in the winter months.

An adit established as part of historical (between 1965 and 1980) access to a lead/zinc/silver deposit in the upper Meloy Creek watershed discharges groundwater mostly in the spring and summer months (approximately May to August). This station (W43) was found to have the highest concentrations of cadmium, lead, silver and zinc of all the stations sampled. However, due to the relatively small flow from the adit, only one cadmium sample (0.00004 mg/L in April 2011) resulted in the exceedance of CCME guidelines in the lower reach of Casino Creek at W4.

Some effects from Proctor Gulch and the historical adit are observed in Dip Creek at station W5, just downstream of Casino Creek, particularly for copper, cadmium, lead and zinc; however, the effects are greatly reduced in comparison with Casino Creek as background concentrations for these metals are much lower in the upstream Dip Creek watershed. Although less pronounced an overall similar spatial pattern of upstream to downstream decreasing concentrations of cadmium, zinc, copper, aluminum, iron and lead was also observed in Canadian Creek and Britannia Creek. The uppermost station on Canadian Creek (W7) is situated in close proximity to the ore body and therefore likely receives groundwater discharge with similar water quality to Proctor Gulch.

On the whole, hardness, conductivity and nitrogen based nutrients were higher in the winter months. Conversely, total suspended solids (TSS), phosphorus based nutrients, organic matter and metal concentrations were higher in the summer months for the majority stations, indicating a seasonal trend most likely related to the different primary sources of streamflow (surface runoff during the summer and groundwater discharge during the winter) between these two seasons.

7.3.3.1 Determination of Natural Baseline Conditions

The evaluation of potential effects on water quality often requires the development of alternative water quality objectives, such as site-specific water quality objectives (SSWQOs). However, before SSWQOs can be developed for potential contaminants of concern, it is necessary to determine whether or not the baseline water quality is actually natural. For the Casino Project, this determination focuses on the two acid rock drainage sources identified in the Water and Sediment Baseline Report (Appendix 7A), and discussed in Section 7.3.3. The two sources in question are the discharge from the historical adit (Site 43) located in upper Meloy Creek and the disturbances up slope from Proctor Gulch (Site W12), a tributary located in the headwaters of Casino Creek. Development of SSWQOs must be based on natural baseline conditions and not influenced by anthropogenic sources.

Proctor Gulch has been documented as a naturally occurring tributary that drains the south-eastern side of the mineralized zone of Patton Hill. According to a report prepared for Pacific Sentinel Gold Corporation on the effect of natural acid rock drainage on Casino Creek by Himmelright (1994), Proctor Gulch has a nearly neutral pH of around 6.4 before it intermittently disappears underground, where it is presumed to pass through the Casino Fault; when the water re-emerges, its chemistry changes considerably, with a drop in pH to pH 3.5 and increases in metal content. This natural acid rock drainage then flows into Casino Creek, where water is approximately neutral prior to mixing with Proctor Gulch discharge (pH 7.22 measured in 1994 and pH 7.16 measured in 2011). Since there doesn't appear to be an anthropogenic cause for the water quality in Proctor Gulch, it is considered to be a natural contribution to the Casino Creek watershed.

The historical adit is located in upper Meloy Creek watershed. Water discharges via a pipe to surface only during the spring and summer months and is frozen from October to April. At the point of discharge it travels down the watershed for roughly two kilometres before joining Meloy Creek proper. The adit is a remnant of historical mining activities and as such, is considered an anthropogenic source of water. For development of SSWQOs, a preliminary analysis was conducted to assess whether or not the adit had any effects on the water quality of lower Casino Creek at Site W4.

Accounting for Loadings from the Adit

Quantifying the loading of the adit water to Casino Creek was carried out by comparing water quality data sets of the adit water (W43) and lower Casino Creek before discharge into Dip Creek (W4) on the two sampling events where flow and quality were measured at both sites, in August 2011 and October 2011. Flow at W43 was measured by filling a bucket with water from the adit and recording the number of seconds it took to fill it to a known volume. Average flow at W43 on August 23, 2011 was 0.8 L/s and October 4, 2011 was 0.41 L/s. Discharge at W4 was based on the streamflow record, which is calculated by applying the rating curve (developed from the manual point discharge measurements) to the continuous water level recorded at the station (Appendix 7B). Flow/discharge values were multiplied by the concentrations to obtain a load in milligrams per second. Loadings from W43 were then subtracted from W4 and an adjusted concentration was calculated.

With the exceptions of cadmium and zinc and to a lesser degree, dissolved lead, the adjusted concentrations were only marginally lower than the original concentrations. On average, the adjusted concentrations for all the other parameters were close to 100% of the unadjusted concentration (on average 99.7%, with a min to max range of 93.5% to 100.0%). This means that virtually no loading of these parameters are contributed by the adit and it appears that the adit has a negligible impact to Casino Creek for the majority of the parameters tested (i.e. the entire suite of parameters analysed for the 2008-2012 baseline program). Therefore, the concentrations of these parameters already represent natural baseline conditions and do not need to be adjusted.

It does appear, however, that the adit water is a significant contributor of cadmium and zinc and possibly dissolved lead. On both sampling events, estimated cadmium and zinc loadings at W4 are similar to loadings at W43, indicating that the adit is likely the major source of these metals (nearly 100% of the load is from the adit). Although it appears that the adit water contributes most of the cadmium and zinc loadings to Casino Creek, it is also important to consider that there may be some geochemical solubility control in Meloy or Casino Creek that is removing cadmium and zinc. Despite this unknown, it is abundantly clear that only cadmium, zinc and possibly lead, are influenced by the adit discharge. Therefore, any development of SSWQOs for the Casino Project will take into consideration that the current baseline conditions in Casino Creek incorporate a loading of cadmium, zinc and lead that is from an anthropogenic source.

7.3.4 Groundwater Quality

Detailed baseline information is contained in the Hydrogeology Baseline Report (Appendix 7C). Groundwater chemistry is variable throughout the Project area and has been characterized in terms of the proposed Open Pit area, the hillslope area, and the Casino Creek valley area. As shown in Figure 7.2-2, water quality samples were collected from 20 groundwater quality monitoring wells that were strategically installed in the vicinity of and down gradient of key proposed project facilities, which include the Ore Stockpiles, Open Pit, TMF, and Heap Leach Facility (HLF).

The ion characterization of the groundwater samples from the proposed Open Pit area identified calcium and sulphate as the dominant ions, and the dominant ion composition of samples collected from the hillslope area was calcium and bicarbonate. Groundwater chemistry of samples collected from the Casino Creek valley area were generally interpreted as intermediate to that of the hillslope and proposed Open Pit areas. The groundwater ion characterization varied along the Casino Creek valley but samples were generally dominated by calcium, bicarbonate, and sulphate in the upper limits of the valley, calcium, magnesium, bicarbonate, and sulphate through the middle of the proposed TMF area, and calcium and bicarbonate in the vicinity of the proposed TMF embankment.

The deposit is a sulphidic ore body and sulphate has been measured at very high concentrations in this area (up to 1,100 mg/L). Mean total dissolved solids (TDS) concentrations are indicative of groundwater that is moderately to highly mineralized. In the proposed Open Pit area, significant variability in groundwater metals and metalloid concentrations was observed between samples collected from the Proctor Gulch monitoring wells and from monitoring well 94-337. The variability in the ore body geochemistry results in groundwater with low pH and moderate hardness in the vicinity of 94-337 and neutral pH and very hard water in the Proctor Gulch area. In the samples from 94-337, cadmium, cobalt, copper and zinc were detected at concentrations that exceeded the Yukon Contaminated Sites Regulation (YCSR) limits, and aluminum and iron were detected at concentrations that exceed the Canadian Environmental Quality Guidelines - Water Quality Guidelines for the Protection of Aquatic Life (CCME). In the Proctor Gulch area groundwater samples, cadmium and cobalt were detected at concentrations that exceeded the YCSR limits and arsenic, iron, uranium, and zinc were detected at concentrations that exceeded the CCME limits.

In the hillslope area, mean TDS values in water collected from monitoring wells were indicative of slight to moderately mineralized groundwater. Samples from monitoring wells installed near the historic Meloy Creek mine adit reported higher mean TDS values than others from the hillslope area. Slightly higher mean TDS and higher concentrations of sulphate, sodium, fluoride, and chloride were reported in water samples obtained from the shallow groundwater well compared to the deep well. In samples from the hillslope area, cadmium, copper, and zinc were the only metals detected at concentrations that exceed the CCME guideline limits on a regular basis.

In the Casino Creek valley, mean TDS values for groundwater samples were indicative of slightly to highly mineralized conditions. Cadmium, copper, iron, and uranium were the only metals that were detected at concentrations exceeding the CCME guideline limits on a regular basis from the vicinity of the proposed TMF in the Casino Creek valley area. The elevated concentrations were not widespread and are reflective of relatively heterogeneous groundwater chemistry conditions that may result from localized variability in mineralization and from mixing with groundwater originating from the deposit area. Arsenic and zinc were also reported at concentrations that exceeded the CCME guideline limit, but the exceedances were infrequent.

7.3.5 Sediment Quality

Sediment samples were collected from a total of 21 stations during sampling periods 1993-1995 and 2008-2012. Highest concentrations of many of the metals analysed occurred in upper Casino Creek. These metals include antimony, arsenic, bismuth, cadmium, cobalt, copper, iron, lead, manganese, molybdenum, silver, thallium and zinc.

Total metals in stream sediments tend to decrease with increasing distance from the headwaters of Casino Creek. Station R2 in a tributary to Dip Creek has one of the lowest sediment metals concentrations of all the stations in the Casino project RSA and is representative of unmineralized background conditions. Stations W16 (mid-Dip Creek 27 km downstream of Casino Creek), and W20 and W21 on the Klotassin River, show similarly low metals concentrations.

Spatial trends indicate that the source of the elevated stream sediment concentrations in the study area is likely the mineralized zone on Patton Hill. For cadmium, copper and zinc, it also appears that a certain degree of deposition occurs at W8 below the Proctor Gulch confluence, and that this may be due to a precipitation of the metals in response to a pH shift in the water. Arsenic concentrations throughout the study area exceed the CCME Interim Sediment Quality Guideline (ISQG) and are reflective of natural sources from weathered rocks and soils. However, the elevated arsenic concentrations at most sites in upper Casino Creek and Canadian Creek exceed even the Probable Effects Level (PEL) guideline and are likely from the natural ARD in the groundwater near the ore body.

7.4 PROJECT-SPECIFIC EFFECTS

7.4.1 Project Interactions and Potential Effects

Several project components and activities were identified as having potential interactions with water quality in the LSA. Interactions between Project components and activities and water quality were identified using the matrix shown in Table 7.4-1.

Potential effects focused on three key areas for detailed discussion:

- Discharge, seepage and runoff from the TMF;
- Contaminate loading through blasting residues or atmospheric deposition; and
- General erosion and sedimentation processes.

Within each section, effects were further assessed by each project component and phase. All potential project effects were compiled within this framework (Table 7.4-2), assessed for residual impacts following mitigation and compensation measures (Section 7.4.3), and determined for significance (Section 7.4.4).

Table 7.4-1 Potential Interactions between the Project and Water Quality

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	Y	• Human sewage and grey water
Aggregate sources / Borrow Sites	C	N	• An interaction is not anticipated as the vast majority of the potential borrow sites are within the mine footprint and therefore all water will be directed into the TMF
Airstrip and Airstrip Access Road	C, O, CD	Y	• Blasting residues leaching from excavated rock • Dust created from blasting • Increased erosion and sedimentation into Casino and Dip Creek drainages
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O	N	• An interaction is not anticipated as the explosives storage is over 1 km from the nearest watercourse
Concentrate Transport and Loading	O	Y	• Concentrate or chemical spills
Concrete Batch Plant Operation	C, O	N	• An interaction is not anticipated because all contact water will be collected and directed into the TMF
Contracted Employment	C, O, CD	N	• An interaction is not anticipated with contracted employment
Cyclone Sand Plant	C, O	N	• An interaction is not anticipated because all contact water will be collected and directed into the TMF
Dismantling of Facilities	CD	N	• An interaction is not anticipated with dismantling

Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
			activities
Diversion of Canadian Creek	C, O	Y	• Increased erosion and sedimentation into Canadian Creek during construction of diversion
Drilling and Blasting (Noise, Fly Rock, Vibration)	C, O	Y	• Dust and nitrogen residues created from blasting
Fish Habitat Compensation Construction	C, O	Y	• Increased erosion and sedimentation at compensation construction sites
Freegold Road Extension	C, O, CD	Y	• Blasting residues leaching from excavated rock • Increased erosion and sedimentation at road crossings • Dust created from construction blasting and traffic
Freegold Road Upgrade	C, O, CD	Y	• Blasting residues leaching from excavated rock • Increased erosion and sedimentation at road crossings • Dust created from construction blasting and traffic
Fuel Storage and Distribution System	C, O	Y	• Fuel spill
Gold Extraction Plant / Oxide Ore Processing	C, O	N	• An interaction is not anticipated because all contact water will be collected and directed into the TMF
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C	Y	• Increased erosion and sedimentation into surface waters
Hazardous Materials Storage, Transport, and Disposal	C, O	Y	• Chemical spill
Heap Leach Facility	C, O	N	An interaction is not anticipated because: • Contact water contributes to process makeup requirements or directed to the TMF • Non-contact water is directed to the TMF • All leach solution is recirculated and there is no discharge during operations or closure.
Heap Leach Pad	C, O	Y	• Increased erosion and sedimentation into surface waters
Laydown Areas	C, O	N	• An interaction is not anticipated as the laydown area is not located near a watercourse
LNG Transport to site	C, O	N	• An interaction is not anticipated as in the event of a spill, LNG would rapidly vaporize and therefore in its gaseous state would not affect a watercourse

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O	Y	• Diesel fuel spill
Maximum Disturbance Area	C, O, CD	N	• An interaction is not anticipated with the project footprint as a whole
Mine Development	C, O, CD	N	• An interaction is not anticipated with mine development in the socio-economic context
Mine Staffing	C, O, CD	N	• An interaction is not anticipated with mine staffing
On-site equipment and vehicle use	C, O, CD	Y	• Dust, emissions and road runoff
Open Pit Mining	C, O	Y	• Dust and nitrogen residues created from blasting Other typical interactions are not anticipated because: • During operations, all contact water will be collected and directed into the TMF • At closure, seepage from the Pit Lake is expected to discharge within the Casino Creek valley upslope of the TMF facility; no seepage will occur to Canadian Creek
Ore Conveyors	C, O	Y	• Dust created from ore on overland transfer conveyors
Ore Crushing	C, O	Y	• Dust created from the crushing of ore
Ore Hauling	C, O	Y	• Dust created from the transport of ore on roads
Ore Stockpiles	C, O	Y	• A small percentage of the seepage may pass under the TMF to the water management pond
Processing Facilities for Sulphide Ore	O	N	• An interaction is not anticipated because all mine contact water will be directed into the TMF
Reagent Storage and Distribution	C, O	N	• An interaction is not anticipated because reagents are not located near a watercourse
Site Reclamation / Re-Vegetation	O, CD	N	• An interaction is not anticipated with reclamation activities
Site Security and Fencing	C, O, CD	N	• An interaction is not anticipated with security and fencing
Surface Water Management (Contact Water)	C, O, CD	N	• An interaction is not anticipated because all contact water will be collected and directed into the TMF
Surface Water Management (Non-Contact Water)	C, O, CD	N	• All drainage entering watercourses will be un-altered with the exception of the Canadian Creek diversion
Tailings Management	CD	Y	• TMF foundation seepage by-passing the WMP

Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Facility			to Casino Creek • Discharge from the Winter Seepage Mitigation Pond (WSMP) to Casino Creek • Discharge from TMF Spillway to Casino Creek
Topsoil Stockpiles	CD	Y	• Increased erosion and sedimentation into Dip Creek tributaries
Traffic (Equipment and Materials to Site)	C, O, CD, PC	Y	• Dust, emissions and road runoff
Waste management: garbage and sewage waste facilities	C, O,	Y	• Spills from hazardous wastes, fuels and lubricants
Waste rock and Overburden Disposal	C, O, CD	N	• An interaction is not anticipated because all waste rock and overburden will be disposed in the TMF
Water Supply	C, O	N	An interaction is not anticipated because: • Initial water supply is within TMF footprint • Long-term supply is from a riverbank caisson and radial well system adjacent to the Yukon River. Extraction of groundwater will have a negligible impact on the Yukon River water table.

Note:

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Table 7.4-2 Potential Effects on Water Quality

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
TMF foundation seepage by-passing WMP and discharging into Casino Creek (unrecovered seepage)	CCME/BC MOE guidelines for all parameters tested	O, CD	Change in surface water quality in Casino Creek and Dip Creek	Adverse
TMF seepage from WSMP and TMF spillway discharging into Casino Creek (project discharge)	CCME/BC MOE/MMER guidelines for all parameters tested	CD,PC	Change in surface water quality in Casino Creek and Dip Creek	Adverse
Blasting residues from ore and waste rock carried into Casino	CCME guidelines for nitrate, ammonia and	C, O	Change in surface water quality in Casino Creek	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
Creek	nitrite			
Dustfall and acidic deposition in Canadian Creek and Casino Creek	Baseline levels of TSS, alkalinity and sulphate	O	Change in surface water quality in Canadian Creek and Casino Creek	Adverse
Increased erosion and sedimentation due to construction activities	CCME guidelines for TSS and turbidity	C, O	Change in surface water quality in creeks located in LSA	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

7.4.1.1 Discharges from the TMF

The water management plan for the mine site has been designed to direct all Project related discharges to the TMF, and therefore all discharges to the receiving environment are to Casino Creek and eventually Dip Creek. Mine components such as the Plant Site, HLF and Open Pit do not have any direct pathways to the receiving environment. Since all the contact water from these mine components ultimately ends up in the TMF, potential water quality effects focus on discharges from the TMF.

It should be noted that seepage from the ore stockpiles into the groundwater system has the potential to affect water quality through metals loading. As described in Appendix 7E, numerical groundwater modeling shows that the majority of groundwater seepage ends up in either the Open Pit or the TMF pond; however, a portion of groundwater seepage from some of the ore stockpiles is expected to remain below the TMF pond and eventually discharge to the Casino Creek drainage. Although these seepages have direct effects on groundwater quality, all this was eventually reaches surface and is incorporated into the surface water quality model (Appendix 7F).

Potential effects resulting from seepage from the Open Pit will only occur during the Post-Closure phase once the Open Pit is flooded to maintain a Pit Lake with a surface elevation above that of the TMF pond. Numerical groundwater model results indicate that all seepage from the Pit Lake will report to the upper Casino Creek groundwater system, and will discharge to Casino Creek upstream of the TMF. As with the seepages from the ore stockpiles, the effects to groundwater are reflected in the surface water quality model results.

A water management pond will be located downstream of the TMF main embankment during construction and operations that will collect runoff from the TMF embankment and TMF seepage, and pump it back to the TMF pond. At Closure, the water management pond will be decommissioned and a groundwater cut-off wall and seepage collection pond (Winter Seepage Mitigation Pond (WSMP)) will be constructed. During Post-Closure, the TMF pond will be allowed to discharge naturally downstream via the South TMF Wetland and TMF closure spillway to Casino Creek. Once the TMF is allowed to discharge pumping of seepage back to the TMF will cease, and the WSMP will store seepage from the TMF during the winter and release the stored water during the summer. Ultimately, the two discharge pathways from the TMF to Casino Creek are from the WSMP and the TMF spillway, which converge at a mixing point approximately 250 m above the confluence of Brynelson Creek.

7.4.1.2 Water Quality Model

A mass load balance model developed in GoldSim for surface water within and downstream of the Project footprint was prepared in support of this assessment. Development of the Water Quality Model (Appendix 7F) integrated several components:

- Background (baseline) water quality (Appendix 7A);
- Geochemical source terms (Appendix 7D) to predict the rate of mass loading from each source into the water management system and downstream environment; and
- Water balance model (Appendix 7E), which integrated baseline and Project phase groundwater analyses (Appendix 7C and 7E), baseline hydrology (Appendix 7B) and a mine operations water balance.

The water quality model was developed to predict receiving environment water quality within the mine area and downstream in Casino Creek (and then to Dip Creek), for the construction, operations, closure and post-closure phases of mine development. PHREEQC geochemical modelling software was also used in combination with GoldSim. The key assumptions used in the development of this model for the receiving environment predictions are:

- Model simulation was run for a time period beginning a few years prior to Construction and continued for 200 years following the beginning of Operations using monthly time steps
- Average environmental conditions were used:
  - Average monthly flows
  - Seasonal median baseline water quality
- Loadings to the receiving environment include:
  - Seepage bypass of the Water Management Pond
  - WSMP Discharge; and
  - TMF Spillway Discharge.
- Background loading to Casino and Dip Creeks was incorporated into the model using baseline concentrations.

The water management schedule, as it relates to the water quality model, is described below.

Construction (Year -4 to Year -1):

Construction of the TMF commences approximately 36 months prior to mill start-up in order to collect enough surface water runoff for mill start-up. Surface water runoff from the ore stockpiles, plant site and waste rock storage area will be collected behind the TMF once the starter embankment is constructed. The water management pond is established in Year -3 downstream of the starter Main embankment and will function as a sediment control pond where all sediment laden water generated during construction will be collected. Treated water will be discharged to Casino Creek during Year -3 and pumped back to the TMF pond in Years -2 and -1.

Operations (Year 1 to Year 22):

Tailings and process water will be actively deposited to the TMF during this phase. The water management pond, located downstream of the TMF main embankment, will collect and pump back the TMF embankment runoff and seepage to the TMF pond.

Runoff collection ditches downstream of the final footprints of the ore stockpiles will be established to route water to local collection ponds, which will then be directed to the TMF pond. Groundwater seepage from the low grade

supergene oxide ore stockpile will be mitigated using a groundwater collection or infiltration suppression system that will direct the water to the TMF pond.

Closure and Decommissioning (Year 23 to 25); Post-Closure (Years 26+)

Closure Water Management Phase I (approximately Years 23 to 30)

Closure Water Management Phase I will consist of active water management. Passive treatment systems in the form of wetlands will be constructed in the northern reaches of the TMF footprint (North TMF Wetland) and adjacent to the TMF Main embankment (South TMF Wetland). The TMF pond will be pumped to the Open Pit for five years following operations, at a rate of approximately 1,200 m^3/hr, to draw down the TMF pond elevation for construction of the TMF wetlands. The WSMP will be constructed downstream of the TMF embankment, will include a groundwater cut-off wall, and will continue to recycle seepage and embankment runoff to the TMF pond. The heap leach facility will be rinsed and drained, and draindown water will be treated for selenium and mercury by a bioreactor prior to being discharged to the Open Pit. A cover will then be placed on the heap that will reduce infiltration to 20% of average annual net precipitation. Closure Water Management Phase I will end when the TMF pond has reached its maximum capacity.

Closure Water Management Phase II (approximately Years 31 to 114+)

Closure Water Management Phase II will consist of passive water management once the TMF pond begins spilling and prior to discharge of the Pit Lake to the North TMF Wetland. A spillway and downstream channel are required to convey excess water in the TMF to prevent overtopping of the embankments. The closure spillway will be constructed in the west abutment of the West embankment and a constructed channel and plunge pool will convey the spillway flow to Casino Creek downstream of the TMF. The WSMP will store TMF groundwater seepage during the winter low flow months. The collected seepage will then be discharged from the WSMP during the summer months when TMF spillway discharges.

Closure Water Management Phase III (approximately Years 114 to 220+)

Closure Water Management Phase III will begin when the Pit has been flooded and starts discharging to the TMF pond through the North TMF Wetland. Pit water will be stored in winter and only released to the North TMF Wetland during the summer when passive treatment is most effective. The TMF and WSMP will continue to operate as described in Closure Water Management Phase II.

7.4.1.3 Water Quality Model Predictions

Water Quality is predicted in Casino Creek at model point M18 (just downstream of the confluence of Brynelson and Casino Creek) and W4 (mouth of Casino Creek). W4 is a baseline water quality monitoring site, while M18 is a modeled site, although baseline hydrology was collected at M18. M18 represents the water quality at the point of discharge to the receiving environment. W4 represents the water quality at the mouth of Casino Creek just prior to discharge into Dip Creek. Water quality in Casino Creek between these two locations is gradational between these two sets of results. Water quality in Dip Creek is modeled at W5, a baseline monitoring site just downstream of the Casino Creek confluence. Estimated water quality predictions for the entire suite of 29 parameters are described in Appendix 7F; only the ones that exceed CCME or BC MOE guidelines and those listed under *MMER* Schedule 4 as a deleterious substance are discussed in detail in this assessment.

The water quality predictions were modelled from Construction through to Post-Closure with monthly outputs over a 200 year period. The predicted water quality parameters are presented in Table 7.4-3 and are compared to CCME guidelines for the protection of freshwater aquatic life. For parameters without a CCME guideline, the BC MOE working and approved 30 Day Averages and Maximum values are used. Where available, the 30 Day

Averages are used instead of the maximum values as a conservative measure. *MMER* authorized limits are applied to water quality at the combined effluent discharge point, which is a mixing point at the downstream end of the TMF spillway where the flow mixes with the WSMP discharge (approximately 250 m upstream of Brynelson Creek) at mine closure.

Table 7.4-3 Water Quality Model Parameters and CCME and BC MOE Guidelines

Species ID	Units	CCME	BC MOE	MMER
Hardness	mg/L $CaCO_3$	-	-	-
Acidity	mg/L	-	-	-
Alkalinity	mg/L $CaCO_3$	-	10 to 20, dependent on sensitivity to acid inputs	-
Sulphate $(SO_4)^h$		-	128 @ hardness = 0-30 mg/L 218 @ hardness = 31-75 mg/L 309 @ hardness = 76-180 mg/L 429 @ hardness = 181-250 mg/L	-
Cyanide (Total CN)	mg/L	-	-	1
Cyanide (WAD)	mg/L	0.005	0.010	-
Chloride (Cl)	mg/L	120 (short-term)	-	-
Fluoride $(F)^h$	mg/L	0.12 (interim)	0.4 @ hardness = 10 mg/L (max) 1.3 @ hardness = 100 mg/L	-
Aluminum (Al)	mg/L	0.005 if pH<6.5 0.1 if pH ≥6.5	0.05, dissolved, when pH≥6.5 0.1, dissolved (max)	-
Antimony (Sb)		-	0.02	
Arsenic (As)	mg/L	0.005	0.005	0.5
Barium (Ba)		-	1 (30-d average) 5 (max)	-
Cadmium $(Cd)^h$	mg/L	0.000012 to 0.000083 for hardness 30 to 290 mg/L	0.000012 to 0.000083 for hardness 30 to 290 mg/L	-
Calcium (Ca)		-	-	-
Chromium (Cr)	mg/L	0.0010 for Cr(VI) 0.0089 for Cr(III)	0.0010 for Cr(VI) 0.0089 for Cr(III)	-
Cobalt (Co)		-	0.110 max 0.004 30-d average	-
Copper $(Cu)^h$	mg/L	0.002 @ hardness < 90 mg/L 0.004 @ hardness > 180	0.013 to 0.019 from hardness 120 to 180 mg/L (30-d average)	0.3
Iron $(Fe)^h$	mg/L	0.3	1 (total, short-term max) 0.35 (dissolved, short term max)	-
Lead $(Pb)^h$	mg/L	0.001 to 0.007 (for hardness 60 to 180 mg/L)	0.004 @ hardness = 30 mg/L 0.016 @ hardness = 290 mg/L	0.2
Magnesium (Mg)	mg/L	-	-	-
Manganese $(Mn)^h$	mg/L	-	0.7 @ hardness = 30 mg/L 1.9 @ hardness = 290 mg/L	-
Mercury (Hg)	mg/L	0.000026	0.00000125 to 0.00002, dependent on percentage of	-

Species ID	Units	CCME	BC MOE	MMER
			methyl mercury	
Molybdenum (Mo)	mg/L	0.073	1 (30-d average) 2 (max)	-
Nickel (Ni) [h]	mg/L	0.025 @ hardness < 60 mg/L to 0.15 @ hardness > 180 mg/L	0.025 @ hardness < 60 mg/L to 0.15 @ hardness > 180 mg/L (max)	0.5
Potassium (K)		-	-	-
Selenium (Se)	mg/L	0.001	0.002 (30-d average)	-
Silver (Ag) [h]	mg/L	0.0001	0.00005 @ hardness ≤100 mg/L 0.0015 @ hardness ≥100 mg/L (30-d average)	-
Sodium (Na)	mg/L	-	-	-
Thallium (Tl)	mg/L	0.0008	0.0008 (30-d average)	-
Uranium (U)	mg/L	0.033 short term 0.015 long term	0.3 (max)	-
Zinc (Zn) [h]	mg/L	0.03	7.5 @ hardness ≤ 90 mg/L to 240 @ hardness = 400 mg/L	0.5

Notes:
CCME: Freshwater Aquatic Life
BCMOE: 30-day Average and Maximum
MMER: Maximum Monthly Mean
h: hardness dependent

7.4.1.3.1 TMF Pond Water Quality

During Operations, all runoff from undisturbed areas within the TMF catchment will be directed to and collected in the TMF pond along with all contact and process water. During Closure Water Management Phase I, the TMF pond level will be managed to maintain a water cover over the saturated waste rock with all excess pond water pumped to the Open Pit to aid in the improvement of TMF supernatant pond water quality and wetland construction. During Closure Water Management Phase II, upward fluxes of water through the submerged waste rock are the dominant loads to the TMF Pond. During Closure Water Management Phase III, the Pit Lake discharge is an additional load to the TMF Pond. Table 7.4-4 shows the average concentrations for the modeled parameters during typical years of Operations, Closure Water Management Phase II (when the TMF is discharging but the Open Pit is not) and Closure Water Management Phase III (when the Open Pit is discharging).

Table 7.4-4 Water Quality of TMF Pond During Typical Operations and Post-Closure Years

	Operations (Year 13)	Closure Water Management Phase II (Year 100)	Closure Water Management Phase III (Year 120)
Hardness	1191	400	398
Acidity	2	4	15
Alkalinity	12	150	158
Sulphate	1259	275	296
Cyanide (Total)	<0.001	<0.001	<0.001
Cyanide (WAD)	<0.001	<0.001	<0.001
Bromide	0.01	0.22	0.41
Chloride	34	8	9
Fluoride	2.14	0.57	0.65
Aluminum	3.57	0.06	0.05
Antimony	0.006	0.010	0.011
Arsenic	0.006	0.003	0.004
Barium	0.067	0.085	0.083
Cadmium	0.00071	0.00021	0.00018
Calcium	472	131	145
Chromium	0.0028	0.0008	0.0011
Cobalt	0.003	0.022	0.039
Copper	0.36	0.10	0.09
Iron	0.0017	0.0002	0.0002
Lead	0.0015	0.0030	0.0027
Magnesium	3	20	19
Manganese	0.44	0.52	0.50
Mercury	0.000014	0.000013	0.000015
Molybdenum	0.34	0.07	0.07
Nickel	0.009	0.006	0.012
Potassium	68	6	6
Selenium	0.016	0.004	0.005
Silicon	0.37	2.34	2.12
Silver	0.00006	0.00004	0.00005
Sodium	35	14	14
Thallium	0.00048	0.00010	0.00010
Uranium	0.018	0.052	0.046
Zinc	0.04	0.02	0.02

7.4.1.3.2 Pit Lake Water Quality

Blasting in the Open Pit will leave the wall rock fractured and exposed to weathering processes. The exposed wall will eventually oxidize and its runoff will become a source of mass loading into the Pit Lake. Following active mining in the pit, dewatering will be discontinued, and the Open Pit will be allowed to fill with water by

groundwater recharge, overland runoff, and direct precipitation. The formation of the Pit Lake will perpetually receive mass loading from the portion of the pit wall that remains exposed.

During the Closure Water Management Phase I (Year 23 to Year 30), the Marginal Grade Stockpile will be placed in the Open Pit, and TMF Pond water and heap draindown water will be pumped to the Open Pit. It is also assumed that 5% of the low grade ore will not be milled and will also end up being placed in the Pit. The Pit Lake will fill to its maximum water storage capacity around Year 113 and will discharge to the TMF North Wetland for treatment prior to discharge to the TMF Pond. Table 7.4-5 shows the average water quality of the Pit Lake upon initial discharge and at Post-Closure.

Table 7.4-5 Water Quality of the Pit Lake During Typical Post-Closure Years

	Closure Water Management Phase II (Year 113)	Closure Water Management Phase III (Year 199)
Hardness	464	334
Acidity	69	68
Alkalinity	185	194
Sulphate	478	351
Cyanide (Total)	<0.001	<0.001
Cyanide (WAD)	<0.001	<0.001
Bromide	1.34	1.09
Chloride	18	9
Fluoride	1.16	0.86
Aluminum	0.009	0.010
Antimony	0.019	0.010
Arsenic	0.006	0.004
Barium	0.076	0.061
Cadmium	0.00392	0.00350
Calcium	242	198
Chromium	0.0027	0.0024
Cobalt	0.130	0.078
Copper	0.37	0.36
Iron	0.0001	0.0001
Lead	0.0014	0.0009
Magnesium	14	13
Manganese	0.54	0.42
Mercury	0.000025	0.000022
Molybdenum	0.18	0.10
Nickel	0.047	0.029
Potassium	8	3
Selenium	0.008	0.005
Silicon	2.20	2.18

	Closure Water Management Phase II (Year 113)	Closure Water Management Phase III (Year 199)
Silver	0.00103	0.00054
Sodium	16	10
Thallium	0.00017	0.00012
Uranium	0.062	0.055
Zinc	0.39	0.37

7.4.1.3.3 Predicted Discharge Water Quality

Two sources make up the discharge effluent: the TMF Spillway water and the WSMP water. The WSMP water will only be released between May and November in order to mix with the TMF Spillway water. This discharge effluent will be the point of discharge into the receiving environment, which means *MMER* guidelines will be applicable, until the mine becomes a Recognized Closed Mine. Details on the water quality of the discharge sources throughout the mine life is discussed in Appendix F as this assessment focuses only on Post-Closure when water is discharged to the receiving environment.

MMER limits were compared with the maximum annual concentrations for the parameters regulated by *MMER*, which include As, CN (total), Cu, Pb, Ni and Zn. Predictions were not made for TSS as it is assumed that sediment control practices employed throughout construction and operations and ongoing monitoring will maintain TSS to less than detectable or at most <5 mg/L on a monthly basis. At closure and post-closure, TSS is assumed to remain very low in the receiving environment, which is attributable to the presence of the upstream TMF pond. Figure 7.4-1 below shows the predicted maximum annual concentrations for the *MMER* regulated parameters of the discharge at the mixing point of the TMF spillway and WSMP water. The figures clearly show that none of the parameters exceed *MMER* limits.

For all the figures below, these acronyms and short forms are used:

- C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure
- Phase I, II, III refer to "Closure Water Management Phase")

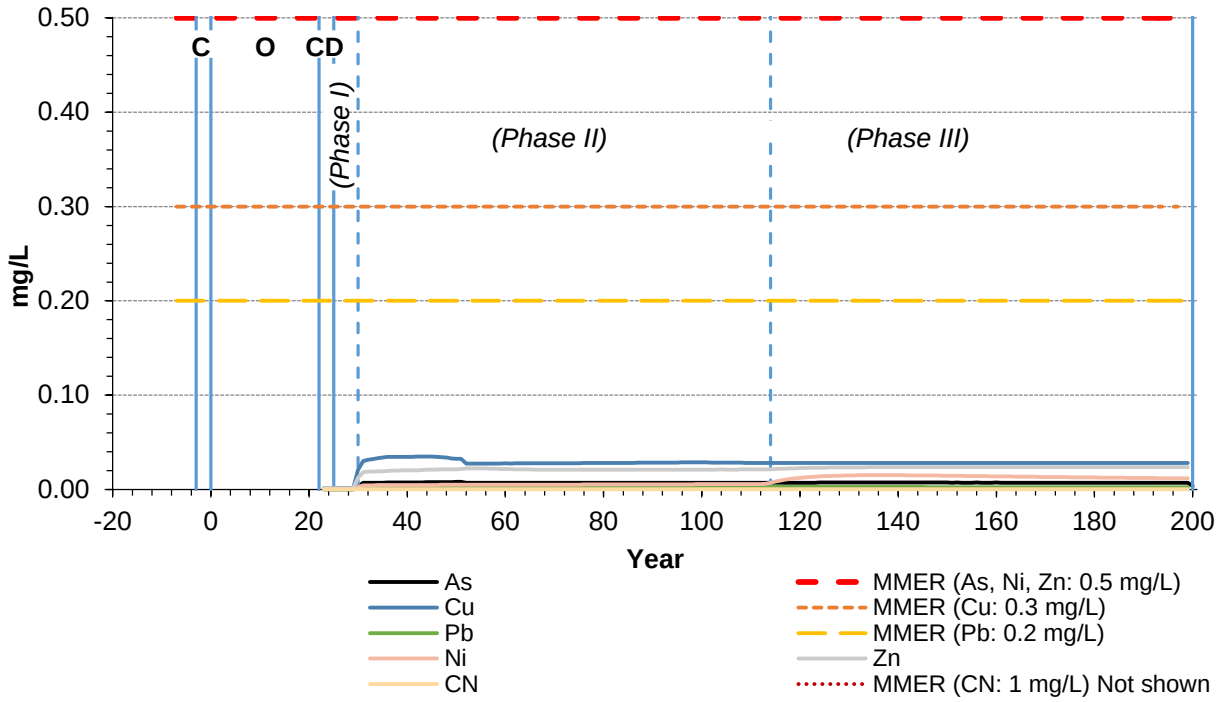


Figure 7.4-1 Predicted Maximum Annual Values for the Discharge at the Mixing Point

7.4.1.3.4 Predicted Water Quality in Casino Creek

Casino Creek is the main receiving water body throughout the life of mine. Predicted water quality in this creek is highly variable and is dependent on the mine schedule. The following discussion of predicted water quality is applicable to the entire length of Casino Creek, downstream of the Brynelson Creek confluence (i.e. from M18 to W4).

Construction

Water quality during construction is mainly a result of pre-existing baseline conditions, although seepage through the TMF starter dam may also be contributing loading at this phase. The modelled water quality results are characterized by low hardness and acidity. Copper and Al exceed CCME guidelines because they do naturally in the baseline.

Operations

During the operations phase, water quality predictions in Casino Creek are driven by the unrecovered TMF foundation seepage. According to the numerical groundwater modelling (Appendix 7E), approximately 90-95% of the TMF foundation seepage is predicted to be recovered by the water management pond assuming that the pond is maintained with as low of a water level as possible. The remaining 5-10% of foundation seepage (up to 2.2 L/s by the end of operations) is expected to bypass the pond and escape further downstream to Casino Creek. The foundation seepage is made up of mostly the tailings and waste rock seepage and the sand plant slurry underflow, with a potential minor contribution from stockpile seepage. It is important to note that the stockpile seepage was conservatively assumed to be un-altered by its passing through the TMF facility. Modeled concentrations steadily increase throughout the operations period with the same CCME exceedances as for

construction plus the addition of Cd and F. Hardness also increases throughout the operations phase while alkalinity remains the same as during Construction.

Closure and Decommissioning and Post-Closure

Closure Water Management Phase I

TMF seepage continues to be pumped back to the TMF pond and therefore early in this phase downstream water quality is very similar to during Operations. After the WSMP is constructed, the cut-off wall results in 100% capture of TMF seepage and a resultant improvement in water quality in Casino Creek to pre-Operation levels.

Closure Water Management Phase II

Water quality during this phase is driven by discharge from the WSMP during May through November, and TMF Spillway discharge which will mix prior to entering Casino Creek. Water in the WSMP will be acidic and high in metals; however, mixing of WSMP flows with TMF spillway flows will result in neutral pH water entering Casino Creek, and metals that are soluble at low pH, such as Al, or soluble under anoxic conditions, such as Fe will precipitate out of solution. Modeled predictions that exceed CCME guidelines in Casino Creek include Cu, Cd and F, as during Operations, with the addition of Mo, Se and U. There are no CCME guidelines for sulphate but the BC MOE guideline is exceeded when using the baseline hardness to derive the calculated guideline.

Closure Water Management Phase III

The water quality predictions during this phase are driven by the same factors as WMP Closure Phase II plus the addition of the Pit Lake discharge into the TMF. The Open Pit is predicted to overflow at around Year 114, with the discharge first going through the North TMF wetland and then eventually the South TMF wetland before discharging into Casino Creek via the TMF spillway. The treatment wetlands effectively improve the water quality of a number of parameters from the TMF discharge to the point that very few parameters exhibit detectable spikes in Casino Creek throughout this phase. Modeled parameters: Cu, Cd, Mo, Se, U, SO_4 and F, continue to exceed CCME/BC MOE guidelines. A peak in predicted concentration for Se is clearly related to the overflow of the Open Pit at Year 114.

7.4.1.3.5 Predicted Water Quality in Dip Creek

Casino Creek flows into Dip Creek and thus water quality predictions follow the same patterns and are driven by the same sources as Casino Creek. Modelled concentrations in Dip Creek are generally improved due to the higher dilution and fewer parameters exceed CCME/BC MOE guidelines.

Construction

Cu is predicted to exceed CCME guidelines right at the beginning of the construction phase, since Cu exceeds CCME in the baseline at W5. Other parameters that exceed CCME during this phase are Cd and Fe, which can also be attributed to elevated background levels.

Operations

During Operations, Cd, Cu and Fe continue to exceed guidelines and hardness continues to increase.

Closure and Decommissioning and Post-Closure

Closure Water Management Phase I

There is very little change in water quality in all of the modelled parameters during this phase. A small reduction in water quality concentration occurs once the WSMP is in place and begins to collect all seepage and runoff from the TMF. The same three metals continue to exceed CCME guidelines.

Closure Water Management Phase II

As with water quality predictions in Casino Creek, a small spike in concentration occurs during the initial flush of the TMF spillway and WSMP. Cadmium, Cu and Fe continue to exceed CCME guidelines and F and Se begin to exceed CCME during this phase.

Closure Water Management Phase III
For the most part, modeled concentrations remain stable throughout this phase. Cu, Cd, Fe, Se and F are predicted to exceed CCME guidelines during this phase.

7.4.1.3.6 Water Quality Model Results Conclusions

Throughout the Project Phases, there are a total of seven parameters that exceed CCME/BC MOE guidelines in Casino Creek: Cd, Cu, Mo, Se, U, SO_4 and F. Of these parameters, only Cu, Cd, Se and F continue to exceed CCME guidelines at various Project Phases in Dip Creek. In this assessment, these seven parameters are considered to be the Contaminants of Concern (COC) because they exceed CCME guidelines (or BC MOE in the case of SO_4) in the Casino and Dip Creek receiving environments. Iron also exceeds CCME guidelines in Dip Creek but this is unrelated to the predicted project discharge. Baseline conditions show that upstream of the confluence with Casino Creek, Dip Creek has Fe concentrations that exceed CCME guidelines during the months of May and June.

7.4.1.4 Contaminant Loading through Blasting Residues, Dust and Emissions

7.4.1.4.1 Blasting Residues

The Casino Project requires the use of explosives during construction of the infrastructure site pads, construction of access roads, and production of the Open Pit. Blasting will be carried out using an ammonium nitrate and fuel oil emulsion (ANFO) product manufactured at the Casino mine site. Fixed emulsion and ammonium nitrate will be stored on site. Residues from blasting will contain nitrogen compounds that will remain on the surface of waste rock, tailings and excavated rock and be available for transport by contact water.

Generally, ANFO is made up of 94% NH_4NO_3 (of which 35% is nitrogen) and 6% fuel oil (Morin and Hutt, 2009). However, during blasting the reaction often does not completely consume the explosive, leaving behind residual nitrogen. The amount of nitrogen residue is dependent on many different factors including the handling of explosives and efficiency of the blast. Limited research exists on the prediction of nitrogen species in mine site drainages from explosive residues. The Ferguson and Leask (1988) case study is most relevant to the Casino Project as both are open pit mines, primarily use ANFO explosives, and are situated in cool, dry climates at higher elevations (1,000 m to 2,500 m). Ferguson and Leask (1988) found that 0.2% of explosives remain as residues and are lost to runoff in dry conditions and between 2% and 5% in wetter conditions. Considering the relatively dry climate at the Casino Project, it has been conservatively estimated that 1% of the explosives remain on site as blasting residue.

Total nitrogen in blasting residues is approximately apportioned as follows: 87% as nitrate-N, 11% as ammonia-N and 2% as nitrite-N (Ferguson and Leask 1988). Nitrate-N and ammonia-N are generated through blasting, whereas nitrite-N is an intermediate species of ammonia oxidation to nitrate.

The amount of nitrogen-based nutrient loss to the receiving environment from blasting at mines can be calculated as follows:

- Explosives Consumption (tonnes of ANFO per year) * 0.01 (Percent of explosives lost to drainages) * 0.94 (percent of ammonium nitrate in ANFO) * 0.35 (percent of nitrogen in ammonium nitrate) * 4 or 22 (years in Project Phase).

The estimated total nitrogen loads for the construction and operations phases are detailed in Table 7.4-6.

Table 7.4-6 Estimated Nitrogen Loads during Mine Construction and Operations

Description	Construction	Operations	Total
Waste Rock and Overburden (million tonnes)[1]	10	648	658
Powder Factor (kg ANFO/tonne)	0.25	0.25	-
ANFO Consumption (tonne)[1]	2500	162000	164500
ANFO lost to drainages (%)	1	1	-
Ammonium nitrate in ANFO (%)	94	94	-
Nitrogen in ammonium nitrate (%)	35	35	-
Total Nitrogen loss (tonne)	8	533	541
Tailings from Milled Ore (million tonnes)[1]	0	956	956
Powder Factor (kg ANFO/tonne)	0.25	0.25	-
ANFO Consumption (tonne)	0	239000	239000
ANFO lost to drainages (%)	1	1	-
Ammonium nitrate in ANFO (%)	94	94	-
Nitrogen in ammonium nitrate (%)	35	35	-
Total Nitrogen loss (tonne)	0	786	786
Total Blast Residue Generated (tonnes)			
Nitrate-N	7	1147	1154
Ammonia-N	1	145	146
Nitrite-N	0	27	27
Total-N	8	1319	1327

[1]Based on the production schedule values presented in KP letter VA13-00949 Revised Waste Deposition Strategy, May 2013.

1. Freegold Road Upgrade and Extension

Blasting residues have the potential to leach from excavated rock to access road watersheds. However, the vast majority of the explosives will be used for blasting ore at the mine site. Detailed calculation of nitrogen blasting residues are completed for the mine site only as it is expected that nitrogen loading from the excavated rock along the access roads will be minimal.

2. Open Pit and Tailings Management Facility

The vast majority of blasting at the mine site will take place in the Open Pit and almost all of the contact water during the 4-year construction phase and 22-year operations phase will end up in the TMF. Because of this linkage, these two components will be assessed together as described below.

Construction:

For the first two years of the construction phase (Year -4 and Year -3) blasting will be less as the main activities around the mine site will be site establishment and mobilization efforts, and the initial stripping of the Open Pit is mainly overburden and will require less blasting. The initial open pit stripping will generate approximately 2 to 3 million tonnes of non-reactive waste rock (leached cap) by shoveling and blasting. This material is either stockpiled as gold ore for processing by heap leaching in Year -3, used as fill material for the construction of the embankment shell zones of the TMF, or placed in the waste storage area of the TMF. Assuming a powder factor of 0.25 kg of ANFO/tonne of ore, up to 750 tonnes of ANFO will be consumed during the initial open pit stripping. Total nitrogen lost during this initial phase is therefore approximately 2.5 tonnes, assuming 1% of all explosive material remains behind as residues, and 33% (94% * 35%) of the residue is nitrogen. Water collected within the Open Pit footprint and contact water from the temporary stockpiles will be collected and transferred to the Mine Water Treatment Feed Pond for use by the process plant, which will ensure that all of the blasting residues that wash off of the waste rock will be captured before reaching nearby watercourses.

During the last two years of construction, (Year -2 and Year -1) the ore stockpiles and waste rock storage area will be established. Runoff not collected in the open pit will be collected in ditches and directed to the TMF pond.

As shown in Table 7.4-6, a maximum of 8 tonnes of total nitrogen is expected to be diverted to the TMF during the 4-year construction phase. Since all the contact water is collected and is either used by the process plant or diverted to the TMF, there are no potential effects to water quality.

Operations:

During operations, all of the waste rock and ore removed from the pit will be placed in the TMF, stockpiled and processed or stockpiled for placement in the pit (i.e. the marginal ore stock pile). As shown in Table 7.4-6, a maximum of 1,319 tonnes of total nitrogen is expected to end up in the TMF during the 22-year operations phase. Seepage from the TMF during operations will be collected by the water management pond downstream of the TMF embankment and be pumped back to the TMF; therefore no impacts to water quality in Casino Creek, resulting from nitrogen loading, are expected during the Operations phase.

Closure and Decommissioning and Post-Closure:

No blasting occurs during the Closure or Post-Closure phases, and therefore it is expected that a maximum total of 1,327 tonnes of nitrogen will be left within the TMF at closure. An estimate of the total concentration of nitrogen that accumulates over the life of mine before discharge commences can be calculated by dividing the maximum total of 1,327 tonnes of nitrogen by the total volume of water that accumulates over the life of mine. The total volume of water accumulated in the TMF facility, including the pond, waste rock voids and tailings voids, is approximately 347 Mm^3, as calculated in the YESAB Water Balance Model. Therefore, the maximum concentration of total nitrogen at the end of Operations is 1,327 tonnes divided by 347 M m^3, which is 3.8 mg/L.

After operations, the TMF pond will be pumped to the pit for a period of 5 years, and approximately 30 Mm^3 of contact water containing residual nitrogen will be removed from the TMF. This equates to a removal of approximately 114 tonnes of total nitrogen. The additional water circulated through, and used to fill up, the TMF during closure results in a total water volume of approximately 360 Mm^3 available to mix with the residual nitrogen

load. The resultant maximum total nitrogen concentration in the TMF upon discharge to Casino Creek is 3.4 mg/L, which equates to concentrations of 3.0 mg/L nitrate, 0.37 mg/L ammonia, and 0.068 mg/L nitrite.

Casino Creek is oligotrophic (nutrient poor) and the 90th percentile nitrate, ammonia and nitrite baseline levels at W4 are 0.26 mg/L, 0.08 mg/L and 0.003 mg/L, respectively. The addition of the maximum nitrogen concentrations calculated above would put nitrate, ammonia and nitrite levels in Casino Creek to 3.3 mg/L, 0.45 mg/L and 0.07 mg/L, respectively. Compared with CCME guidelines (13 mg/L, 0.5 mg/L, and 0.06 mg/L, respectively), only nitrite would have a marginal guideline exceedance. However, the nitrogen concentrations calculated above assume that all of the nitrogen that ends up in the TMF remains unchanged for 31 years, a highly unlikely and worst-case scenario. There are many pathways for the reduction in nitrogen loading during the 31 years of combined construction, operations and closure phases. Nitrogen is present as mostly ammonia and nitrate and both are subject to nitrification/de-nitrification reactions which remove nitrogen as N_2 gas. During the 31 years, a portion of the nitrogen will also likely become immobilized within the solids in the TMF. Furthermore, the remaining nitrogen in the TMF pond or on the dam shell is substantially diluted by local runoff. All of these ameliorating factors indicate that although there is potential for increased nitrogen loading to Casino Creek at Post-Closure, it is highly unlikely to result in increases in nitrogen concentrations to beyond CCME guidelines. It is therefore concluded that there will be negligible effects to the water quality of Casino Creek from nitrogen loading at Post-Closure, and it will not be assessed further.

7.4.1.4.2 Dust and Emissions

Project activities such as blasting, ore conveying, crushing and hauling, on-site equipment and vehicle use and traffic along the access roads have the potential to affect air quality and subsequently surface water quality from atmospheric deposition. The air dispersion model CALPUFF was used to assess potential effects to air quality, including rates of particulate deposition and air concentrations of NOx and SO_2. Detailed model results are presented in Section 8. The results of the CALPUFF model show that the dispersion of dust and emissions from project activities mainly affect upper Canadian Creek and Casino Creek.

Potential air quality interactions with water quality at the mine site are from dustfall, and theoretically from acid deposition. Acid deposition could occur if levels of NOx and SO_2 were predicted to be consistently high (ie. above guideline) and wide-spread, and effects of such deposition on the ecological environment would also need to consider the tolerance capacity of the existing environment. The primary sources of NOx and SO_2 emissions at the mine site will be the LNG power plant (NOx), and diesel exhaust from vehicles, equipment and the auxiliary power plant (SO_2). Dustfall, or total particulate matter, is generated at the mine site mainly from blasting in the open pit, ore conveying, crushing and hauling and traffic and equipment use on the access roads. Dust deposition can lead to increased TSS in waterbodies.

CALPUFF modelling indicates that the maximum annual dustfall deposition will occur in Year 11 of Operations due to peak equipment use and maximum waste material movements. Predicted maximum annual dustfall is between 1 and 1.7 mg/(dm^2-d) in upper Canadian Creek and between 0.6 and 0.7 mg/(dm^2-d) in lower Casino Creek. These values are below the BC annual air quality standard of 1.7 to 2.9 mg/(dm^2-d), and therefore potential effects of dustfall on TSS levels in Casino and Canadian Creek as expected to be minor, if not negligible.

Maximum annual SO_2 and NO_2 concentrations will also occur in Year 11 due to estimated peak activity and are also concentrated around the footprint of the Open Pit and TMF. Maximum annual concentrations of SO_2 are predicted to be between 1 and 5 µg/m^3 in lower Casino Creek and upper Canadian Creek, which is well below the Yukon Air Quality standard of 25 µg/m^3. Maximum annual NO_2 concentrations in lower Casino Creek are predicted to be between 30 and 60 µg/m^3 which is within the Yukon Air Quality standards of 60 µg/m^3. NO_2 concentrations in a small portion of the upper Canadian Creek watershed may be as high as 100 to 200 µg/m^3,

which exceed Yukon Air Quality standards; however, based on the localized nature of the NO_2 exceedances, and the absence of SO_2 exceedances, acid deposition is considered negligible.

7.4.1.5 General Erosion and Sedimentation Processes

Erosion of stream banks and increased sedimentation from in-stream construction activities in waterbodies in the Casino Project area have the potential for adverse effects on water quality by exceeding guidelines for total TSS. The CCME guideline for TSS is defined for clear flow and high flow conditions. During clear flows, the guideline is a maximum of 25 mg/L increase from background levels for any short-term exposure (i.e. 24-h period), and a maximum average increase of 5 mg/L from background levels for longer term exposure (i.e. between 24 h and 30 d). During high flows, the guideline is a maximum increase of 25 mg/L from background during the period when background levels are between 25 and 250 mg/L, and a maximum increase of 10% of background levels when background is ≥ 250 mg/L (CCME, 1999).

Many of the activities conducted within the mine site and along the access roads have the potential to result in elevated TSS within nearby water bodies. The primary pathways by which sediment could end up in watercourses, and TSS could become elevated, include:

- Ground disturbance during construction and decommissioning of mine site infrastructure and access roads;
- Particulate matter deposition caused by vehicle and equipment traffic within the mine site area and along the access roads;
- Particulate matter deposition caused by open pit blasting and ore and waste rock handling; and
- Runoff from ore and topsoil stockpiles.

Any discharge of water that would result in a sizeable increase in flow within an existing watercourse would likely result in bank destabilization and an increase in TSS; however, no such discharges have been identified downstream of the Project. Furthermore, any sediment mobilized within the mine site during operations and decommissioning will end up in the TMF pond, where it will settle out of suspension.

7.4.2 Identification of Mitigation Measures and Potential Residual Effects

Mitigation measures were identified and compiled for each potential effect on water quality (Table 7.4-11). For the purposes of this assessment, mitigation measures include any action, project design feature, or monitoring and management plan that will reduce or eliminate effects on water quality in the LSA. Each mitigation measure was evaluated for its predicted effectiveness on reducing or eliminating impacts. Following the application of all potential mitigation measures, residual effects were identified and carried forward in the assessment to determine significance (Section 7.4.3).

7.4.2.1 Potential Residual Effects

Predicted water quality in Casino Creek and Dip Creek is predicted to exceed CCME guidelines for several parameters, as discussed in Section 7.4.1.3.3. Exceedances result from seepage from the TMF during Operations, and discharge from the Project during Post-Closure. Because CCME guidelines are exceeded as a result of the project, potential residual effects exist, and are identified as follows:

- Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage; and
- Change in surface water quality in Casino Creek and Dip Creek due to TMF discharge.

7.4.2.2 General Mitigation Measures

All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Air Quality Management Plan and Water Management Plan, and Transport Canada's Aerodrome Standards and Recommended Practices, which all aim to reduce or eliminate effects on water quality by incorporating Best Management Practices (BMPs), such as:

- Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading);
- Monitoring of TSS and turbidity during construction to ensure compliance with regulatory guidelines (<25 mg/L increase if background levels are less than 250 mg/L, <10% increase if background levels are greater than 250 mg/L; CCME 2001);
- Stabilizing and re-vegetating disturbed areas following construction, as appropriate;
- Designing appropriate sediment settling ponds that conform to BC MELP (2001) guidelines;
- Designing appropriate diversion ditch systems to minimize contact water;
- Designing appropriate collection ditch systems to collect contact water; and
- Using dust suppressants and enforcing traffic speed limits along all access roads.

In addition to mitigation and compensation measures, an environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and biological communities within the LSA, as required. Monitoring during the operations phase will aid calibration of the water quality model predictions and additional mitigation or compensation measures will be incorporated on an as-needed basis. Throughout the life of the Casino Project, water management will be the primary tool used to preserve water quality. Water management and general reclamation measures are discussed below.

7.4.2.2.1 Water Management

The objectives of the water management plan are to ensure sufficient water is available to support ore processing, while minimizing the potential for storm flows to cause damage to mine infrastructure and the potential for mining activities to cause adverse effects to downstream water quality. Water will be controlled in a manner that minimizes erosion in areas disturbed by construction activities and prevents the release of sediment laden water to the receiving environment. Highlights of key strategies from the water management plan are described below. A full description of the water management plan can be found in Appendix 4C.

Operational Water Management Strategy

The strategy to minimize contact water by diverting around Project infrastructure where possible, and maximize the use of the water within the project area by collecting and managing all site runoff from disturbed areas, recycling water within the HLF, storing surplus water within the TMF and recycling process water from the TMF to the mill and cyclone plant.

Sediment and Erosion Control Strategy

Design criteria for the various sediment control elements will be based on industry standard guidance documents (BC MELP, 2001; MEMNG, 1998). Sediment mobilization and erosion will be managed throughout the site by installing sediment controls prior to construction activities, limiting the disturbance as much as possible and reducing water velocity across the ground, particularly on exposed surfaces and in areas where flow tends to concentrate. During operations, diversion ditches will be established and disturbed land surfaces will be stabilized

to minimize erosion. This will be achieved by implementing progressive rehabilitation of disturbed land, construction drainage controls to improve stability, promoting infiltration, constructing appropriate sediment control devices and restricting access to rehabilitated areas.

Numerous design elements were included to achieve the objectives of the water management plan, including:

- Coffer dams and pumping systems
  - A coffer dam will be constructed with the TMF starter footprint to capture all runoff from the upstream areas and route it to the sediment pond downstream.
- Sediment and erosion control elements and BMPs
  - Typical BMPs that will be used at the project are runoff collection ditches, energy dissipaters, sediment traps, slope drains, surface roughening, filter bags, water bars, diversion structures, silt fences, sediment basins, temporary seeding, and mulching.
- Sediment settling and water collection ponds
  - Temporary sediment settling ponds will be constructed downstream of all construction activities to treat sediment laden water and discharge to existing channels via energy dissipating structures. Collection ponds will also be constructed at the toe of all stockpiles
- Water management pond
  - This pond will collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF
- Winter seepage mitigation pond
  - This pond will function as a mitigation measure at closure to store seepage from the TMF during the winter months (December to April) when there is no dilution from surface water runoff in Casino Creek.

7.4.2.2.2 Reclamation

A Conceptual Closure Plan (Appendix 4B) has been developed for the project. Key aspects of the plan are summarized as follows:

- Place all marginal grade ore (MGO), residual low grade ore (LGO) and contaminated material from the footprint of the ore stockpiles into the Open Pit
- Flood the Open Pit. This will be achieved by temporarily pumping water from the TMF pond to the pit, allowing Canadian Creek to discharge directly to the pit, and allow natural runoff and precipitation to accumulate. Flooding the pit will minimize the potential oxidation of the pit walls.
- Restore all disturbed areas to original topography and re-vegetate
- Construction of an overflow channel (spillway) to allow surface water to discharge from the TMF
- Construction of two engineered wetlands (North TMF wetland and South TMF wetland) that will passively treat contaminants in the Pit Lake overflow and the TMF pond overflow prior to discharge to Casino Creek.
- Construction of a seepage interception pond downstream of the TMF embankment that will store TMF seepage during the winter and discharge it during the summer.

- Rinsing and treatment of the HLF water to remove cyanide. The heap will then be drained, and draindown water will be passed through a bioreactor for treatment of selenium and mercury prior to being pumped to the Open Pit. A cover designed to reduce infiltration to 20% of net precipitation will then be placed over the heap, all components of the HLF required for operations will be decommissioned and excess runoff will discharge naturally to the TMF pond.
- Long-term monitoring of the aquatic environment, the structural stability of infrastructure remaining in Post-Closure, and wetland functionality.

7.4.3 Determination of Residual Effects

7.4.3.1 Proposed Alternative Guidelines

7.4.3.1.1 Development and Rationale

Historically, Canadian water quality guidelines were derived using a safety factor approach, as described in CCME (1991). This approach involves application of a conservative safety factor (often tenfold) to the toxicological effect level for the most sensitive species in order to calculate the guideline. This method provides a conservative estimate of a parameter concentration that is expected to be safe across a broad range of environments in Canada. This precautionary approach does address the possibility that species exist that are more sensitive than those that have been tested; however, it can also result in an overly conservative guideline not directly applicable to environment in which it is being applied.

For the Casino Project, the CCME guidelines were used as the primary benchmark for comparing the potential effects of project discharges to the receiving environment waterbodies. As the water quality guidelines recommended by CCME are often based on the toxicological effects of the most sensitive species, this represents the most conservative approach for assessment of potential water quality effects.

As described in Section 7.4.3.3 and 7.4.3.4, Cu, Cd, Mo, Se, U, SO_4 and F are expected to exceed CCME guidelines in the receiving environment at some point during the mine life as a result of project discharges, and are therefore considered contaminants of concern (COCs). In order to assess whether these exceedances constitute a residual effect, not just a potential residual effect, each COC was further assessed by evaluating the applicability of the CCME guideline and determining whether or not an alternative guideline, such as a SSWQO or a guideline from another jurisdiction, i.e. BC MOE or the United States Environmental Protection Agency (US EPA) would be more appropriate. Derivation of SSWQO's for the seven COCs are presented below, and summarized in Table 7.4-7. The derivation of the copper and cadmium alternative guidelines is discussed in full detail below, while the other five COCs are summarized here but the specific effects to aquatic life are discussed in full detail in Section 10.4.1.3.

Copper

Development of a SSWQO was considered to be the most appropriate alternative guideline for cooper, due to the naturally high baseline concentrations. In British Columbia and Yukon, generic Water Quality Guidelines (WQG) provide a basis for assessing water quality conditions in most of the region. However, it is possible that those criteria are over or under protective at sites with unique conditions. Under these circumstances, it may be necessary to modify the generic water quality criteria to account for the conditions that occur at the site (i.e. physico-chemical properties or differences in biological communities between the site and those used to derive the generic WQG). This issue can be addressed by developing a SSWQO. The British Columbia Ministry of Environment Lands and Parks (BCMELP) (1997) outlines four methods for deriving SSWQOs, and two of these

methods were selected: the Background Concentration Procedure (BCP) and the Water Effects Ratio Procedure (WERP). The BCP was used to derive the SSWQO and the WERP was used as secondary support.

The BCP is used in situations where surface waters have natural concentrations of substances that exceed generic guidelines. Section 7.3.3.1 verifies that baseline Cu concentrations in Casino Creek and Dip Creek are not influenced by the anthropogenic loading from the adit and are therefore considered to be representative of natural conditions. Therefore, the BCP method is an appropriate method for deriving a SSWQO for copper. Derivation of the SSWQO requires the use of available baseline data to determine an acceptable upper limit of background concentrations, which is then put forth as a SSWQO. There are many different approaches to defining the upper limit of background (BCMELP 1997; CCME 2003) including, but not limited to, the 95% confidence limit, 90th or 95th percentile, the maximum, and the mean plus 2 standard deviations. SSWQOs for copper in Casino Creek are developed based on water quality at site W4, as this site has the lowest concentrations of metals in Casino Creek and is therefore the most conservative. SSWQOs for copper in Dip Creek were developed at W5, immediately downstream of the confluence of Casino Creek. In Casino Creek, the 95th percentile SSWQO (0.025 mg/L) would be protective during all project phases at both M18 and W4 although it is important to note that the 90th percentile SSWQO (0.015 mg/L) is appropriate for W4 for the majority of the phases and is just slightly lower than the maximum annual copper predictions at M18. In Dip Creek, the 90th percentile SSWQO (0.0065 mg/L) is proposed for copper.

The WERP evaluates the toxicity of a contaminant of concern that is spiked separately into the site water and the laboratory water studied in parallel. The toxicological endpoint from each test water, EC50 or IC25 values, can be compared, and the ratio between the values can be applied to derive a SSWQO. In this case, three toxicological tests were performed on water collected at W4 in lower Casino Creek on April 8th, 2013, including both acute and chronic endpoints: 96-h rainbow trout acute test, 48-h *Ceriodaphnia dubia* acute test, and 7-d *Ceriodaphnia dubia* three brood reproduction test. WERP testing was completed using winter water samples as Cu is known to be more bioavailable when organic carbon concentrations are lowest; this results in development of a conservative Water Effects Ratio (WER). The results varied at 1.6 for both the rainbow trout and *Ceriodaphnia* acute tests and 2.8 for the *Ceriodaphnia* reproduction test. Despite the relatively small WER, these results still show that there is an incremental level of natural protection to the toxic effects of Cu in water from lower Casino Creek. Although this test was carried out on water from lower Casino Creek, the results can be applicable to Dip Creek as well, which has similar Cu and organic carbon concentrations to Casino Creek. Therefore, these WERP tests are supportive of the SSWQO developed for Cu in Casino and Dip Creeks using the BCP.

Cadmium

The evaluation of the adit loading to Casino Creek summarized in Section 7.3.3.1 indicates that one of the major sources of Cd to Casino Creek is from the adit. This means that a SSWQO approach using the BCP is not appropriate, although it is important to note that elevated cadmium concentrations are seen in baseline conditions in the local and regional study areas. Lower Dip Creek, Britannia Creek and the Yukon River all have cadmium concentrations that occasionally exceed CCME guidelines, especially in the winter months. However, to err on the conservative side, a different approach was taken to develop alternative water quality objectives for Cd by considering the applicability of a different jurisdictional guideline. Although the CCME guidance of Cd (CCME 1999) is generally appropriate for Canadian use, the US EPA criterion (National Recommended Water Quality Criteria, Aquatic Life Criteria from the US Environmental Protection Agency 2001) for Cd was considered as an alternative perspective because it uses a more recent and detailed guideline development process.

One of the key factors in determining Cd guidelines is the hardness levels. Water hardness is critical for understanding cadmium toxicity as it is a well-known toxicity modifying factor. The toxicity modification is a result

of the chemical reaction of cadmium with hydroxide and carbonate in the water resulting in precipitation of the insoluble form, cadmium carbonate ($CdCaO_3$) (McCarty *et a*l. 1978). This occurs rapidly and quickly reduces the bioavailability of most of the total water column cadmium even before it has a chance to settle out into the sediment. Thus, the toxicity reduction occurs because much less bioavailable cadmium is present in the water column rather than from alterations in the mode/mechanism of toxic action.

Both CCME and US EPA criteria are hardness dependent. Using a median baseline hardness of 111 mg/L and 90 mg/L for Casino Creek and Dip Creek, respectively, the CCME criteria is 0.000036 mg/L and 0.000030 mg/L, respectively. In contrast, the US EPA criteria based on dissolved chronic Cd concentrations is 0.000270 mg/L and 0.000230 mg/L, respectively, which is close to an order of magnitude higher. Although this may appear to be a substantial deviation in guidelines, it is important to note that the US EPA guidance is more recent, based on much more thorough literature evaluation and analysis, and CCME has recognize their Cd guidance is outdated and has a revised guidance document currently under review.

For these reasons, the proposed alternative Cd guideline is to apply the US EPA criteria of 0.00027 mg/L for Casino Creek and 0.00023 mg/L for Dip Creek.

Molybdenum

British Columbia is currently the only province in Canada where Mo is mined, and consequently is also the only province with an approved molybdenum guideline. The BC MOE 30-day average for total Mo is 1 mg/L, which is almost 14 times higher than the CCME guideline of 0.073 mg/L (Fletcher et al. 1997). Considering the Casino mine will be producing copper, gold and molybdenum concentrate, it is proposed that the BC guideline of 1 mg/L is used as the alternative guideline for Mo.

Selenium

CCME, BC MOE and US EPA water quality guidelines are based on a lowest observed effect level (LOEL) of 0.01 mg/L of Se introduced by the International Joint Commission (IJC) to protect species in the Great Lakes (IJC 1981). For the CCME guideline, a safety factor of 10 was applied to the LOEL to end up with the guidance of 0.001 mg/L Se. The BC MOE guideline of 0.002 mg/L incorporates a safety factor of 5 to recognize that Se is an essential trace element for animal nutrition and that it is the bioaccumulation of Se through the food chain (chronic effects) that is the major source, not through the water column. The US EPA guideline of 0.005 mg/L is based on the same field studies cited in IJC (1981), but differs from the CCME and BC MOE guidelines in that it employs the Se concentration at which no effects were observed as the guideline, rather than using the LOEL multiplied by a safety factor. To err on the side of conservatism, the BC MOE guideline is proposed as the alternative guideline for Se.

Uranium

Although not as extreme as Cu, baseline levels of U are also elevated in Casino Creek and Dip Creek. U concentrations appear to be naturally elevated at several sites in the LSA and RSA, including upper Dip Creek and all sites on Britannia Creek. This is not surprising as British Columbian and Yukon stream levels of U are highest amongst all streams in Canada (Garrett, 2007). At the Casino mine site elevated U concentrations appear to be ubiquitous and unrelated to the ore body. Thus, a SSWQO based on the maximum value (0.019 mg/L) was considered to be the most appropriate as two out of six winter samples from the 2008-2012 water quality baseline study (Appendix 7A) exceeded the CCME long term guideline of 0.015 mg/L.

Sulphate

No approved federal water quality guidelines for the protection of freshwater aquatic life were identified for sulphate in Canada, the USA or elsewhere. In April 2013, BC MOE approved a chronic 30-day guideline, which was developed using the results of contemporary studies (Meays and Nordin, 2013). The influence of water hardness was clearly apparent from these studies and resulting sulphate water quality guidelines for the protection of aquatic life were developed based on the most sensitive species (rainbow trout) with a safety factor of 2 applied. Application of the approved 30-day average water quality guidelines using baseline median hardness of 111 mg/L and 90 mg/L for Casino Creek and Dip Creek, respectively, results in a sulphate guideline of 309 mg/L for both creeks.

Fluoride

For fluoride, the maximum BC MOE guideline was used as an alternative water quality guideline in place of CCME as it incorporates water hardness, which has a proven influence on fluoride toxicity. The maximum BC MOE guideline for fluoride produces guidelines of 1.4 mg/L and 1.3 mg/L for Casino and Dip Creeks, respectively.

Table 7.4-7 Proposed Alternative Water Quality Objectives

Creek	Parameter	CCME Guideline	Proposed Water Quality Objective	Source
Casino	Copper	0.003	• 0.025	• SSWQO-BCP based on the 95th percentile
Casino	Cadmium	0.000036	• 0.00027	• US EPA chronic dissolved (baseline hardness)
Casino	Molybdenum	0.073	• 1.0	• Approved BC MOE 30-day average
Casino	Selenium	0.001	• 0.002	• Approved (Interim) BC MOE 30-day average
Casino	Uranium	0.015	• 0.019	• SSWQO-BCP based on the maximum
Casino	Fluoride	0.12	• 1.4	• Approved BC MOE maximum
Casino	Sulphate	None	• 309	• Approved BC MOE 30-day average (baseline hardness)
Dip	Copper	0.0022	• 0.0065	• SSWQO-BCP based on 90th percentile
Dip	Cadmium	0.000030	• 0.00023	• US EPA chronic dissolved (baseline hardness)
Dip	Iron*	0.30	• 0.78 • 0.71	• SSWQO-BCP based on the 95th percentile for C, O and CD; • SSWQO-BCP based on the 90th percentile for PC.
Dip	Fluoride	0.12	• 1.3	• Approved BC MOE maximum

Notes:
CCME: Canadian Council of Ministers of the Environment
BC MOE: British Columbia Ministry of Environment
U.S. EPA: United States Environmental Protection Agency
SSWQO-BCP: Site-specific water quality objective – background concentration procedure
C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

7.4.3.1.2 Application of Proposed Alternative Guidelines in Casino Creek

The maximum annual and monthly predicted water quality for each COC in Casino Creek is presented below, and compared against the corresponding SSWQO. Maximum annual water quality is presented by the worst (highest concentration) month for each year throughout the entire project phases. Monthly concentrations are presented during the worst year as the seasonal assessment. Where the year of highest concentrations differed between W4 and M18, W4 was chosen to represent the worst year in Casino Creek for that parameter.

For all the figures below, these acronyms and short forms are used:

- C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure; and
- Phase I, II, III refer to "Closure Water Management Phase".

Copper

The predictions for Cu concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-2. The water quality model predicts Cu concentrations to start at around baseline during the construction period, which is above CCME guidelines, and continue to increase annually throughout the operations phase to approximately 0.008 mg/L. The median copper concentration at post-closure is predicted to be about 0.015 mg/L. Both W4 and M18 Cu concentrations are above the 90th percentile SSWQO during the first several years of Closure Water Management Phase II but drop below the 90th percentile SSWQO at W4 for the rest of the post-closure phase. The slight elevation above the 90th percentile SSWQO at M18 is due to the annual peaks in November when the WSMP is still discharging and at a time of anticipated lower flows. Concentrations stay well below the 90th percentile SSWQO at both M18 and W4 for the rest of the months and throughout the all of the project phases.

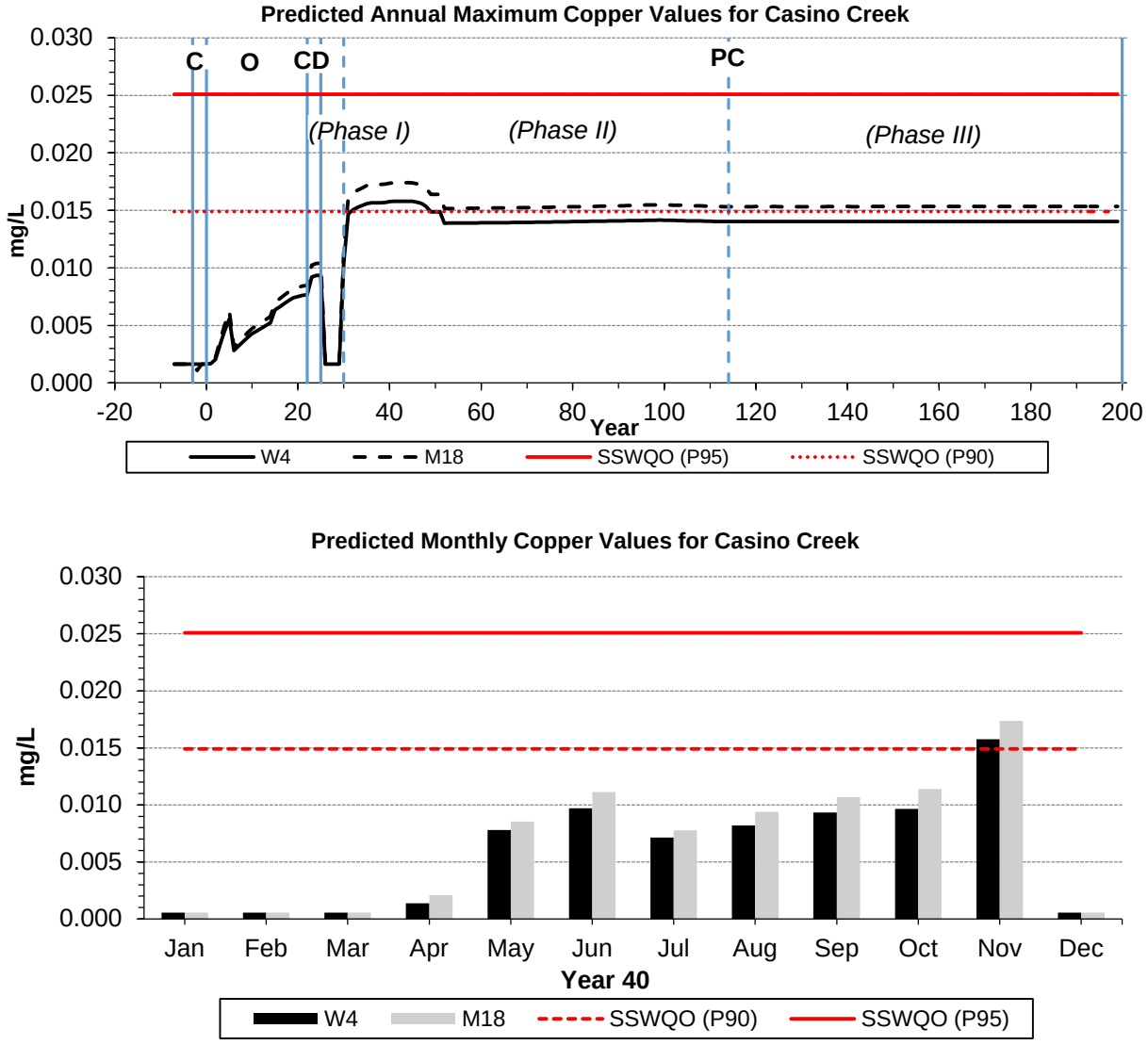


Figure 7.4-2 Predicted Annual Maximum and Monthly Copper Concentrations for Casino Creek

Cadmium

The predictions for dissolved Cd concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-3. The proposed guideline is the US EPA chronic guideline (0.000027 mg/L) for dissolved cadmium using baseline hardness (111 mg/L $CaCO_3$). The water quality model predicts dissolved cadmium concentrations in Casino Creek to increase annually throughout the operations phase to a maximum of around 0.00021 mg/L. The maximum cadmium concentration at post-closure is predicted to be 0.00050 mg/L at M18 and 0.00045 mg/L at W4, which is above the proposed US EPA chronic guideline, using baseline hardness. However, median predicted hardness during post-closure is 352 mg/L at M18 and 318 mg/L at W4. The corresponding US EPA chronic guideline for dissolved cadmium would be 0.00060 mg/L (using W4 hardness), which is well above the predicted Cd concentrations as shown in Figure 7.4-3. On a seasonal basis, predicted Cd is above US EPA

guidelines during most of the open water season (June, August, September, October and November) but remain well below the US EPA guideline based on the predicted hardness.

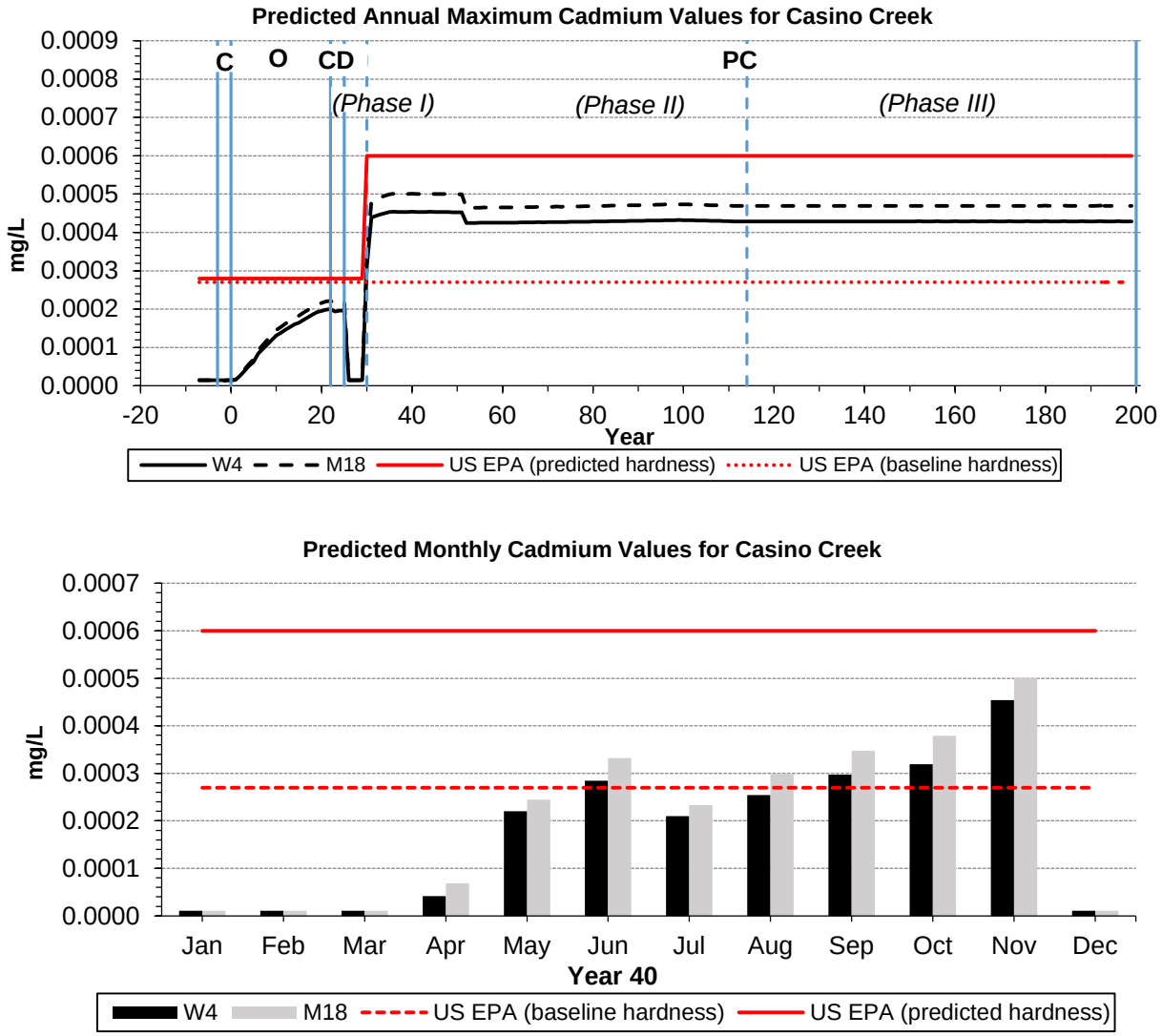


Figure 7.4-3 Predicted Annual Maximum and Monthly Cadmium Concentrations for Casino Creek

Molybdenum

The predictions for Mo concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-4. The water quality model predicts Mo concentrations to increase annually throughout the operations phase to approximately 0.042 mg/L. The maximum Mo concentration at post-closure is predicted to be about 0.100 mg/L. Concentrations at both M18 and W4 throughout all the project phases are predicted to remain well below the BC MOE guideline 30-day guideline of 1 mg/L. Predicted Mo concentrations are marginally above CCME (0.073 mg/L) only during June, Aug, Sep, Oct and peaking in November of each year.

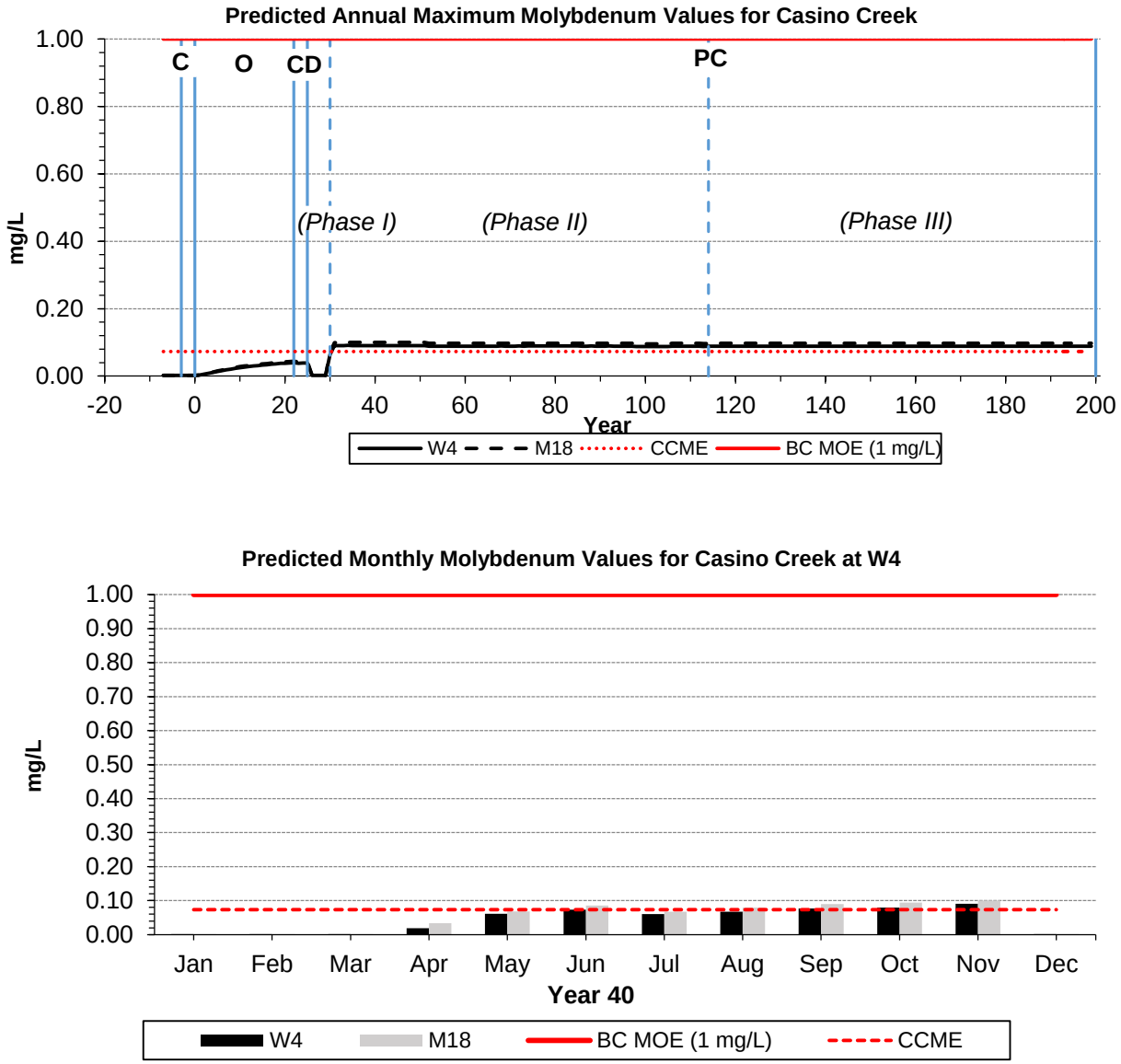


Figure 7.4-4 Predicted Annual Maximum and Monthly Molybdenum Concentrations for Casino Creek

Selenium

The predictions for Se concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-5. The water quality model predicts Se concentrations to increase annually throughout the operations phase to approximately 0.0015 mg/L. The maximum Se concentration at post-closure is predicted to be 0.0040 mg/L at M18. Se concentrations peak in Closure Water Management Phase II when the TMF starts to discharge via the spillway and again at the start of Closure Water Management Phase III when the Open Pit starts to discharge. Throughout the project phases, predicted annual maximum Se concentrations are above the proposed alternative BC MOE guideline of 0.002 mg/L although less than the US EPA guideline of 0.005 mg/L. Elevated Se concentrations occur during the period of discharge from the WSMP, which is between April and November at both W4 and M18.

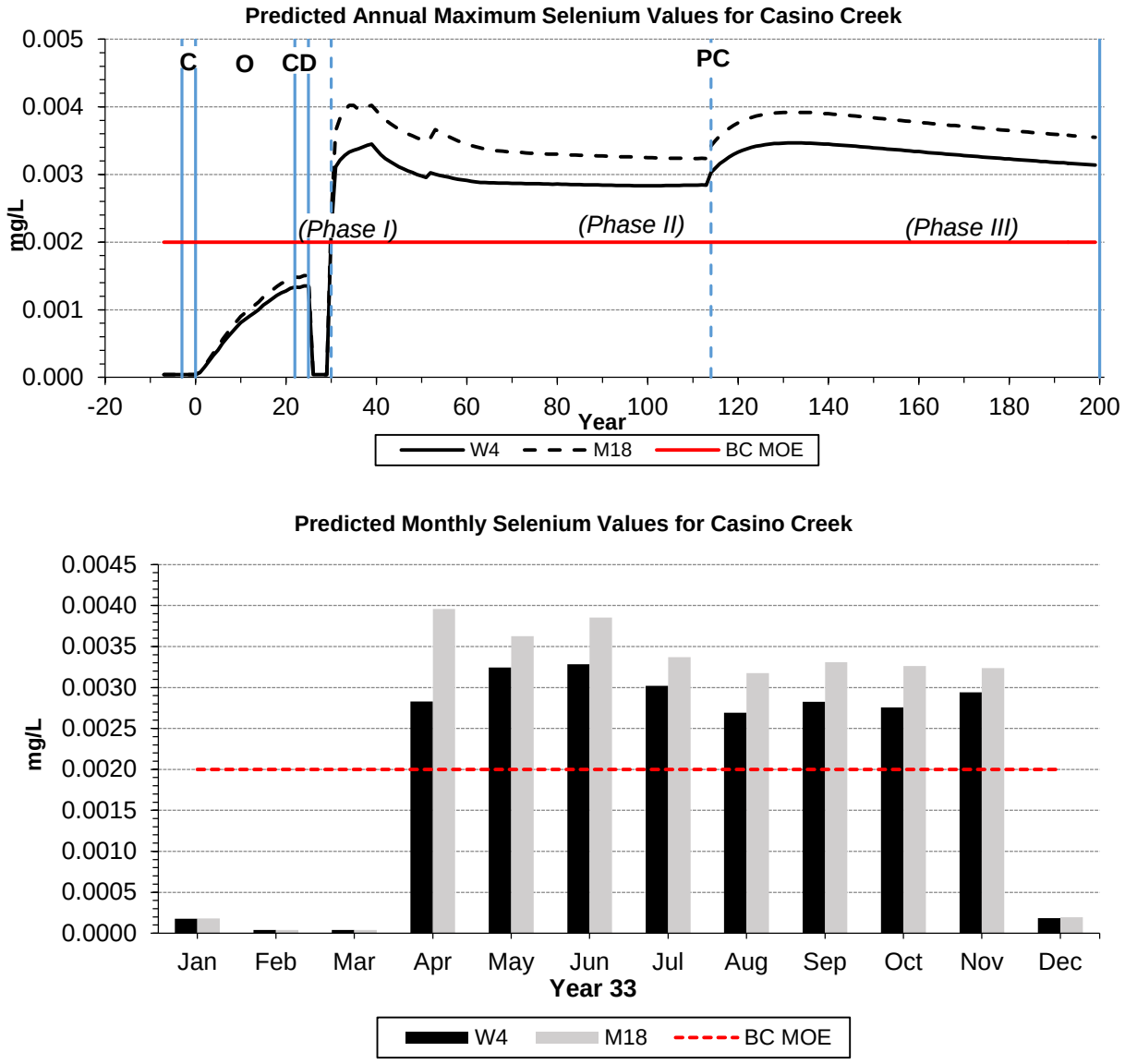


Figure 7.4-5 Predicted Annual Maximum and Monthly Selenium Concentrations for Casino Creek

Uranium

The predictions for U concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-6. The water quality model predicts U concentrations to increase annually throughout the operations phase to approximately 0.013 mg/L. The maximum U concentration at post-closure is predicted to be 0.021 mg/L at M18. The proposed SSWQO based on the maximum baseline value is exceeded at M18 at post-closure, which is due to the seasonal peak in November only. Predicted U concentrations are below the SSWQO for the rest of the year.

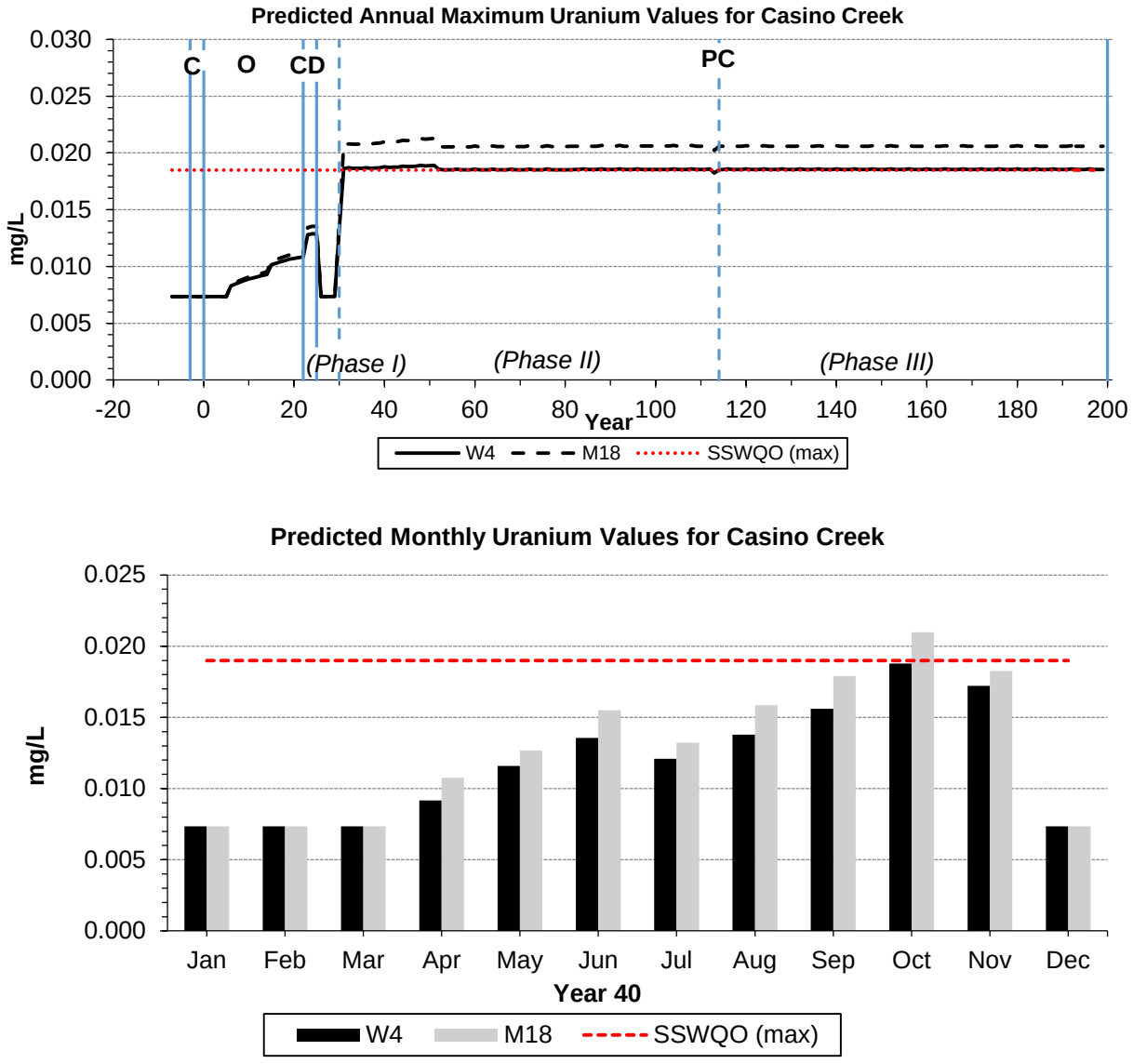
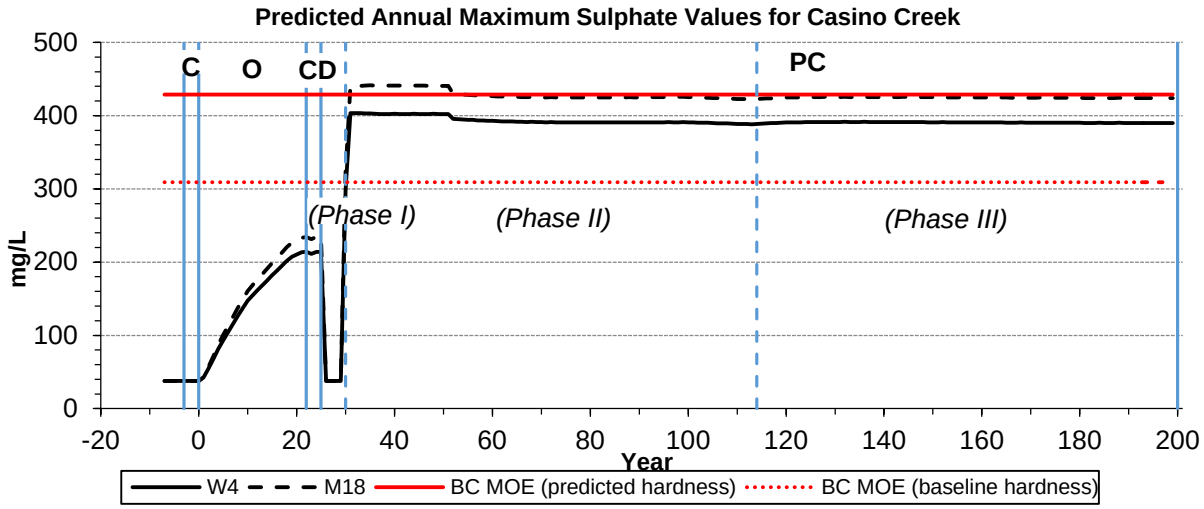


Figure 7.4-6 Predicted Annual Maximum and Monthly Uranium Concentrations for Casino Creek

Sulphate

The predictions for SO_4 concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-7. The water quality model predicts SO_4 concentrations to increase annually throughout the operations phase to approximately 225 mg/L. The maximum SO_4 concentration at post-closure is predicted to be about 441 mg/L at M18 and 404 mg/L at W4, with exceedances above the BC MOE guideline at M18 in November during the first few years of the post-closure phase. Seasonally, SO_4 is predicted to exceed the BC MOE guideline using baseline hardness during the open water season between April and November but will remain below the BC MOE guideline using predicted hardness for all months except of November.



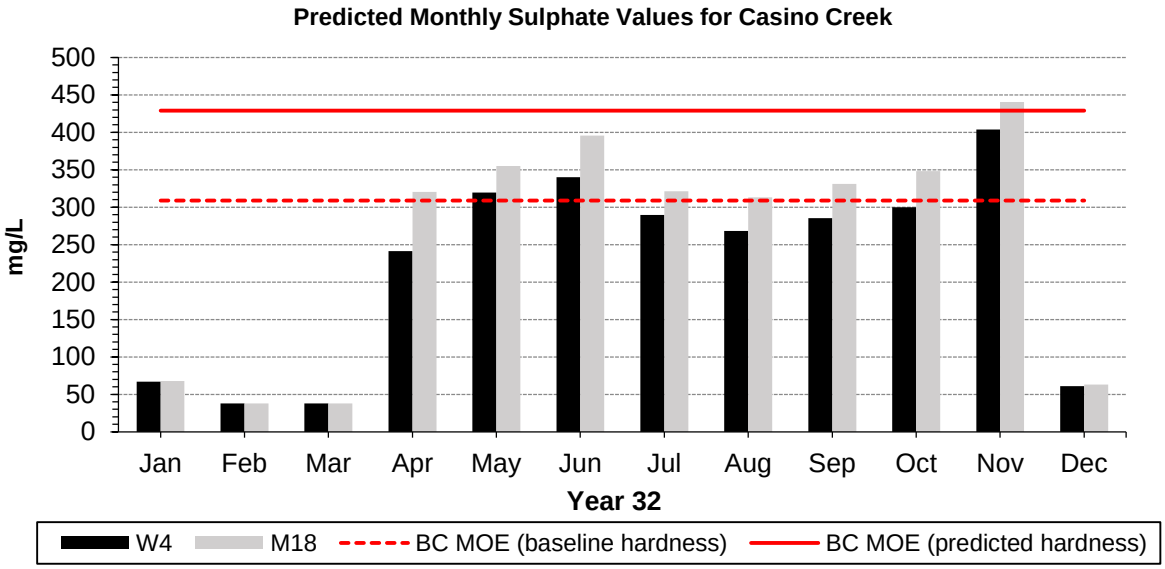


Figure 7.4-7 Predicted Annual Maximum and Monthly Sulphate Concentrations for Casino Creek

Fluoride

The predictions for F concentrations at M18 and W4 in Casino Creek are presented on Figure 7.4-8. The water quality model predicts F concentrations to increase annually throughout the operations phase to approximately 0.39 mg/L. The maximum F concentration at post-closure is predicted to be 0.80 mg/L at M18. Predicted F concentrations after the construction phase are above CCME guidelines but remain well below the proposed alternative guideline from BC MOE of 1.4 mg/L.

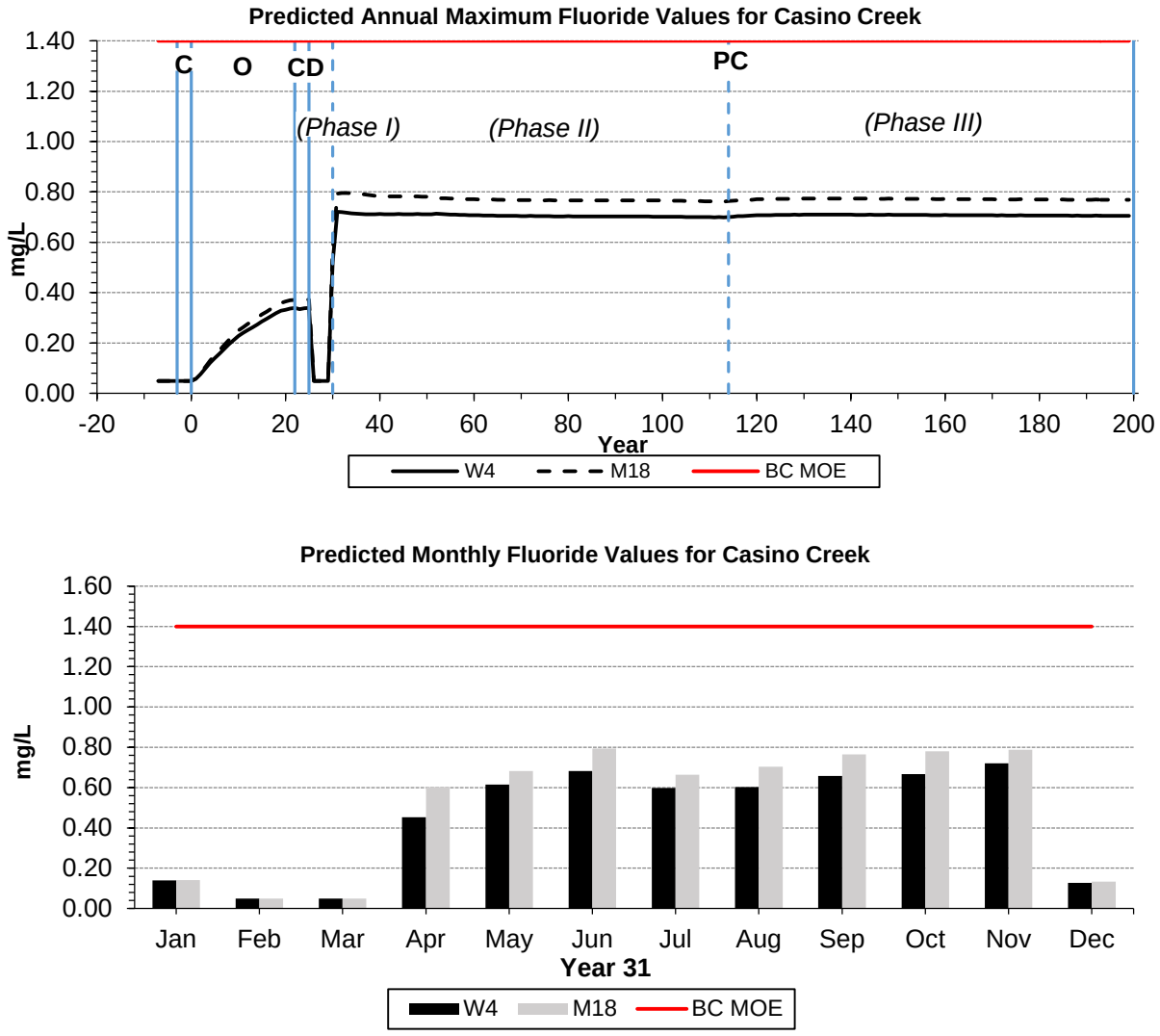


Figure 7.4-8 Predicted Annual Maximum and Monthly Fluoride Concentrations for Casino Creek

A summary of the predicted water quality in Casino Creek at M18 and W4 is shown in Table 7.4-8 and Table 7.4-9, respectively. Each project phase is represented by the range of concentrations in a typical year. The construction period was not included as there are no substantial deviations from baseline.

Table 7.4-8 Summary Predicted Water Quality in Casino Creek at M18 in Typical Years of Each Project Phase

Parameter	Proposed Water Quality Objective	Operations (Year 20)		Closure and Decommissioning (Year 25)		Post-Closure (Year 100)	
		min	*max*	*min*	*max*	*min*	*max*
Hardness		70	290	70	297	116	487
Acidity		0.62	1.49	0.61	1.49	0.72	3.40

Alkalinity		51	87	50	87	62	169
Sulphate	309	27	230	27	235	38	425
Cyanide (Total)		0.00025	0.00042	0.00025	0.00042	0.00010	0.00043
Cyanide (WAD)		0.00021	0.00025	0.00021	0.00025	0.00006	0.00025
Chloride		0.46	5.66	0.47	5.81	0.25	13.29
Fluoride	1.4	0.05	0.36	0.05	0.37	0.05	0.77
Aluminum		0.0072	0.0654	0.0071	0.0654	0.0079	0.0546
Antimony		0.00015	0.00055	0.00015	0.00055	0.00014	0.01452
Arsenic		0.00042	0.00094	0.00043	0.00096	0.00036	0.00376
Barium		0.040	0.066	0.040	0.065	0.058	0.079
Cadmium	0.00027	0.00002	0.00022	0.00002	0.00022	0.00001	0.00047
Calcium		20	100	20	102	31	178
Chromium		0.00009	0.00042	0.00009	0.00043	0.00005	0.00128
Cobalt		0.00011	0.00117	0.00013	0.00156	0.00001	0.01659
Copper	0.025	0.0014	0.0083	0.0017	0.0104	0.0006	0.0155
Iron	0.99	0.094	0.738	0.095	0.731	0.002	0.047
Lead		0.00004	0.00020	0.00004	0.00021	0.00002	0.00234
Magnesium		4.9	9.7	4.9	10.1	9.7	17.7
Manganese		0.016	0.323	0.016	0.329	0.004	0.688
Mercury		0.000005	0.000007	0.000005	0.000007	0.000005	0.000015
Molybdenum	1	0.0026	0.0425	0.0027	0.0432	0.0019	0.0960
Nickel		0.0002	0.0008	0.0002	0.0009	0.0001	0.0044
Potassium		0.94	1.36	0.94	1.36	1.39	5.20
Selenium	0.002	0.00007	0.00142	0.00008	0.00151	0.00004	0.00325
Silicon		4.88	5.29	4.80	5.24	1.99	5.24
Silver		0.000003	0.000010	0.000003	0.000010	0.000003	0.000035
Sodium		3.0	10.0	3.0	10.3	4.8	15.4
Strontium		0.11	0.35	0.11	0.38	0.18	0.64
Thallium		0.000007	0.000076	0.000007	0.000078	0.000001	0.000157
Uranium	0.019	0.0028	0.0111	0.0029	0.0135	0.0073	0.0206
Zinc		0.0014	0.0043	0.0015	0.0049	0.0011	0.0165

Notes:

Exceeds Proposed WQO

Sulphate: *Approved BC MOE 30-day average (baseline hardness)*

Fluoride: *Approved BC MOE maximum*

Cadmium: *US EPA chronic dissolved (baseline hardness)*

Copper: *SSWQO-BCP based on the 95th percentile*

Molybdenum: *Approved BC MOE 30-day average*

Selenium: *Approved (Interim) BC MOE 30-day average*

Uranium: *SSWQO-BCP based on the maximum*

Table 7.4-9 Summary of Predicted Water Quality in Casino Creek at W4 in Typical Years of Each Project Phase

Parameter	Proposed Water Quality Objective	Operations (Year 20)		Closure and Decommissioning (Year 25)		Post-Closure (Year 100)	
		min	*max*	*min*	*max*	*min*	*max*
Hardness		68	273	69	278	116	453
Acidity		0.63	1.49	0.63	1.49	0.72	2.68
Alkalinity		51	88	50	87	64	147
Sulphate	309	25	210	26	214	38	391
Cyanide (Total)		0.00025	0.00042	0.00025	0.00042	0.00012	0.00043
Cyanide (WAD)		0.00022	0.00025	0.00022	0.00025	0.00011	0.00025
Chloride		0.41	5.11	0.42	5.22	0.25	12.13
Fluoride	1.4	0.05	0.33	0.05	0.34	0.05	0.70
Aluminum		0.0072	0.0655	0.0072	0.0655	0.0079	0.0557
Antimony		0.00015	0.00051	0.00015	0.00051	0.00014	0.01237
Arsenic		0.00041	0.00088	0.00041	0.00090	0.00036	0.00327
Barium		0.040	0.065	0.040	0.065	0.058	0.074
Cadmium	0.00027	0.00002	0.00020	0.00002	0.00020	0.00001	0.00043
Calcium		20	93	20	95	31	164
Chromium		0.00008	0.00038	0.00008	0.00039	0.00005	0.00113
Cobalt		0.00010	0.00105	0.00011	0.00140	0.00001	0.01217
Copper	0.025	0.0012	0.0075	0.0014	0.0094	0.0006	0.0141
Iron	0.99	0.073	0.664	0.072	0.655	0.004	0.057
Lead		0.00003	0.00018	0.00003	0.00019	0.00002	0.00172
Magnesium		4.9	9.7	4.9	10.1	9.7	15.6
Manganese		0.013	0.291	0.013	0.295	0.004	0.627
Mercury		0.000005	0.000007	0.000005	0.000007	0.000005	0.000013
Molybdenum	1	0.0023	0.0384	0.0023	0.0389	0.0019	0.0876
Nickel		0.0002	0.0007	0.0002	0.0008	0.0001	0.0032
Potassium		0.94	1.37	0.94	1.37	1.39	4.18
Selenium	0.002	0.00006	0.00128	0.00006	0.00135	0.00004	0.00283
Silicon		4.91	5.29	4.88	5.26	2.86	5.24
Silver		0.000003	0.000009	0.000003	0.000009	0.000003	0.000027
Sodium		2.9	9.5	2.9	9.7	4.8	14.5
Strontium		0.11	0.34	0.11	0.36	0.18	0.59
Thallium		0.000006	0.000068	0.000006	0.000070	0.000001	0.000143
Uranium	0.019	0.0027	0.0107	0.0028	0.0129	0.0073	0.0185
Zinc		0.0013	0.0040	0.0014	0.0045	0.0011	0.0124

Notes:

Exceeds Proposed WOO
Sulphate: *Approved BC MOE 30-day average (baseline hardness)*
Fluoride: *Approved BC MOE maximum*
Cadmium: *US EPA chronic dissolved (baseline hardness)*
Copper: *SSWOO-BCP based on the 95th percentile*
Molybdenum: *Approved BC MOE 30-day average*
Selenium: *Approved (Interim) BC MOE 30-day average*
Uranium: *SSWQO-BCP based on the maximum*

7.4.3.1.3 Application of Proposed Alternative Guidelines in Dip Creek

The maximum annual and monthly predicted water quality for each COC in Dip Creek is presented below, and compared against the corresponding SSWQO. Maximum annual water quality is represented by the worst (highest concentration) month for each year. Monthly concentrations are presented during the worst year as the seasonal assessment.

Copper

The predicted Cu concentrations at W5 in Dip Creek are presented on Figure 7.4-9. The water quality model predicts Cu concentrations to start at around baseline during the construction period, which is above CCME guidelines, and remain stable throughout the operations phase at approximately 0.0028 mg/L. The maximum copper concentration at post-closure is predicted to be 0.0043 mg/L. Concentrations stay well below the 90th percentile SSWQO of 0.0065 mg/L throughout the all of the project phases.

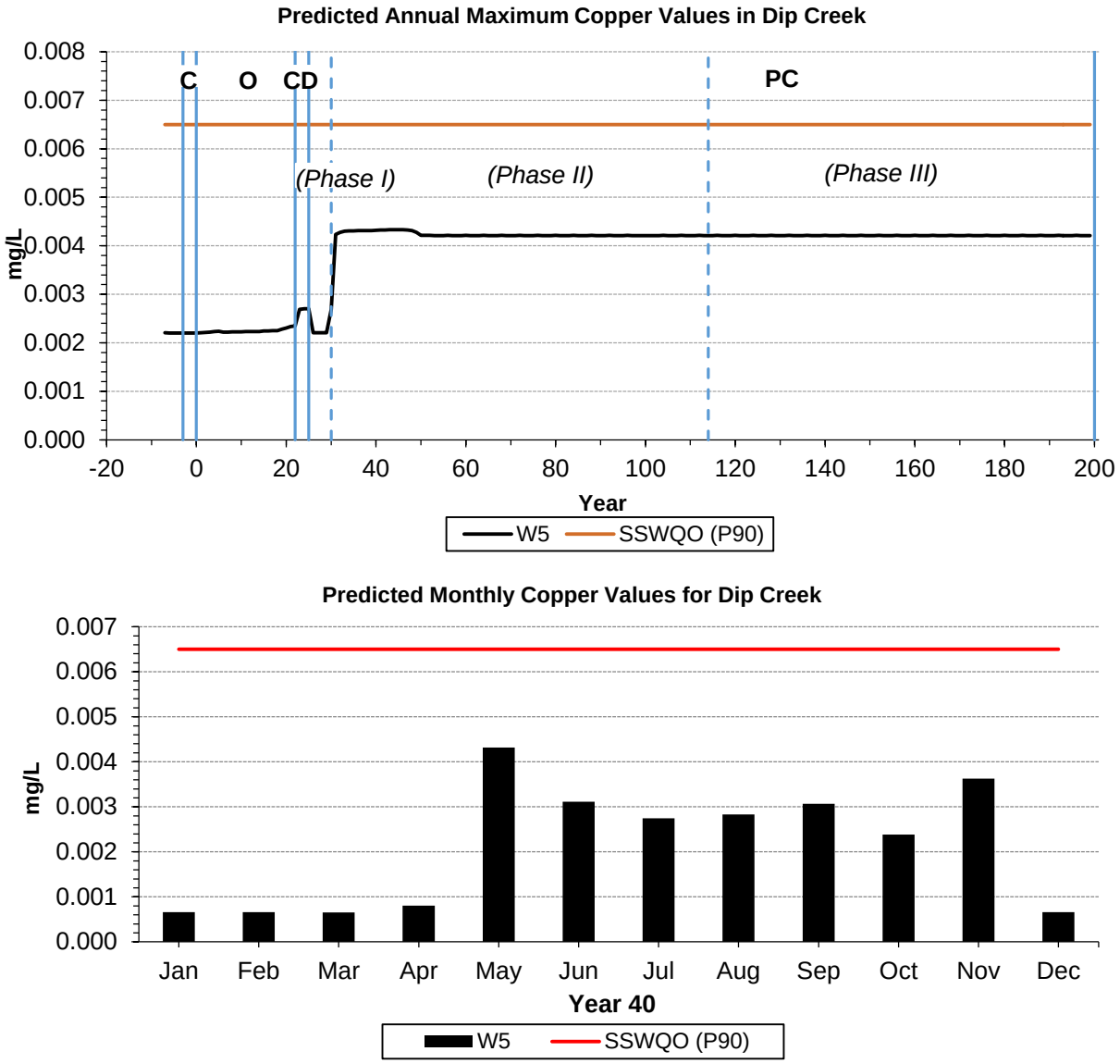


Figure 7.4-9 Predicted Annual Maximum and Monthly Copper Concentrations for Dip Creek

Cadmium

The predicted Cd concentrations at W5 in Dip Creek are presented on Figure 7.4-10. The proposed guideline is the US EPA chronic guideline (0.000023 mg/L) for dissolved cadmium using baseline hardness (90 mg/L $CaCO_3$). The water quality model predicts cadmium concentrations in Dip Creek to increase annually throughout the operations phase to a maximum of around 0.000054 mg/L. The maximum cadmium concentration at post-closure is predicted to be 0.00011 mg/L. Predicted Cd concentrations remain well below the US EPA guideline using baseline hardness throughout all the project phases and during all months of every year.

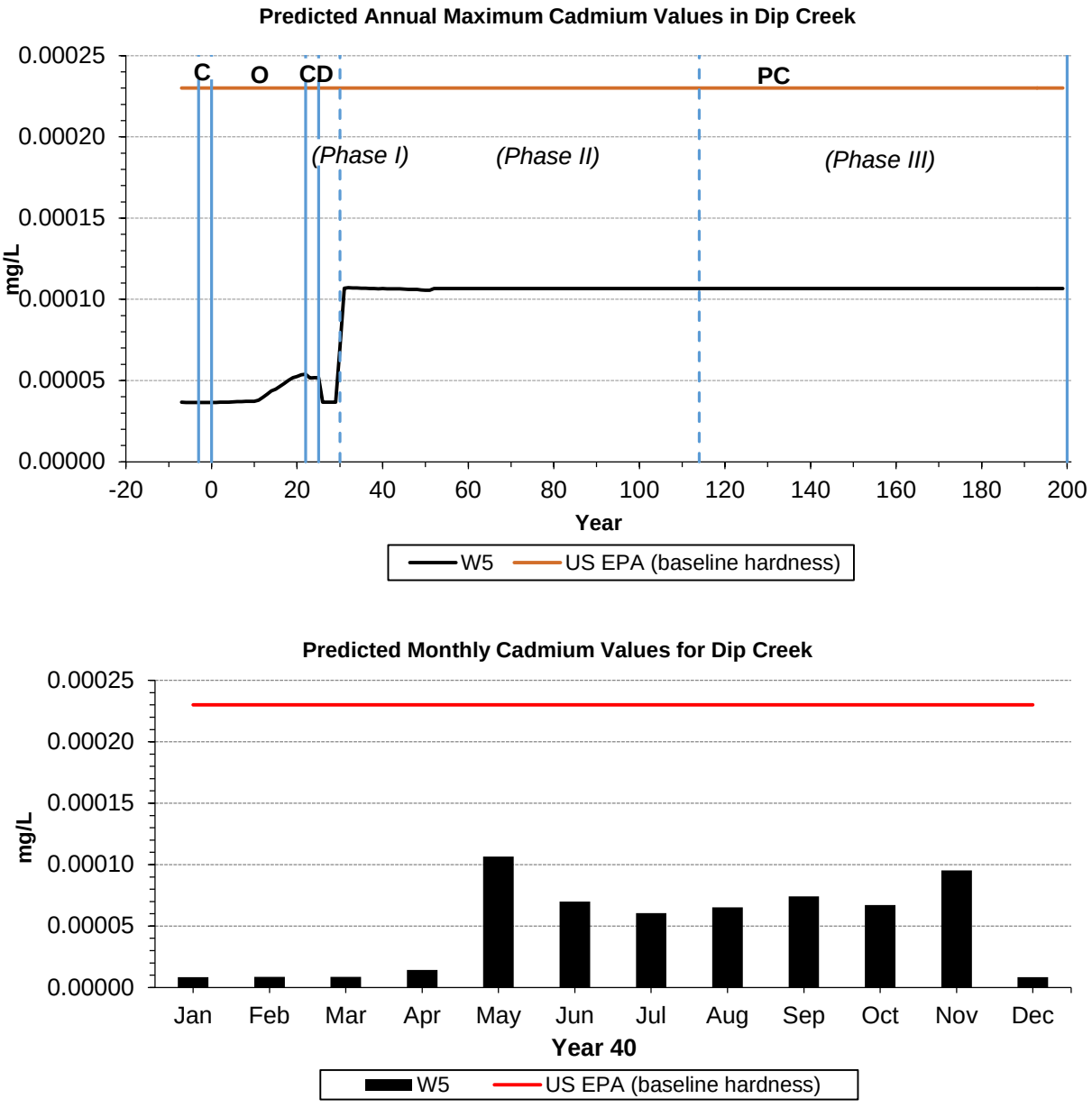


Figure 7.4-10 Predicted Annual Maximum and Monthly Cadmium Concentrations for Dip Creek

Iron

The predicted Fe concentrations at W5 in Dip Creek are presented on Figure 7.4-11. The water quality model predicts maximum Fe concentrations to exceed CCME guidelines because the background data used for the model has naturally elevated total Fe in May. Predicted maximum Fe concentrations are below the proposed 95th percentile SSWQO during the construction, operations and closure and decommissioning phases and decrease below the 90th percentile SSWQO for post-closure. Seasonally, it is clear that exceedance of the CCME guideline or SSWQO are restricted to the month of May only. Predicted maximum Fe concentration at post-closure, once the TMF begins to discharge and provide dilution to the elevated Fe in Dip Creek, is predicted to be 0.60 mg/L which is well below the proposed 90th percentile SSWQO of 0.71 mg/L.

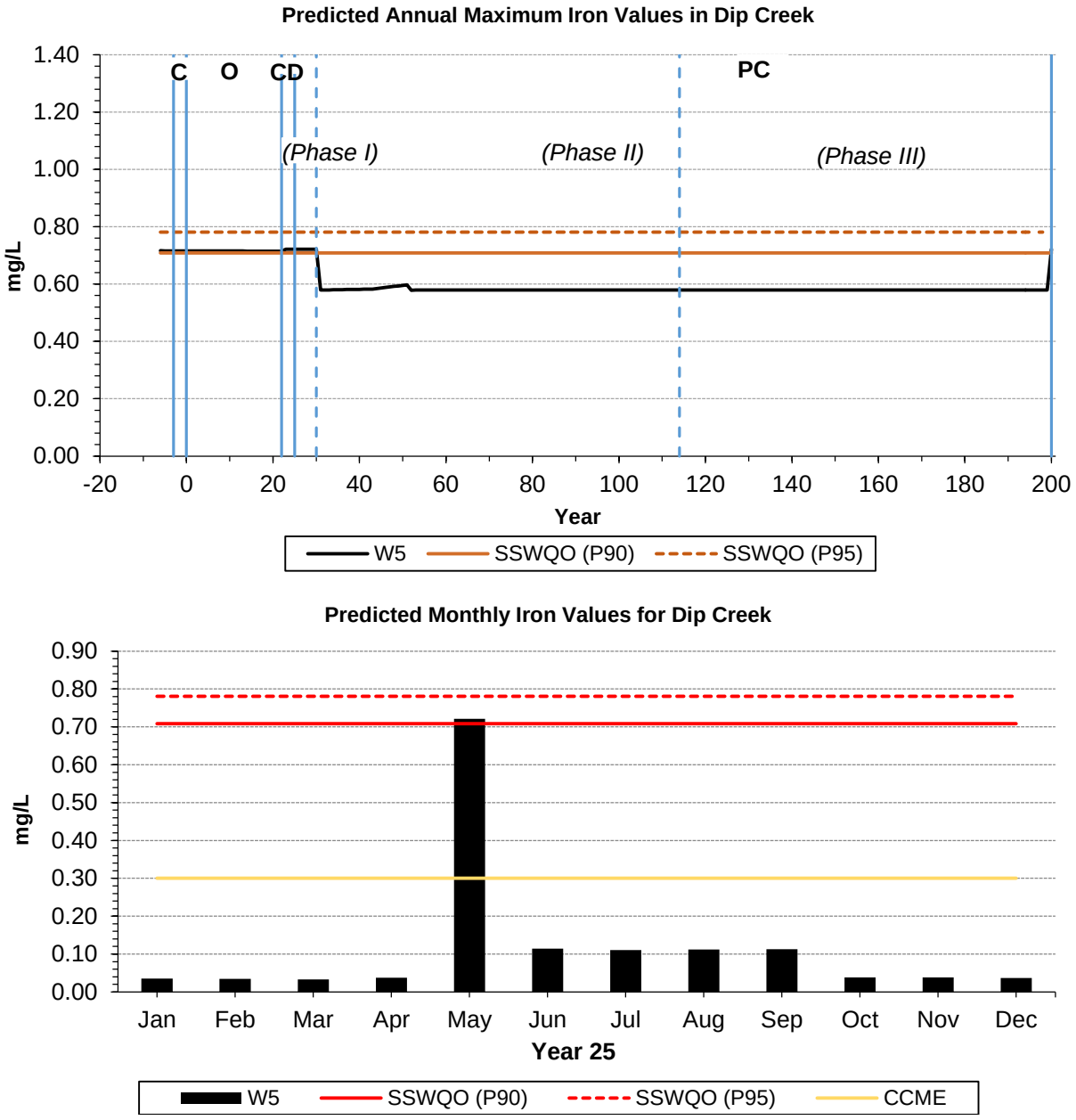


Figure 7.4-11 Predicted Annual Maximum and Monthly Iron Concentrations for Dip Creek

Selenium

The predicted Se concentrations at W5 in Dip Creek are presented on Figure 7.4-12. The water quality model predicts Se concentrations to increase annually throughout the operations phase to approximately 0.00048 mg/L. The maximum Se concentration at post-closure is predicted to be 0.0013 mg/L. Se concentrations are predicted to exceed CCME guidelines only during Closure Water Management Phase II when the TMF pond discharges into Casino Creek via the spillway. Seasonally, Se concentrations only exceed CCME guidelines during the month of May. For the rest of the year and for all of construction, operations and post-closure after discharge of the Open Pit, predicted Se concentrations remain well below both CCME and BC MOE guidelines.

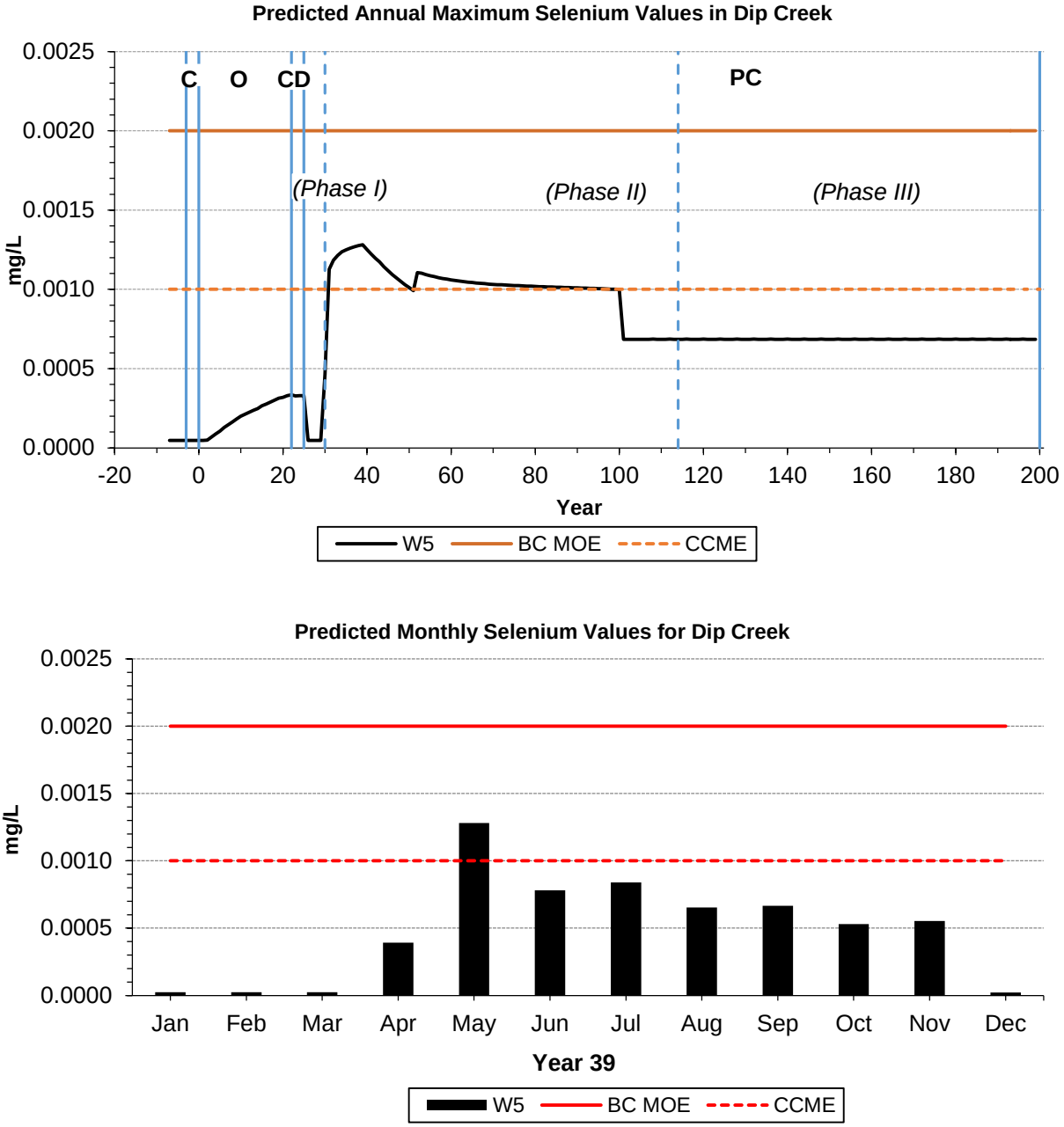
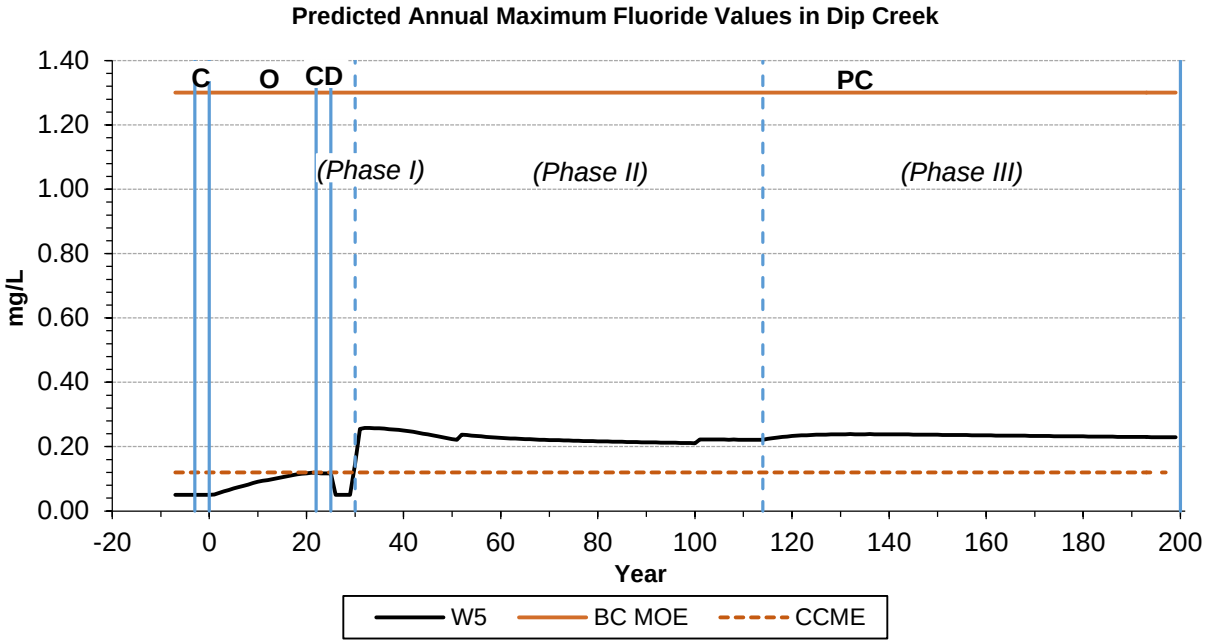


Figure 7.4-12 Predicted Annual Maximum and Monthly Selenium Concentrations for Dip Creek

Fluoride

The predicted F concentrations at W5 in Dip Creek are presented on Figure 7.4-13. The water quality model predicts F concentrations to increase annually throughout the operations phase to approximately 0.12 mg/L, which is also the CCME guideline. The maximum F concentration at post-closure is predicted to be 0.26 mg/L. The predicted maximum F concentrations are below the CCME guideline up to post-closure, after which time they exceed CCME but remain well below the proposed hardness adjusted alternative guideline from BC MOE of 1.3 mg/L.



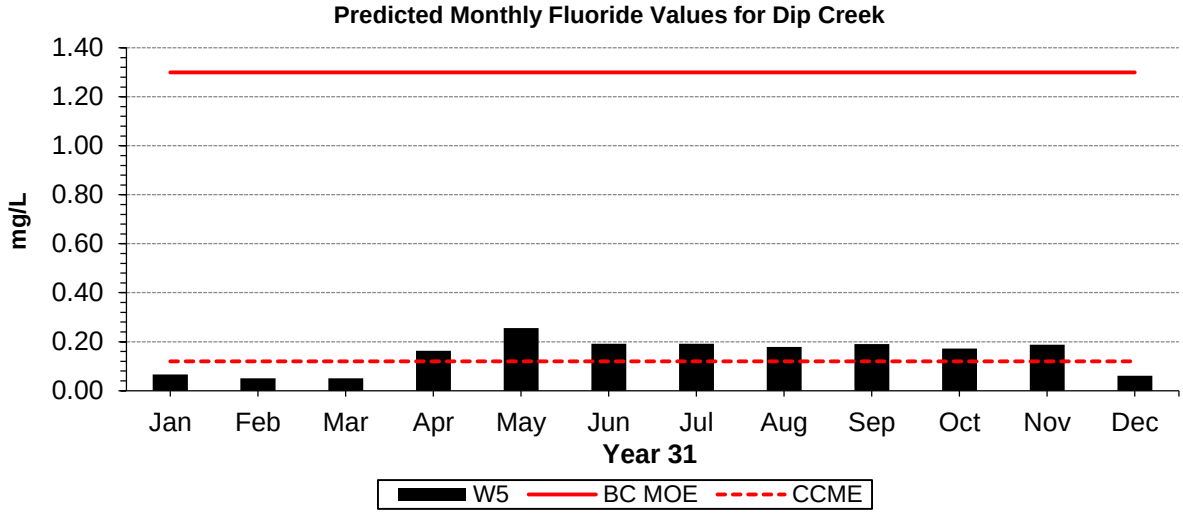


Figure 7.4-13 Predicted Annual Maximum and Monthly Fluoride Concentrations for Dip Creek

A summary of the predicted water quality in Dip Creek at W5 is shown in Table 7.4-10. Each project phase is represented by the range of concentrations in a typical year. The construction period was not included as there are no substantial deviations from baseline.

Table 7.4-10 Summary of Predicted Water Quality in Dip Creek at W5 in Typical Years of Each Project Phase

Parameter	Proposed Water Quality Objective	Operations (Year 20)		Closure and Decommissioning (Year 25)		Post-Closure (Year 100)	
		min	*max*	*min*	*max*	*min*	*max*
Hardness		57	156	57	157	119	189
Acidity		0.95	2.99	0.95	3.00	1.13	3.06
Alkalinity		47	107	47	107	66	121
Sulphate		8	67	8	67	25	98
Cyanide (Total)		0.00025	0.00049	0.00025	0.00049	0.00022	0.00039
Cyanide (WAD)		0.00024	0.00052	0.00024	0.00053	0.00021	0.00042
Chloride		0.27	1.41	0.27	1.41	0.25	3.42
Fluoride	1.3	0.05	0.12	0.05	0.12	0.05	0.21
Aluminum		0.0071	0.0942	0.0071	0.0944	0.0072	0.0849
Antimony		0.00008	0.00017	0.00008	0.00016	0.00007	0.00292
Arsenic		0.00023	0.00072	0.00023	0.00073	0.00023	0.00134
Barium		0.046	0.074	0.046	0.074	0.050	0.075
Cadmium	0.00023	0.00001	0.00005	0.00001	0.00005	0.00001	0.00011
Calcium		15	45	15	45	31	58
Chromium		0.00005	0.00058	0.00005	0.00058	0.00005	0.00070
Cobalt		0.00005	0.00041	0.00006	0.00042	0.00004	0.00389
Copper	0.0065	0.0008	0.0023	0.0008	0.0027	0.0007	0.0042
Iron	0.78/0.71	0.047	0.738	0.047	0.743	0.032	0.594
Lead		0.00002	0.00054	0.00002	0.00054	0.00002	0.00094
Magnesium		4.8	10.3	4.8	10.3	7.3	11.9
Manganese		0.015	0.088	0.015	0.088	0.021	0.205
Mercury		0.000005	0.000005	0.000005	0.000005	0.000005	0.000007
Molybdenum		0.0008	0.0096	0.0008	0.0095	0.0008	0.0219
Nickel		0.0003	0.0009	0.0003	0.0009	0.0002	0.0018
Potassium		0.68	1.00	0.68	0.99	1.01	1.85
Selenium	0.002	0.00003	0.00032	0.00003	0.00033	0.00002	0.00100
Silicon		4.04	5.29	4.02	5.28	3.47	5.29
Silver		0.000003	0.000004	0.000003	0.000004	0.000003	0.000012
Sodium		2.5	6.1	2.5	6.1	4.7	6.9
Strontium		0.11	0.27	0.11	0.27	0.23	0.32
Thallium		0.000002	0.000017	0.000002	0.000017	0.000001	0.000039

Uranium		0.0033	0.0091	0.0033	0.0096	0.0064	0.0106
Zinc		0.0006	0.0030	0.0006	0.0030	0.0006	0.0065

Notes:

Exceeds Proposed WQO
Fluoride: Approved BC MOE maximum
Cadmium: US EPA chronic dissolved (baseline hardness)
Copper: SSWQO-BCP based on the 95th percentile
Iron: Not a COC; SSWQO-BCP for natural elevated Fe based on the 90th percentile for PC and 95th
Selenium: Approved (Interim) BC MOE 30-day average

7.4.3.2 Discussion of Residual Effects

After consideration of the proposed alternative guidelines discussed in the previous sections, the only parameters that continue to exceed the proposed guidelines in Casino Creek are:

- **Cd**: at Post-Closure, Cd exceeds the US EPA guideline based on baseline hardness but not predicted hardness; exceedances occur in June, August, September, October and November at both M18 and W4.
- **Se**: at Post-Closure, Se exceeds the BC MOE guideline between April and November at both M18 and W4, but does not exceed the US EPA guideline.
- **U**: at Post-Closure, U exceeds the maximum BCP-SSWQO in October at M18 but not at W4.
- **SO_4**: at Post-Closure, SO_4 exceeds the BC MOE guideline based on baseline hardness but not predicted hardness; exceedances occur between April and November at M18 and in May, June and November at W4.

After consideration of the proposed alternative guidelines discussed in the previous sections, no parameters exceed proposed guidelines in Dip Creek.

Based on the continued exceedances in Casino Creek, residual water quality effects are predicted for this watercourse. Potential effects, mitigations, and residual effects for water quality are summarized below in Table 7.4-11.

Table 7.4-11 Identification of Mitigation Measures and Potential Residual Effects for Water Quality

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (*or Enhancement*) Measure[1]	Predicted Effectiveness	Residual Effect
Change in surface water quality in Casino Creek due to unrecovered seepage	O,CD	Adverse	The water management pond will intercept 90-95% of seepage and pump it back to the TMF.	High	No
Change in surface water quality in Dip Creek due to unrecovered seepage	O,CD	Adverse	The water management pond will intercept 90-95% of seepage and pump it back to the TMF.	High	No

Change in surface water quality in Casino Creek due to project discharge	PC	Adverse	Water Management and Passive Treatment (i.e. Construction of two engineering wetlands: North TMF wetland and South TMF wetland, construction of a WSMP to contain seepage during December to April and release during higher flows).	Low	Yes
Change in surface water quality in Dip Creek due to project discharge	PC	Adverse	Water Management and Passive Treatment (i.e. Construction of two engineering wetlands: North TMF wetland and South TMF wetland, construction of a WSMP to contain seepage during December to April and release during higher flows).	High	No
Changes in surface water quality due to blasting residues	O	Adverse	Divert all contact water to the TMF; BMPs for explosives selection, drilling, handling and loading.	High	No
Changes in surface water quality due to atmospheric deposition	O	Adverse	Divert all contact water to the TMF; BMPs for drilling, handling and loading ore; traffic speed limits, dust suppressants.	High	No
Change in surface water quality from increased erosion and sedimentation	C,O,CD	Adverse	Water management and BMPs for sediment control as outlined in the Erosion and Sedimentation Control Plan; modify culvert and bridge design for areas with increased sensitivity to disturbances	High	No

Notes

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

7.4.4 Significance of Residual Effects

Significance of residual effects was evaluated based on several criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for water quality (Table 7.4-11). Ratings were assigned to each individual residual effect and compiled in Table 7.4-12.

Table 7.4-11 Determining Significance of Residual Effects for Water Quality

Criteria	Rating	VC Specific Definitions
Magnitude	Low	Predicted effects on water quality are higher than baseline but less than Water Quality Guidelines (WQG)
	Medium	Predicted effects on water quality are above the threshold (WQG or if baseline is higher than WQG the threshold is baseline plus 10%) and less than 10x WQG
	High	Predicted effects on water quality are above 10x WQG
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts <2 years
	Long Term	Effect lasts more than 2 years but less than 25 years (equivalent to estimated Life-of-Project (Construction, Operations, Closure and Decommissioning)
	Permanent	Effect continues beyond Post-Closure phase into the foreseeable future
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur.
	High	High likelihood that the predicted residual effect will occur.

Table 7.4-12 Significance of Residual Effects for Water Quality

Residual Effect	Predicted Degree of Effect After Mitigation (*or Enhancement*) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Change in surface water quality in Casino Creek due to project discharge (PC)	Adverse	Medium	Local	Permanent	Frequent	Irreversible	Low Resilience	High	Not Significant

7.4.5 Discussion of Significance

Predicted water quality in Casino Creek exceeds CCME and BC MOE freshwater aquatic life guidelines for seven parameters: Cu, Cd, Mo, Se, U, SO_4 and F. Exceedances for several of these parameters were also predicted in Dip Creek. However, after assessment against proposed alternative guidelines, which include developed

SSWQO's and applicable guidelines from other jurisdictions, only Cd, Se, U and SO_4 concentrations continued to exceed, and only in Casino Creek during post-closure. Furthermore, three of the exceeding parameters could be considered to be lower than alternative guidelines not selected for application in this assessment, as described below, while U is only predicted to exceed in part of Casino Creek:

- Cd would not exceed the US EPA guideline if predicted hardness were used to calculate the post-closure guideline, rather than baseline hardness.
- Se would not exceed the US EPA guideline if it were applied in the assessment of Se.
- SO_4 would not exceed the BC MOE guideline if predicted hardness were used to calculate the post-closure guideline, rather than baseline hardness.

Based on this discussion, the overall residual effect of the proposed Project on surface water quality is rated as not significant, due to the low geographical extent, moderate magnitude of the anticipated effect and moderate probability of occurrence. The assessment of significance is contingent on the complete implementation of mitigation measures, including a successful water management plan and reclamation and closure plan. The level of confidence applied for the residual effect is defined in Section 5 and considered moderate (50% to 80%). This is based on the inherent nature of uncertainties associated with water quality modelling and the dependencies on numerous input sources.

Table 7.4-13 Summary of Residual Effects for Water Quality

Residual Effects	Direction	Significance	Level of Confidence
Change in surface water quality in Casino Creek due to project discharge (PC)	Adverse	Not Significant	Moderate

7.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

7.5.1 Introduction

Seepage and discharge from the TMF during Post-Closure have the potential for residual effects on water quality. In this section, identified residual effects were further assessed for their potential to cumulatively interact with other past, present, and future projects which overlap spatially and temporally with the Casino Project.

7.5.2 Identification of other Projects or Activities

Appendix 5B is a list of all potential past, present and likely future projects and activities that could reasonably be expected to have a spatial or temporal interaction with the residual effects of the Casino Project. Section 5 provides further details into the compilation of this list. The projects and activities in Appendix 5B include quartz mines, mineral and placer claims, heritage sites, and registered outfitting and trapline concessions. These projects and activities were assessed on whether or not they met three conditions, as outlined in Section 5, to warrant further assessment of cumulative effects. They are reiterated here:

1. Adequate qualitative and/or quantitative information which is publicly available to allow for spatial and temporal characterization;
2. Spatial overlap with the residual effects of the Casino Project; and
3. Temporal overlap with the residual effects of the Casino Project.

Of these projects and activities, potential overlap of water quality residual effects with the Casino Project includes (Table 7.5-1):

- Past mining in the Casino Creek watershed;
- Present mining at the Minto Copper Mine;
- Current development and future mining at the Carmacks Copper Mine;
- Past, present, and future mineral exploration around the Casino Mine site and within watersheds along the Freegold access corridor; and
- Past, present and future placer mining around the Casino Mine site and within watersheds along the Freegold access corridor.

While there are numerous other projects and activities outlined in Appendix 5B, insufficient data often precluded any assessment of a potential interaction with the Casino Project. Only projects for which data are available are reported herein. In addition, as the projects and activities that have potential for a cumulative effect are the same for fish and aquatic resources and they are for water quality, much of the assessment of cumulative effects are similar between the two VCs. Ultimately, any effects to water quality will be carried forward to the cumulative effects assessment to fish and aquatic resources and therefore, further details on the description of the potential cumulative effects are discussed in Section 10.5.

Table 7.5-1 Residual Effect Information for Other Projects or Activities – Water Quality

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Mining				
• **Historic Casino Property Mining**	Past	• Cadmium, silver, lead, zinc loading into Casino Creek from historical adit	Casino Creek from confluence of Meloy Creek to confluence of Dip Creek	Life of mine
• **Minto Copper Mine**	Present	• Reduced water quality • Increased erosion and sedimentation	Yukon River, Big Creek, Wolverine Creek, Dark Creek, Unnamed Creek B and Minto Creek	2022
• **Carmacks Copper Mine**	Future	• Increased erosion and sedimentation	Yukon River, Williams Creek, Nancy Lee Creek, Merrice Creek, Crossing Creek, Murray Creek, Nordenskiold River	Project in review; Predicted 8-year mine life
Mineral Exploration				
• **Upper Canadian Creek and Canadian**	Past, Present and	• Reduced water quality • Increased	Canadian Creek	Unknown

Creek	Future	erosion and sedimentation • Disturbances from drilling and trail clearing		
• **Sonora Gulch**			Hayes Creek Watershed	
• **Prospector Mountain**			Hayes Creek and Big Creek Watersheds	
• **Nucleus**			Big Creek Watershed	
• **WS Total**			Big Creek and Crossing Creek Watersheds	
Placer Mining				
• See Appendix 5B for specific placer claim information	Past, Present and Future	• Increased erosion and sedimentation • Reduced water quality	• Canadian and Britannia Creeks • Rude Creek • Seymour Creek • Hayes Creek Watershed • Big Creek Watershed	Indeterminate

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

7.5.3 Interactions and Potential Cumulative Effects

The water quality residual effects of the Casino Project were compared to residual effects of the mining, mineral exploration and placer mining projects and activities identified within the cumulative effects assessment boundaries (Table 7.5-2). Spatially and temporally, there is potential for these residual effects to interact with the water quality residual effects from the Casino project.

Table 7.5-2 Cumulative Effects Assessment Interactions Matrix – Water Quality

Casino Project Residual Effect	**Potential Spatial and Temporal Overlap**							
	Mining			**Mineral Exploration**			**Placer Mining**	
	Cadmium, silver, lead, zinc loading into Casino Creek from historical adit	Reduced water quality due to Minto Copper mining	Increased erosion and sedimentation	Reduced water quality	Increased erosion and sedimentation	Disturbances from drilling and trail clearing	Increased erosion and sedimentation	Reduced water quality
Change in Casino Creek water quality	YES	NO	NO	NO	NO	NO	NO	NO

Note

1 YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

The Casino Property has had a long and varied exploration history. Between 1965 and 1980, silver-rich veins were explored and developed intermittently by underground and surface workings. Remnants of the past exploration activities include an adit with a pipe that discharges water to Casino Creek via surface runoff to Meloy Creek. This water is elevated in silver, lead, cadmium and zinc and has likely been discharging to Casino Creek for the past 33 to 48 years, subsequently lowering water quality Casino Creek (Refer to Appendix 7A). Current baseline conditions in Casino Creek downstream of Meloy Creek have already been altered by the water discharging from the historical adit. While there is a high potential for interaction between the residual effects of these projects, the predicted water quality in Casino Creek has already been discussed in detail in Section 7.4. In other words, any potential cumulative effects from the historic mine and the proposed Casino mine have already been incorporated into the model and assessed.

There are no other interactions present, or reasonably foreseeable Projects that could cause effects to water quality. Past mineral exploration and placer mining activities have already occurred and therefore any historical effects to surface water quality are reflected in the baseline water quality. Any future mineral exploration or placer mining in the area would be expected to adhere to all acts, laws and regulations to ensure no effects to water quality.

Table 7.5-3 Potential Cumulative Effects – Water Quality

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Change in Casino Creek water quality	Historic Mining	Reduced water quality in Casino Creek due to adit discharge and TMF discharge

7.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

As discussed in Section 7.4.7, throughout the life of the Casino Project, water management would be the overarching principle to preserve water quality. Water management, best management practices and general reclamation and closure planning measures will be the primary mitigation measures.

Additional mitigation to be considered by CMC includes permanently sealing the adit pipe in the upper Casino Creek watershed. Although the adit was covered by CMC in 2007, the pipe discharging contaminated water to surface was not. Permanently sealing/plugging the adit to prevent the further discharge of water to surface will be a highly effective mitigation measure to address this potential cumulative effect. One effective approach to sealing the adit would be using a reinforced concrete plug with appropriate grouting. A suitable time to implement this measure may be during the construction of the heap leach facility, as the proposed footprint of the heap leach facility is adjacent to the historic adit.

Table 7.5-4 Additional Mitigation Measures and Residual Cumulative Effects – Water Quality

Potential Cumulative Effect	**Mitigation Measures for Project-Specific Effects**[1]	**Additional Mitigation**[2] (if possible)	**Effectiveness of Additional Mitigation Measure** (Low, Moderate, High, Unknown)	**Residual Cumulative Effect** (Yes/No)
Reduced water quality in Casino Creek due to adit discharge and TMF discharge	• Water Management Plan • Reclamation Plan	Control contaminate discharge from the historic adit in upper Casino Creek	High	Yes

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

7.5.5 Significance of Residual Cumulative Effects

The development of the Casino Project would have a residual effect on the water quality VC. The water quality model (Appendix 7F) predicted surface water quality in the main receiving water body of Casino Creek and showed a change in the baseline condition to levels exceeding SSWQO's. The residual cumulative effect from the Casino Project and the adit discharge is incorporated into the water quality and potential effects considered in Section 7.4. Thus, for the same reasons discussed in Section 7.4.9, no significant residual cumulative effects are anticipated.

Table 7.5-5 Significance of Residual Cumulative Effects – Water Quality

Residual Cumulative Effect	**Predicted Degree of Effect After Additional Mitigation Measures**								**Significance of Residual Cumulative Effect** (Significant/Not Significant)
	Direction	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Context**	**Probability of Occurrence**	
Reduced water quality in Casino Creek due to adit discharge and TMF discharge	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

7.5.6 Discussion of Significance of Residual Cumulative Effects

No significant cumulative effects (Table 7.5-6) on water quality are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including the sealing of the adit pipe, as outline in Section 7.5.4.

Table 7.5-6 Summary of Residual Cumulative Effects – Water Quality

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Reduced water quality in Casino Creek due to adit discharge and TMF discharge	Adverse	Not Significant	High

7.6 SUMMARY AND CONCLUSIONS

No significant water quality change (Table 7.4-13) or cumulative effects (Table 7.5-6) are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including an effective water management plan and reclamation plan, which are outlined in Appendix 4D.

While there will be detectable change in surface water quality from the natural range of variability in chemical characteristics in Casino Creek, the predictions fall within a reasonable threshold where alternative water quality guidelines that take into account site-specific water chemistry, such as high water hardness and elevated baseline metal concentrations, are appropriately protective. Residual effects from elevated metal and sulphate concentrations are limited to Casino Creek with vast improvements in water quality downstream in Dip Creek. The designation of non-significance is directly formulated on results from the water quality model (Appendix 7F). Limitations that are associated with the water quality assessment are based on the uncertainties in the water quality model.

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8 – AIR QUALITY

8.1 INTRODUCTION

This section of the Proposal presents the baseline information on air quality in the Casino Project area as well as an assessment of potential environmental effects on air quality from the Casino Project components and activities. This section also includes current and historic baseline information for climate within the Project area, but it does not include an effects assessment. Instead, data regarding current and historic climate conditions will be incorporated into the effects assessments for other VCs.

The assessment of air quality used measurements of SO_2, NO_2, CO, Total Suspended Particulate (TSP), Total Particulate Matter as dustfall (DF), inhalable particulate (PM_{10}) and respirable particulate ($PM_{2.5}$), and will adhere to the methodology outlined in Section 5 of the Proposal.

Section 20 of the Proposal includes a discussion of the potential effects of the environment, including extreme weather events, on the Project.

8.1.1 Regional Setting

The Casino Project is located in the Dawson Range Mountains of the Klondike Plateau, approximately 300 km northwest of Whitehorse. The Freegold Road Extension and proposed Freegold Road Upgrade extend for approximately 200 km southeast from the Project to the village of Carmacks. The Project is situated in the Casino Creek and Canadian Creek watersheds.

The Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern BC, and within the Klondike Plateau ecoregion. The Boreal Cordillera ecozone is broadly characterized by the presence of several mountain ranges, including the Dawson Range, that trend in the north-westerly direction and include extensive plateau regions. The elevation of the project area ranges from approximately 650 masl at the proposed airstrip location to 1,400 masl at Patton Hill.

8.1.2 Rationale for VC Selection

Valued Environmental and Socio-economic Components are broad components of the biophysical, ecosystem, and human environments that, if altered by the Project, would be of concern to First Nations, regulatory agencies, resource managers, scientists, or members of the general public. Air Quality has been chosen as a VC as it can be used as an indicator of both environmental and human health due to the atmosphere's role in transporting air emissions to human, freshwater, and terrestrial environments. Air quality can be further subdivided into three key indicators: ambient air quality concentrations, particulate matter deposition, and greenhouse gases in the atmosphere. Ambient air quality deals with the potential effects of air emissions on the environment. Mining activities generate air emissions due to fuel consumption, erosion, material transfer including ore processing and traffic on unpaved roads, therefore this indicator focuses on major air pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter in the study area. The particulate matter deposition indicator focuses on particulate matter deposition rates which are resulting from mining activities mainly due to fugitive dust. The criteria air contaminants assess the regional dispersion of gases into ambient air and the greenhouse gases indicator assesses the potential contribution of the project related greenhouse gases into atmosphere, and compares this with national total greenhouse release statistics.

8.2 ASSESSMENT BOUNDARIES

The spatial boundaries for air quality consist of the areas where the Project is reasonably expected to have an effect on air quality. The local study area and regional study area are shown on Figure 8.2-1 and is discussed in greater detail in the sections below.

8.2.1 Spatial Boundaries

8.2.1.1 Local Study Area (LSA)

The main source of far-travelling emissions from the mine site are expected to be from the power plants due to the high emission rates, the height of the stacks, as well as the high exhaust temperature conditions. Experience with similar large capacity industrial developments, including copper and gold open pit mines with large power plants suggests that a 60 km by 60 km modelling area would provide a better understanding of regional dispersion of air contaminants. For this reason, the main LSA (LSA 1) for the effects assessment on air quality is the 3600 km^2 (60x60 km) area surrounding the mine site. This area is quadrilateral due to the nature of the modelling programs used. The large study area was established by using experience and the size was verified after model results were obtained.

A major part of the Freegold Road is included in LSA 1 which is enough to understand the approximate distance that air contaminants would disperse during regular mine traffic. An additional LSA (LSA 2) consisting of the 20 km^2 area surrounding the village of Carmacks has also been included in the assessment to account for the effects of the Freegold Road Upgrade and Extension, however no mine related activity will occur in this study area other than traffic by-passing the town. Therefore, no refined modelling studies were performed for LSA 2.

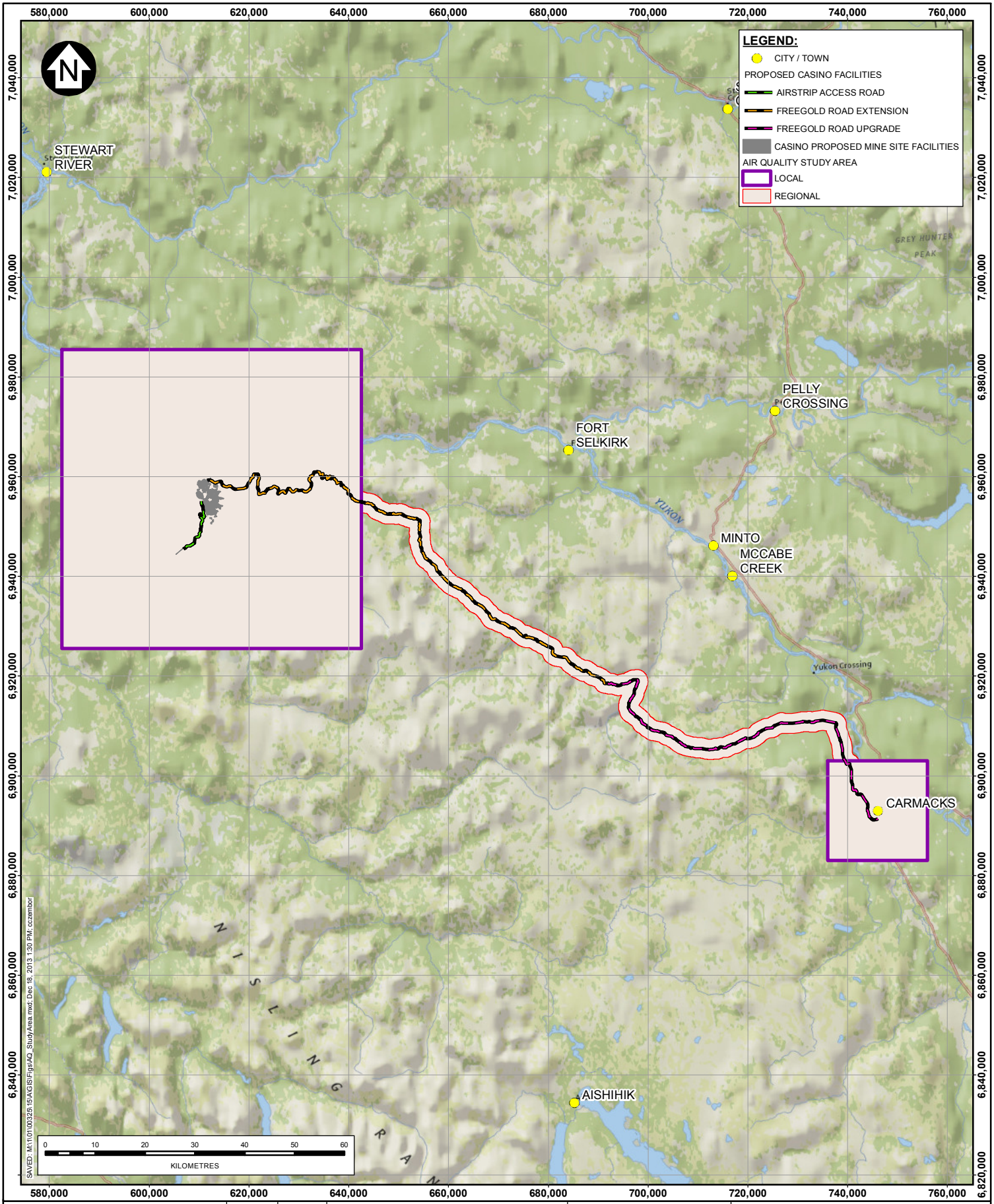
The LSAs that have been chosen are expected to encompass the areas where the concentrations of compounds resulting from emissions from the Casino Project have the potential to exceed a threshold resulting is the occurrence of criteria air contaminants.

8.2.1.2 Regional Study Area (RSA)

The RSA for the effects assessment on air quality consists of LSA 1, LSA 2, and a 4 km buffer (2 km on each side) along the Freegold Road Upgrade and Extension. The RSA is expected to encompass the area where the concentrations of compounds resulting from emissions from the Casino Project are quantifiable and provide understanding of dispersion characteristics over the study area.

8.2.2 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project is provided in Section 4.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	CC
DRAWN	CC
CHK'D	TO
APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE NATIONAL GEOGRAPHIC MAPPING, AE ENGINEERING.
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

REGIONAL AND LOCAL STUDY AREAS - AIR QUALITY

FIGURE 8.2-1

REF 1

P/A VA101-325/15

8.3 BASELINE CONDITIONS

8.3.1 Climate

This section summarizes baseline climate conditions, while greater detail can be found in Appendix 8A. The measurable parameters used to establish baseline conditions were:

- Temperature;
- Rainfall, snowfall, and total precipitation;
- Wind speed and direction;
- Relative humidity;
- Evapotranspiration; and
- Snowfall, snow accumulation, and snowmelt.

In 1993, Hallam Knight Piésold Ltd. (HKPL) installed a climate station near the Casino exploration camp at an elevation of 1,200 m. This station measured temperature and precipitation and operated from 1993 to 1995. In 2008, a new Project climate station was established at approximately the same location by RWDI Air Inc. (RWDI). This station continues to be operational and measures air temperature, rainfall, wind speed and direction, relative humidity, barometric pressure, and snow depth. The temperature and precipitation data collected from site were compared to the long-term record obtained from the climate station at Pelly Ranch. This station is located closest to the Project area (approximately 80 km east) at an elevation of 454 m.

The long-term temperature record from the climate station at Pelly Ranch was used to generate a long-term synthetic series of monthly temperature values for the Casino climate station. The monthly temperatures for the two stations were found to be strongly correlated in the warmer months, but only weakly correlated in the colder months. Thus, two relationships corresponding to these two periods of time were developed for the regression analysis. A 55-year synthetic series of monthly temperature values for the Project site climate station was generated by applying the two regression relationships to the Pelly Ranch monthly temperature record.

The long-term precipitation record from the climate station at Pelly Ranch was used to generate a long-term synthetic series of monthly precipitation values for the Casino climate station. The concurrent precipitation records from the two climate stations were correlated using a comparison of cumulative precipitation and the monthly precipitation at the two locations was found to be moderately well-correlated. A preliminary long-term synthetic series for precipitation was generated which was then further refined using the Casino Watershed Model.

The resultant data series were used to compute summary statistics for the Casino station, which are summarized along with other recommended values for key climatic parameters in Table 8.3-1. The values in this table correspond to an elevation of 1,200 m, but the temperature and precipitation values can be adjusted to reflect conditions at different elevations following the guidelines in Table 8.3-2.

Table 8.3-1 Recommended Values for Key Climatic Parameters

CLIMATIC PARAMETERS (1,200 m ELEVATION)	VALUE
Mean Annual Temperature	-3 C
Mean January Temperature	-18 C
Mean July Temperature	11 C
Extreme Minimum Temperature	-50 C
Extreme Maximum Temperature	30 C
Mean Annual Precipitation	460 mm
Mean Annual Rainfall	305 mm
Mean Annual Snowfall (Water-Equivalent)	155 mm
Mean Annual Rainfall/Snowfall Distribution	66% / 34%
2-Year 24-Hr Rainfall	32 mm
100-Year 24-Hr Rainfall	71 mm
Mean Annual Sublimation	60 mm
Mean Annual Wind Speed	2.3 m/s
Maximum Wind Gust Speed	14.9 m/s
Prevailing Wind Direction	Northerly
Mean Annual Relative Humidity	68%
Mean Annual Potential Evapotranspiration	300 mm
Mean Annual Maximum Snow Water-Equivalent	100 mm
Mean Monthly Snowmelt for May (Water-Equivalent)	85 mm

Table 8.3-2 Elevation Adjustments

CLIMATIC PARAMETERS	VALUE
Mean Monthly Temperature	- 0.65 °C per 100 m
Mean Annual Precipitation	+7% per 100 m

8.3.2 Air Quality

This section summarizes baseline air quality conditions. Greater detail regarding dustfall measurements from 2010 and 2011 can be found in Appendix 8B. Data for dustfall measurements from 2013 can be found in Appendix 8C.

Dustfall measurements were collected according to standards published by the American Society for Testing and Materials (ASTM, 2010). Four dustfall collection canisters were installed at the Casino climate station in areas north, east, south, and west of the mine in August of 2010. The canisters were placed approximately 1.5 m above ground. Dustfall measurements were collected for a month from August to September of 2010 (Event #1) and again for two months from May to June (Event #2) and August to September of 2011 (Event #3). Event #1 was analyzed for fixed dustfall, combustible dustfall, total dustfall, and metals. Event #2 was analyzed only for fixed dustfall, while Event #3 was analyzed for fixed dustfall, combustible dustfall, and total dustfall.

Two dustfall collection canisters were installed at the Casino climate station in areas north and west of the mine in July of 2013. These canisters were placed in the same locations and at the same heights as the three sampling

events in 2010 and 2011. Dustfall measurements were collected for a month from July to August of 2013 (Event #4). Event #4 was analyzed for fixed dustfall, combustible dustfall, total dustfall, and metals. Additionally, Event #4 measured additional parameters including SO_2 and NO_2 concentrations as well as suspended particulate matters in the form of $PM_{2.5}$ and PM_{10}.

The results of the dustfall analyses are presented in Table 8.3-3. Most dustfall measurements were less than the detection limit of 0.11 mg/dm^2/day. Results from the additional sampling from Event #4 are shown in Table 8.3-4. NO_2 and SO_2 were below the detection limit, and are thus assumed to be 0.05 ppb. PM_{10} and $PM_{2.5}$ are well below the Canadian Air Quality Objectives detailed in Table 8.4-1.

Table 8.3-3 Dustfall Analysis Results (mg/dm^2/day)

Sample ID	Northern Location	Western Location	Southern Location	Eastern Location	Blank
Event #1 (Aug – Sep 2010)					
Fixed Dustfall	<0.11	<0.11	<0.11	<0.11	<0.11
Combustible Dustfall	<0.11	<0.11	0.16	<0.11	<0.11
Total Dustfall	<0.11	<0.11	0.22	<0.11	<0.11
Event #2 (May – Jun 2011)					
Fixed Dustfall	0.13	<0.10	<0.10	<0.10	<0.10
Event #3 (Aug – Sep 2011)					
Fixed Dustfall	No Sample	0.11	<0.10	<0.10	<0.10
Combustible Dustfall	No Sample	0.28	0.27	<0.10	<0.10
Total Dustfall	No Sample	0.39	0.32	<0.10	<0.10
Event #4 (Jul – Aug 2013)					
Total Dustfall	<0.10	<0.10	n/a	n/a	n/a

NOTE:
1. The Laboratory Detection Limit is 0.11 mg/dm^2/day

Table 8.3-4 Air Quality Baseline Data – Event #4

Parameter	Average Value
NO_2 (ppb)	<0.1 ppb (<1.88 µg/m^3)
SO_2 (ppb)	<0.1 ppb (<2.61 µg/m^3)
PM_{10} (average)	6.2 µg/m^3
PM_{10} (maximum 24-hour)	9.4 µg/m^3
$PM_{2.5}$ (average)	3.9 µg/m^3
$PM_{2.5}$ (98th percentile)	6.3 µg/m^3

NOTE:
1. NO_2 and SO_2 concentrations were monitored by passive samplers.
2. The minimum detection limit for NO_2 and SO_2 passive samplers are 0.1 ppb.

Table 8.3-5 presents the results of the metal concentrations analysis from the dustfall samples from Event #1 in 2010. The majority of the metal concentrations were below detection limits. The exceptions were aluminum, barium, calcium, copper, lead, magnesium, manganese, strontium, and zinc, which were above detection limits in all four testing locations. In addition, chromium and sodium were detected in the eastern location and nickel was detected in all areas except for the southern location. Table 8.3-6 presents the results of the metal concentrations analyzed from the dustfall samples from Event #4 in 2013. The majority of the metal concentrations were below detection limits. The exceptions were aluminum, barium, calcium, copper, lead, magnesium, manganese, strontium, and zinc, which were above detection limits in both testing locations. In addition, iron and silicon were detected in the western location.

Table 8.3-5 Metals Analysis Results for Event #1 (mg/dm^2/day)

Metals	Northern Location	Western Location	Southern Location	Eastern Location	Control Canister
Aluminum (Al)-Total	0.000411	0.000314	0.000457	0.000540	0.000054
Antimony (Sb)-Total	<0.0000030	<0.0000038	<0.0000043	<0.0000042	<0.0000028
Arsenic (As)-Total	<0.0000030	<0.0000038	<0.0000043	<0.0000042	<0.0000028
Barium (Ba)-Total	0.0000363	0.0000258	0.0000576	0.0000417	<0.0000014
Beryllium (Be)-Total	<0.000015	<0.000019	<0.000022	<0.000021	<0.000014
Bismuth (Bi)-Total	<0.000015	<0.000019	<0.000022	<0.000021	<0.000014
Boron (B)-Total	<0.00030	<0.00038	<0.00043	<0.00042	<0.00028
Cadmium (Cd)-Total	<0.0000015	<0.0000019	<0.0000022	<0.0000021	<0.0000014
Calcium (Ca)-Total	0.00100	0.00155	0.00228	0.00167	<0.00055
Chromium (Cr)-Total	<0.000015	<0.000019	<0.000022	0.000031	<0.000014
Cobalt (Co)-Total	<0.0000030	<0.0000038	<0.0000043	<0.0000042	<0.0000028
Copper (Cu)-Total	0.0000585	0.0000397	0.0000531	0.0000450	0.0000590
Lead (Pb)-Total	0.0000029	0.0000058	0.0000156	0.0000080	<0.0000014
Lithium (Li)-Total	<0.00015	<0.00019	<0.00022	<0.00021	<0.00014
Magnesium (Mg)-Total	0.00028	0.00040	0.00119	0.00044	<0.00014
Manganese (Mn)-Total	0.0000410	0.0000451	0.000113	0.0000587	<0.0000014
Molybdenum (Mo)-Total	<0.0000015	<0.0000019	<0.0000022	<0.0000021	<0.0000014
Nickel (Ni)-Total	0.000036	0.000031	<0.000022	0.000346	<0.000014
Potassium (K)-Total	<0.0015	<0.0019	0.0126	<0.0021	<0.0014
Selenium (Se)-Total	<0.000030	<0.000038	<0.000043	<0.000042	<0.000028
Silver (Ag)-Total	<0.00000030	<0.00000038	<0.00000043	<0.00000042	<0.00000028
Sodium (Na)-Total	<0.0015	<0.0019	<0.0022	0.0026	<0.0014
Strontium (Sr)-Total	0.0000039	0.0000050	0.0000094	0.0000049	<0.0000028
Thallium (Tl)-Total	<0.0000030	<0.0000038	<0.0000043	<0.0000042	<0.0000028
Tin (Sn)-Total	<0.0000030	<0.0000038	<0.0000043	<0.0000042	<0.0000028
Uranium (U)-Total	<0.00000030	<0.00000038	<0.00000043	<0.00000042	<0.00000028
Vanadium (V)-Total	<0.000030	<0.000038	<0.000043	<0.000042	<0.000028
Zinc (Zn)-Total	0.000071	0.000060	0.000124	0.000182	<0.000028

Table 8.3-6 Metals Analysis Results for Event #4 (mg/dm^2/day)

Metals	Northern Location	Western Location
Aluminum (Al)-Total	0.000333	0.000501
Antimony (Sb)-Total	<0.0000025	<0.0000024
Arsenic (As)-Total	<0.0000025	<0.0000024
Barium (Ba)-Total	0.0000158	0.0000282
Beryllium (Be)-Total	<0.000012	<0.000012
Bismuth (Bi)-Total	<0.000012	<0.000012
Boron (B)-Total	<0.00025	<0.00024
Cadmium (Cd)-Total	<0.0000012	<0.0000012
Calcium (Ca)-Total	0.0025	0.0068
Chromium (Cr)-Total	<0.000012	<0.000012
Cobalt (Co)-Total	<0.0000025	<0.0000024
Copper (Cu)-Total	0.000141	0.000426
Iron (Fe)-Total	<0.00074	0.00074
Lead (Pb)-Total	0.000011	0.0000083
Lithium (Li)-Total	<0.00012	<0.00012
Magnesium (Mg)-Total	0.0025	0.0024
Manganese (Mn)-Total	0.0000669	0.0000611
Mercury (Hg)-Total	<0.0000012	<0.0000012
Molybdenum (Mo)-Total	<0.0000012	<0.0000012
Nickel (Ni)-Total	<0.000012	<0.000012
Phosphorus (P)-Total	<0.0074	<0.0071
Potassium (K)-Total	<0.049	<0.047
Selenium (Se)-Total	<0.000025	<0.000024
Silicon (Si)-Total	<0.0012	0.0025
Silver (Ag)-Total	<0.00000025	<0.00000040
Sodium (Na)-Total	<0.049	<0.047
Strontium (Sr)-Total	0.0000070	0.0000235
Thallium (Tl)-Total	<0.0000025	<0.0000024
Tin (Sn)-Total	<0.0000025	<0.0000024
Titanium (Ti)-Total	<0.00025	<0.00024
Uranium (U)-Total	<0.00000025	<0.00000024
Vanadium (V)-Total	<0.000025	<0.000024
Zinc (Zn)-Total	0.000120	0.000206

8.3.3 Greenhouse Gas Emissions

Information on total Yukon and Canadian GHG emissions from 1990 to 2011 was obtained from the National Inventory Report (Environment Canada 2013). These data are shown in Table 8.3-7.

Table 8.3-7 National and Territorial GHG Emissions (in kt of CO_{2e}/year)

Year	Yukon Emissions	Canadian Emissions
1990	537	591,000
2000	451	718,000
2005	450	737,000
2007	418	749,000
2008	381	731,000
2009	345	689,000
2010	341	701,000
2011	374	702,000

In 2011, 702,000 kilotonnes (kt) of equivalent CO_2 (CO_{2e}) were emitted across Canada, which represents a miniscule increase from 2010 levels. In the Yukon, 374 kt of CO_{2e} were emitted, which represents a 9.6% increase over 2011 levels. In general, Yukon generates very low GHG emissions and does not contribute to global emission levels.

8.4 PROJECT-SPECIFIC EFFECTS

Air quality dispersion models are mathematical descriptions of the behaviour of air contaminants in the atmosphere (BC MOE, 2008). For the Casino Project, the US EPA approved version of the CALPUFF air dispersion modelling system was used to predict the effects on air quality. CALPUFF is an effective tool for areas with complex terrain and meteorological conditions, as well as for projects that need to analyze multiple air emission sources in time and space.

The Ministry of Environment Guidelines for Air Quality Dispersion Modelling in British Columbia describes CALPUFF as a Gaussian puff model that can account for time and space-varying meteorological conditions, different source configurations and contaminants, and chemical transformations (BC MOE, 2008). CALPUFF is a modelling system that is comprised of three sub-models:

- CALMET, a meteorological model;
- CALPUFF, to calculate outputs using the meteorological fields produced by CALMET; and
- CALPOST, a model that conducts the analysis and displays outputs.

The CALPUFF model is best suited to the Casino Project because the Project area is surrounded by complex terrain which may result in plumes that tend to follow curvilinear trajectories. Additionally, the CALPUFF model is able to handle multiple air emission sources on a large modelling domain.

The sources of air contaminants for the Project are typical for an open pit mine. The vast majority of air emissions generated during the construction and operation of an open pit mine are derived from power generation and vehicular and equipment use. Therefore, the air emission inventory for the Project included mainly construction and operation vehicles, power generators, routine hauling equipment, and processing units such as crushers and conveyors. The air emissions also include erosion due to gusts of wind at the stockpiles and tailings beaches.

The worst-case conditions for air emissions were modelled for the assessment. Worst case air emissions coincided with the peak in construction activities and the year of operations that had the maximum tonnage of waste rock moved. The selected years are also coincided with the peak number of mobile equipment and thus maximum fuel consumption. The CALPUFF model was run for the entire year to ensure that all climatic conditions were considered.

Geophysical data are important components of the CALPUFF air dispersion model because topography and ground cover both play important roles in the dispersion of air contaminants as well as the deposition of dust. The topography was modified to reflect the changes in elevations at major project components during the modelled year such as open pit depth, waste stockpile height, and ore stockpile height.

The air quality assessment for the Project includes the predicted concentrations of suspended particulate matters (total suspended particulates, $PM_{2.5}$, and PM_{10}) and total particulate matter deposition (dustfall), as well as NO_2, SO_2, and CO. The results of the air quality model were compared with the Yukon Ambient Air Quality Standards (Yukon Environment 2010). Where guidelines don't exist under these standards, the results of the model were compared with Canadian Air Quality Objectives and British Columbia Air Quality Objectives, as shown in Table 8.4-1. This information was then used to complete the air quality effects assessment and cumulative effects assessment.

Table 8.4-1 Air Quality Guidelines

Parameter	Yukon Ambient Air Quality Standards	Canadian Air Quality Objectives	British Columbia Air Quality Objectives
Sulphur Dioxide (SO_2) µg/m^3			
1-hour average	450	450	450
24-hour average	160	160	160
Annual arithmetic mean	25	25	25
Nitrogen Dioxide (NO_2) µg/m^3			
1-hour average	400	1000 (MTL) 400 (MAL)	-
24-hour average	200 (106 ppb)	300 (MTL) 200 (MAL)	-
Annual arithmetic mean	100 (53 ppb) 60 (32 ppb)	100 (MTL) 60 (MAL)	-
Carbon Monoxide (CO) µg/m^3			
1-hour average	14,300 (13 ppm)	35,000 (MAL) 15,000 (MDL)	35,000 28,000 14,300
8-hour average	5,500 (5 ppm)	20,000 (MTL) 15,000 (MAL) 6,000 (MDL)	14,300 11,000 5,500
Total Suspended Particulate Matter (TSP) µg/m^3			
24-hour average	120	400 (MTL) 120 (MAL)	260 (MTL) 200 (MAL) 120 (MDL)
Annual arithmetic mean	60	70 (MAL) 60 (MDL)	75 70 60
Particulate Matter (PM_{10}) µg/m^3			
PM_{10}	-	-	50
Particulate Matter ($PM_{2.5}$) µg/m^3			
24-hour average	30	28 (year 2015) 27 (year 2020)	25
Annual	-	10 (year 2015) 8.8 (year 2020)	8 (6 future goal)
Dustfall mg/dm^2/day			
Dustfall	-	-	1.7, 2.9 (mining) 1.7, 2.3, 3.5, 4.1 (other)

Note:

1. Some objectives were converted from ppb to µg/m^3.
2. MDL is Maximum Desirable Level, MAL is Maximum Allowable Level, and MTL is Maximum Tolerable Level

Air quality models have many steps to predict the air constituent concentrations. The air quality modelling for the Casino Project involved three major steps:

- Identification of main emission sources for SO_2, CO, NO_2, $PM_{2.5}$, PM_{10}, TSP, and dustfall;
- Calculation of emission rates; and
- Dispersion modelling and analysis of model predictions.

The worst case scenario was modelled for the Project. This was selected by using the production schedule for the Project to determine the peak production year. For the construction phase, the worst case scenario was modelled at Year -1, because mine traffic, auxiliary power plants and pioneering are anticipated to reach their maximum at this time. For the operations phase, the worst case scenario was modelled at Year 11, because both equipment use and waste material movement reach their peak at this time. Waste movement is an important factor because the distance for waste storage is longer which requires more fuel and the use of unpaved roads.

Air emission rates were estimated by using the US Environmental Protection Agency (US EPA) AP42 emission factors, approved emission limits, manufacturer specifications and NONROAD2008a software. The emission rates that are produced are expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity that releases the pollutant to the atmosphere (US EPA, 2004). The feasibility study for the Casino Project was used to quantify and locate emission sources in order to estimate emission rates. The results for operations are summarized in Table 8.4-2.

Table 8.4-2 Casino Greenhouse Gases Emission Estimates

Year	Greenhouse Gas Release Projections (kt of CO_{2e})			Annual Total (in kt of CO_{2e})
	Mine Fleet	Power Generation	Other	
-3	108	75	0.2	183
-2	130	75	0.6	206
-1	182	75	1.9	259
1	387	202	3.5	592
2	430	202	3.4	635
3	480	202	3.3	685
4	477	202	4.1	683
5	426	202	5.2	633
6	443	202	5.4	650
7	510	202	4.1	716
8	510	202	3.8	716
9	510	202	3.9	716
10	477	202	3.8	683
11	526	202	4.6	732
12	443	202	4.8	650
13	463	202	4.4	669
14	502	202	4.1	708
15	441	202	3.8	647
16	414	202	3.5	619
17	327	202	2.2	531
18	317	202	1.2	520
19	263	202	4.2	469
20	136	202	5.4	343
21	136	202	5.4	343
22	152	202	3.1	357

Notes:

1. Equipment speeds (other than haul trucks) are based on general mining practices.
2. It was assumes that all vehicles will use diesel fuel and generators will use diesel and LNG.
3. The fuel rates for all vehicles were taken from Caterpillar's Performance Handbook Edition 29.
4. Fuel consumption for vehicles are average and a load factor of 1 was applied. This assumes that equipment will not be overloaded and will be used on adverse grades and experience some high rolling resistance.
5. Working time was calculated as the productive time, which includes loading, unloading, and transporting.
6. The Main Power Plant will be active for the entire operations phase with 90% efficiency.

The dispersion modelling and predictions for air quality considered two cases:

- The “Baseline Case”, which reflect the existing conditions described in Section 8.3; and
- The “Project Case”, which represents the baseline with the addition of the calculated emission rates for the components and activities associated with the Casino Project.

The Project Case was modelled for both the construction and operation phases of the Project which includes baseline conditions and project incremental effects on ambient air quality. The CALPUFF model produced short term (1-Hour, 8-Hour and 24-hour) and long term (annual average) concentrations of the air contaminants and the daily average for monthly dustfall deposition rates over the study area, which includes part of the Freegold Road. The LSA around the Village of Carmacks was not included in the modelling exercise, as there are no mine operations present and mine-related traffic will bypass the town. The results of the modelling were compared to the guidelines detailed in Table 8.4-1.

Construction Phase

In general, the dispersion modelling and predictions indicated that the Project Case for the construction phase of the Project will comply with the guidelines outlined in Table 8.4-1. A summary of the results is presented in Table 8.4-3. During the construction phase, the main contributors to emissions are the pioneering and pre-stripping activities at the Open Pit and the Waste Storage Area. The concentrations in the LSA are shown on Figure 8.4-1 to Figure 8.4-14.

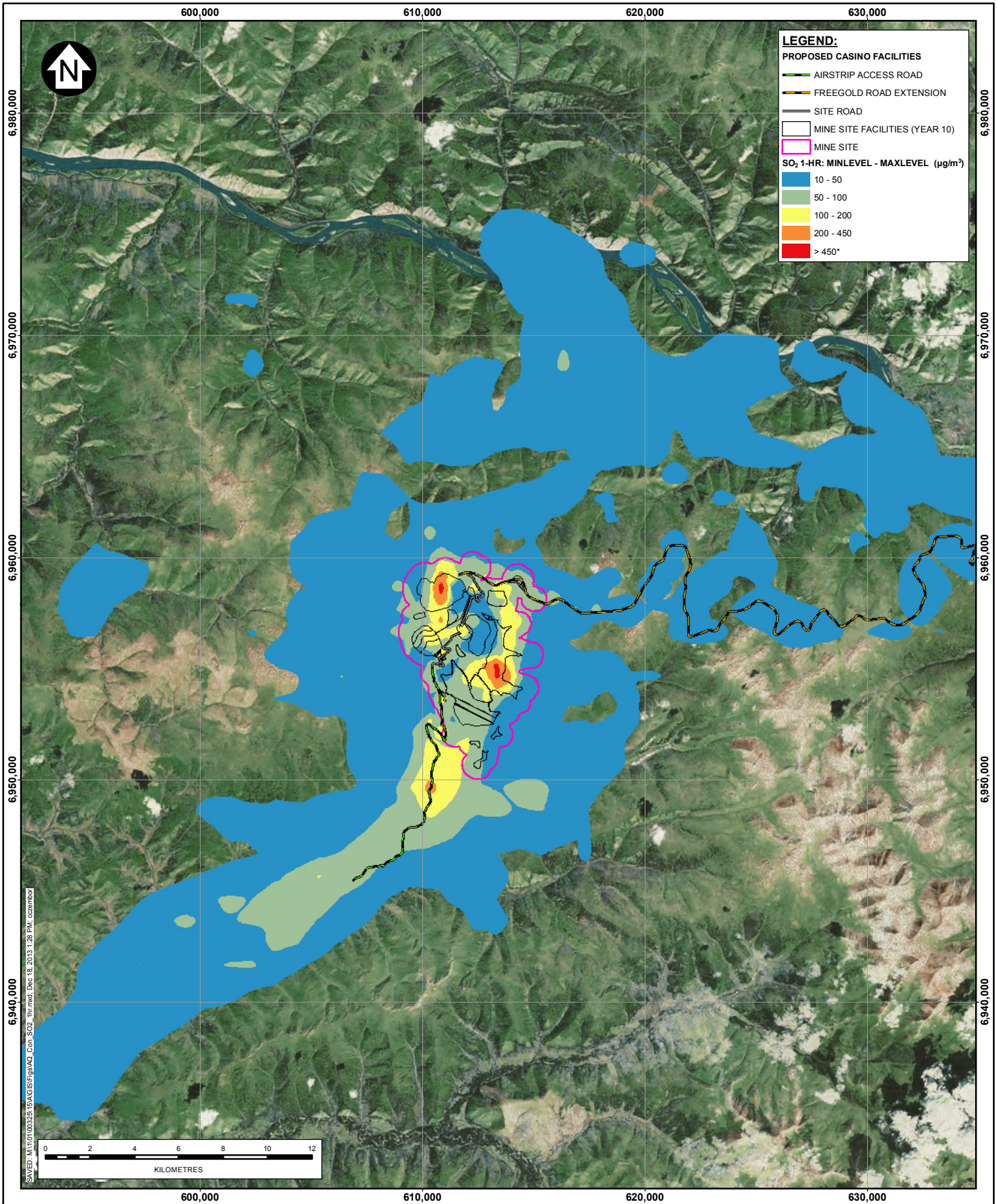
SO_2 and CO levels show minor exceedances within the mine site but not at the Freegold Road. NO_2 levels show exceedances throughout the mine site and extending out into portions of the Freegold Road immediately east of the mine site. This is due to the consumption of LNG at the power plant.

TSP and dustfall levels show exceedances within the mine site but not at the Freegold Road. PM_{10} and $PM_{2.5}$ levels show exceedances throughout the mine site and extending out into portions of the Freegold Road immediately east of the mine site. This is due to pioneering activities related to mine construction.

Table 8.4-3 Summary of Construction Phase Predictions

Air Contaminate	Averaging Period	Guideline	Predicted Air Quality	
			Casino Mine Site	Freegold Road
SO_2	1-hour	450 µg/m^3	Minor exceedances at Open Pit and Waste Storage Area.	Meets maximum 1-hour acceptable objective.
	24-hour	160 µg/m^3	Minor exceedances at Waste Storage Area.	Meets maximum 24-hour acceptable objective.
	Annual	25 µg/m^3	Minor exceedances at Open Pit and Waste Storage Area.	Meets annual average acceptable objective.
NO_2	1-hour	213 ppb (400 µg/m^3)	Exceedances seen throughout mine site.	Exceedances seen at western end of road near entrance to mine site.
	24-hour	106 ppb (200 µg/m^3)	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
	Annual	32 ppb (60 µg/m^3)	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
CO	1-hour	13,000 ppb (14,300 µg/m^3)	Minor exceedances at Open Pit and Waste Storage Area.	Meets maximum 1-hour acceptable objective.
	8-hour	5,000 ppb (5,500 µg/m^3)	Minor exceedances at Open Pit and Waste Storage Area.	Meets maximum 8-hour acceptable objective.
TSP	24-hour	120 µg/m^3 *	Exceedances seen throughout mine site.	Meets maximum 24-hour acceptable objective.
	Annual	60 µg/m^3	Exceedances seen throughout mine site.	Meets annual average acceptable objective.
PM_{10}	24-hour	50 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
$PM_{2.5}$	24-hour	30 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
	Annual	10 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
Dustfall	Annual	Residential: 1.7 mg/dm^2 Industrial: 2.9 mg/dm^2	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.

It is important to note that the receptors inside the mine site boundary were excluded from the comparison (BC MOE, 2008) because air quality at the mine site is subject to work place safety standards during working hours rather than ambient air quality objectives. Additionally, the Project mine site area is restricted to the general public.



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DATE	16DEC'13

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **172 ppbv (~450 µg/m³)**.

CASINO COPPER AND GOLD

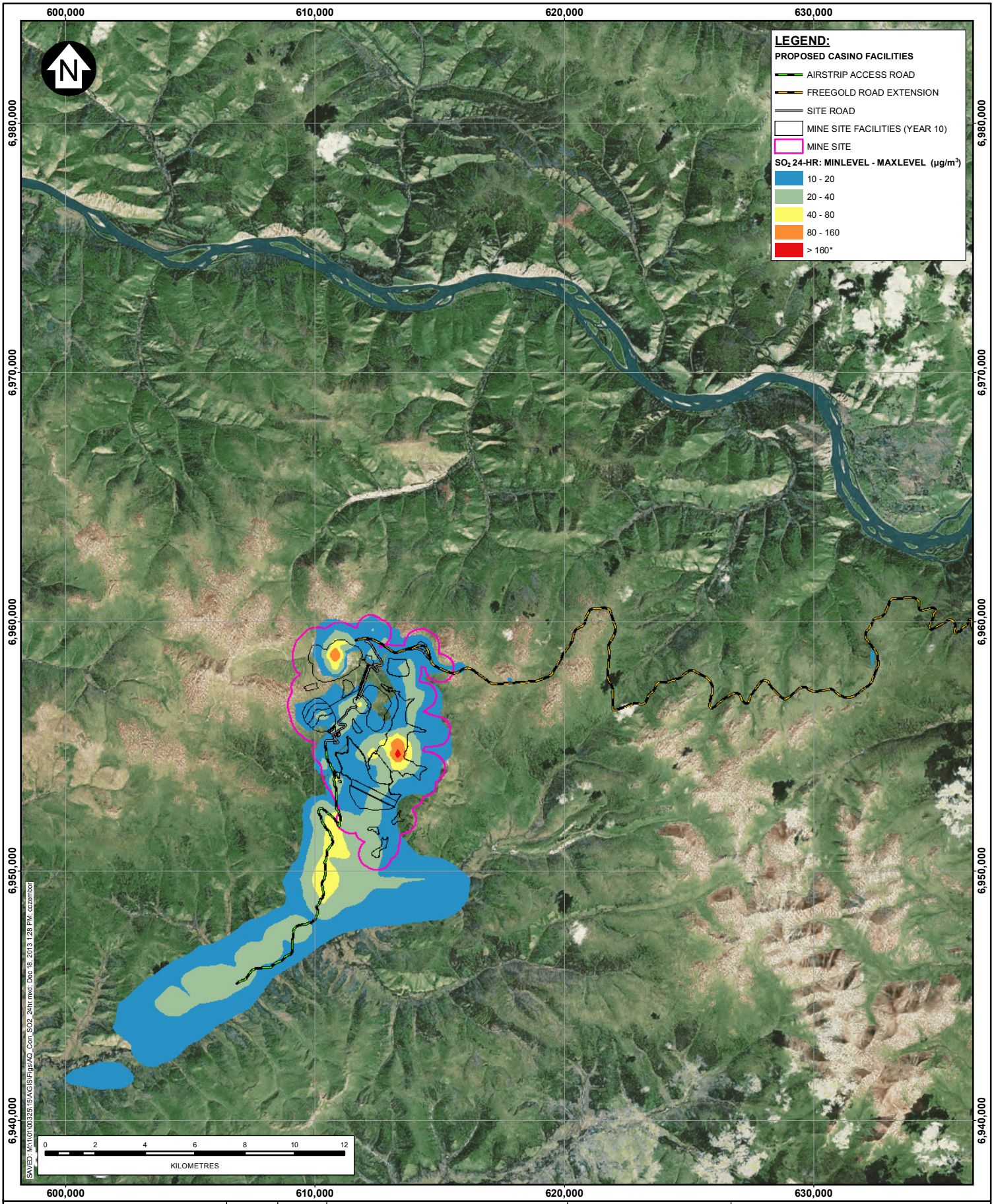
CASINO PROJECT

CONSTRUCTION SO_2 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-1

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **57 ppbv (~160 µg/m³)**.

CASINO COPPER AND GOLD

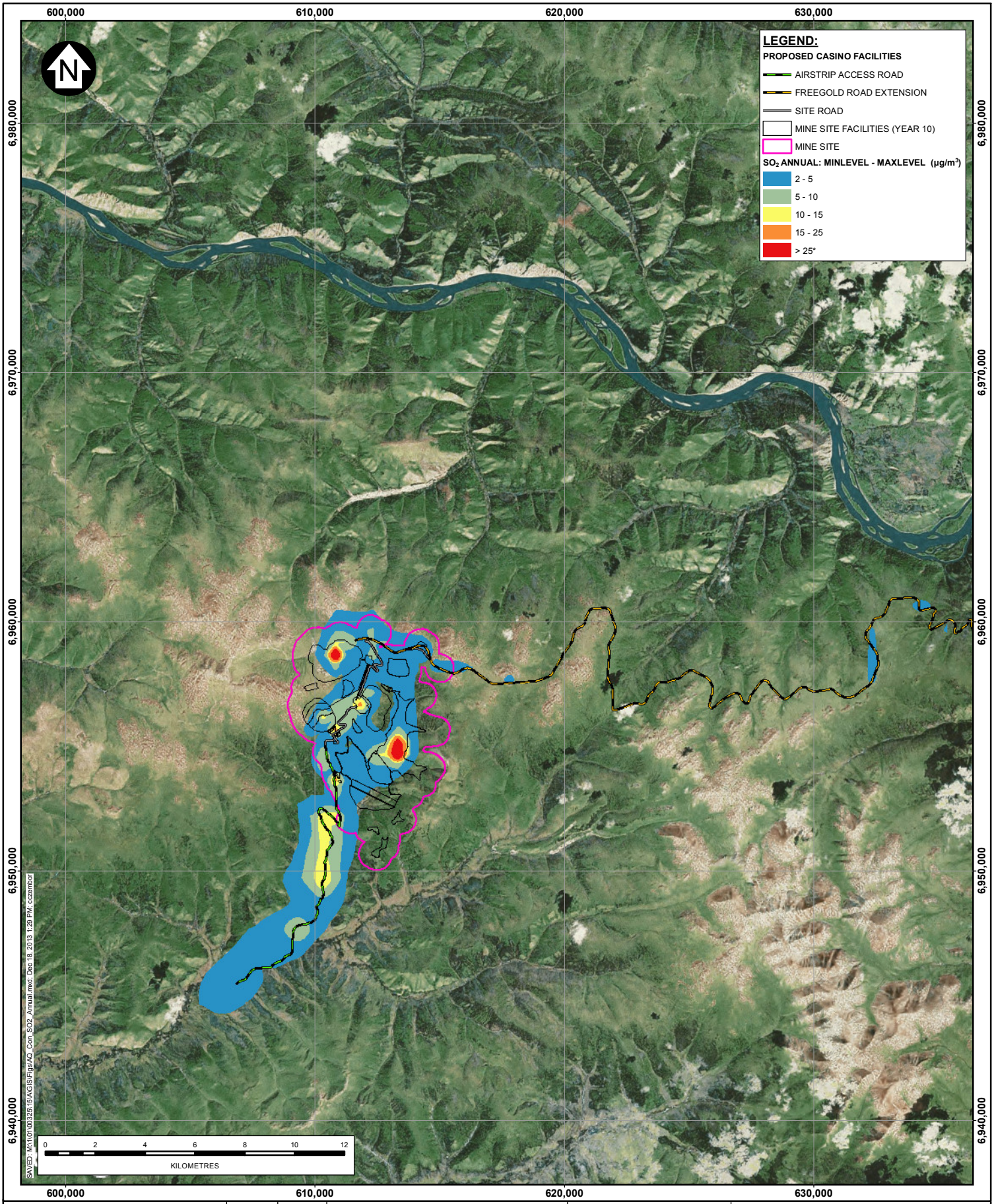
CASINO PROJECT

CONSTRUCTION SO_2 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-2

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 ANNUAL AIR QUALITY STANDARD FOR YUKON IS **11 ppbv (~25 µg/m³)**.

CASINO COPPER AND GOLD

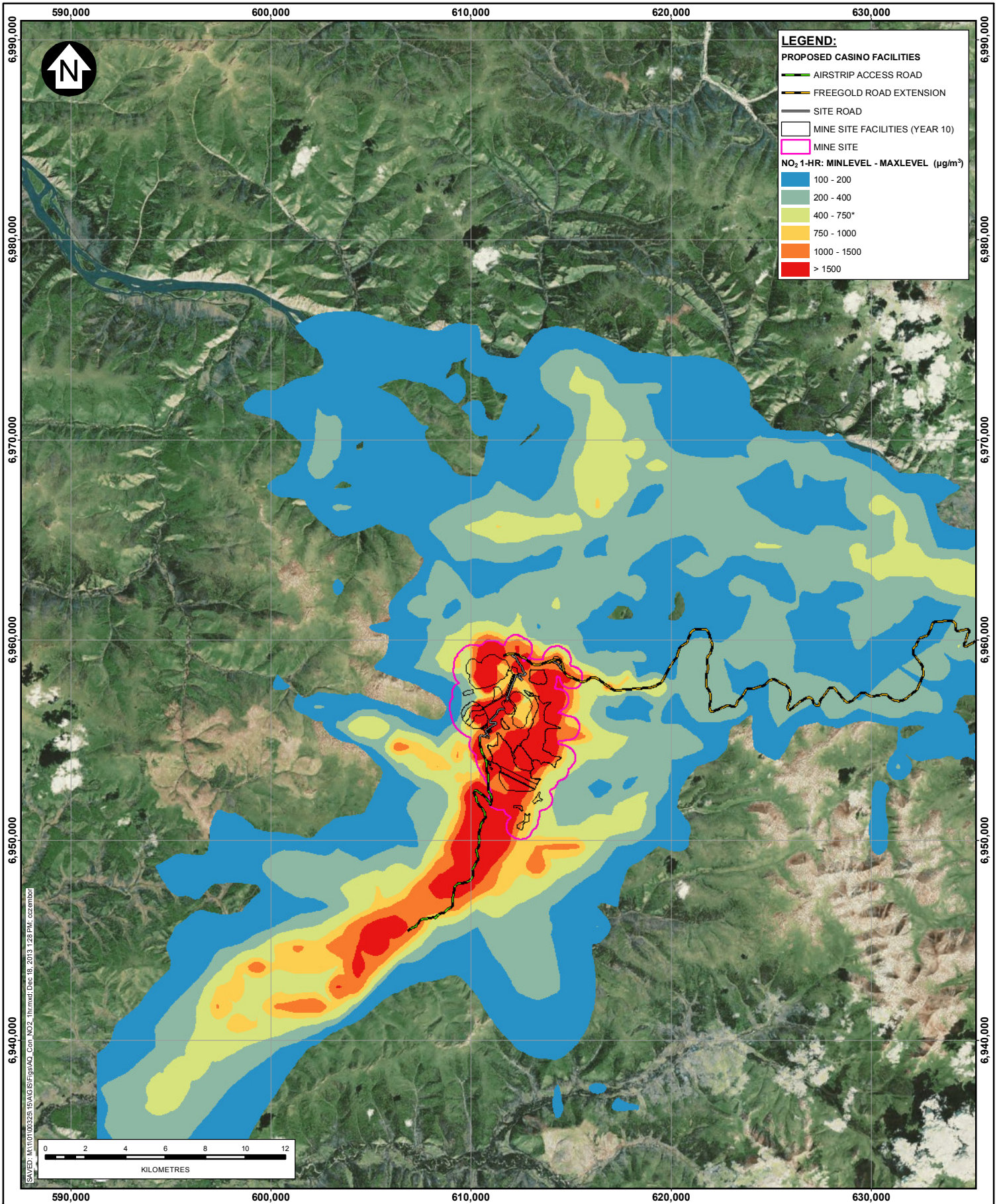
CASINO PROJECT

CONSTRUCTION SO_2 ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-3

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **213 ppbv (400 µg/m³)**.

CASINO COPPER AND GOLD

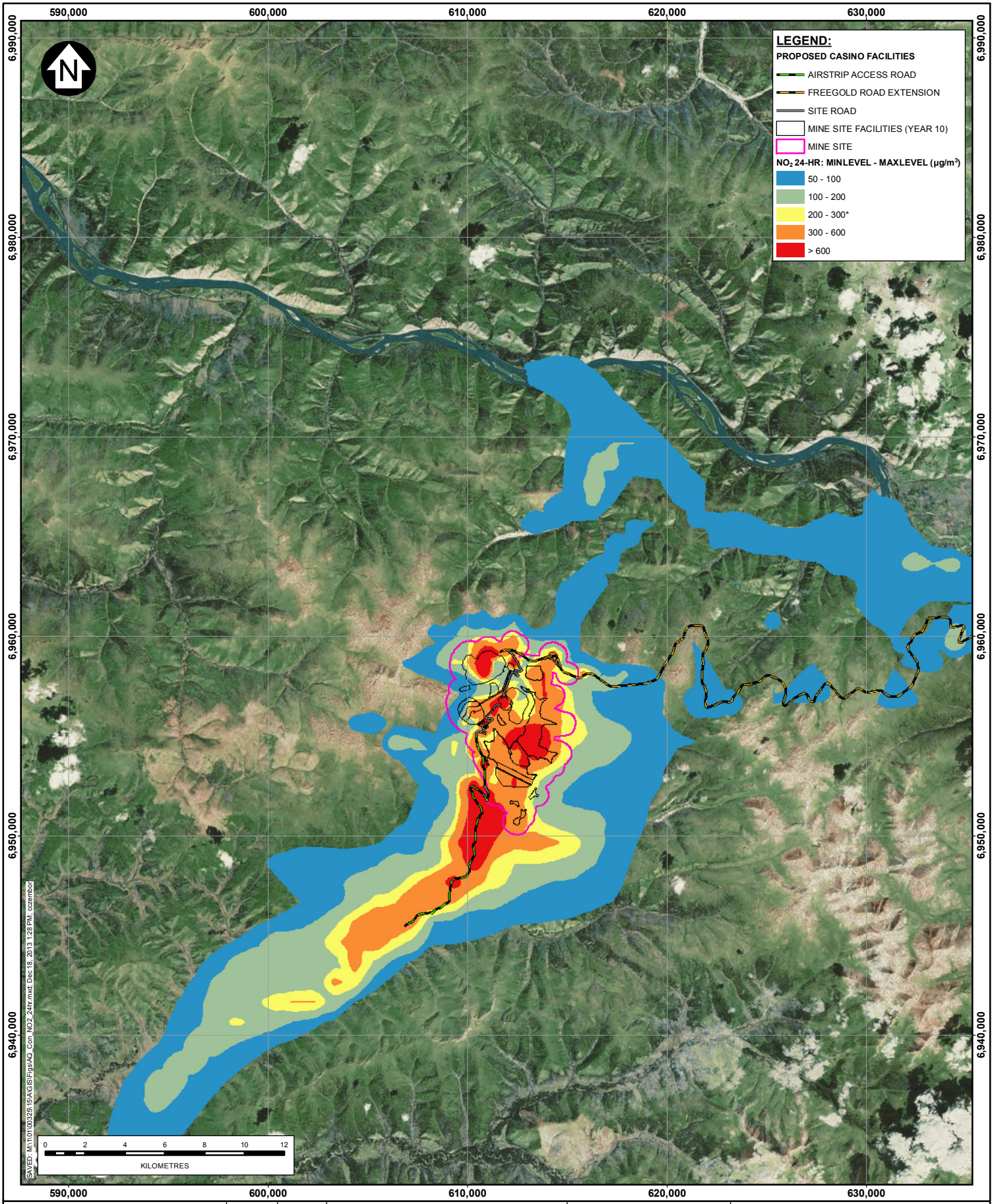
CASINO PROJECT

CONSTRUCTION NO_2 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-4

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **106 ppbv (200 µg/m³)**.

CASINO COPPER AND GOLD

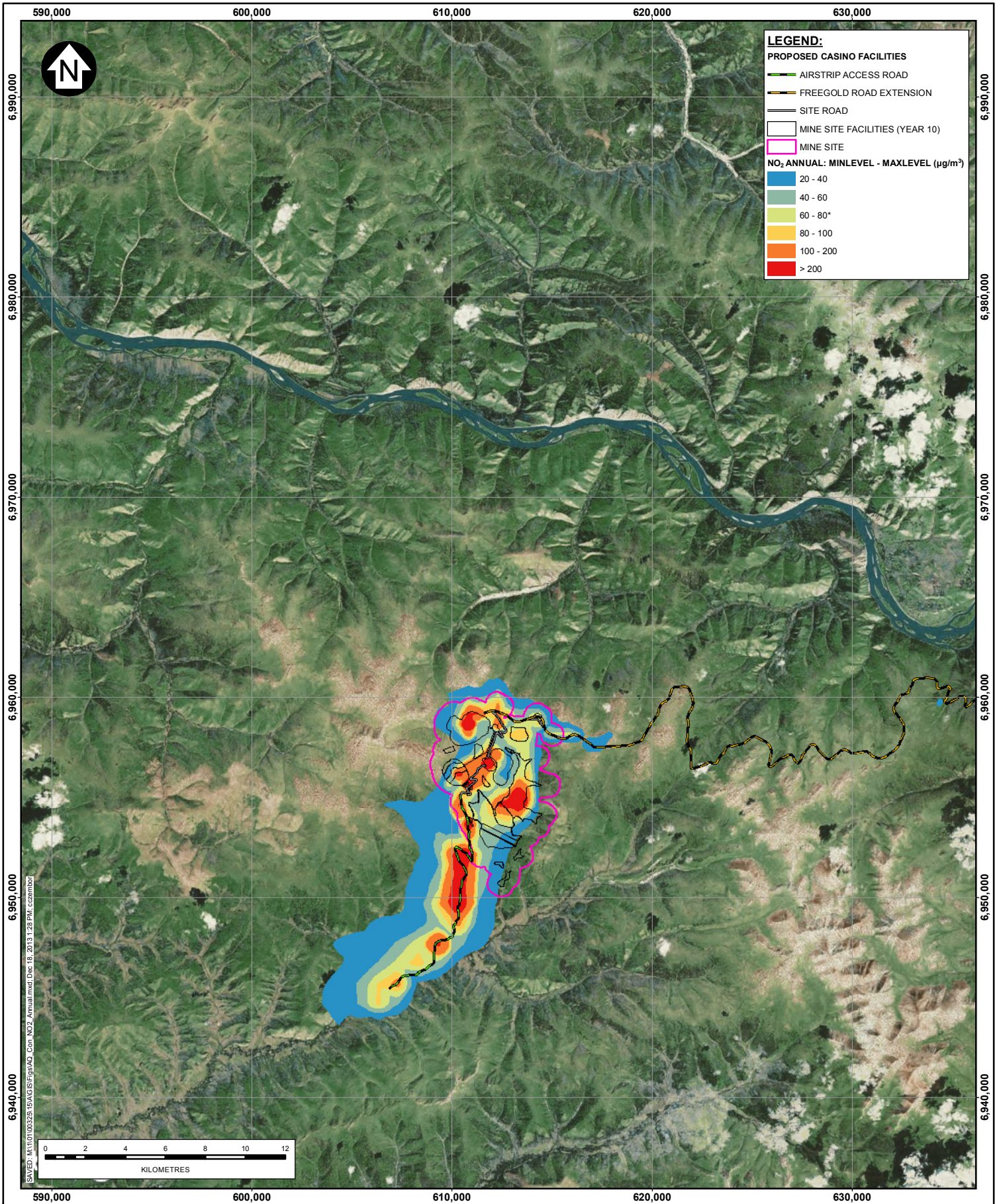
CASINO PROJECT

CONSTRUCTION NO_2 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-5

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 ANNUAL AIR QUALITY STANDARD FOR YUKON IS **32 ppbv (60 µg/m^3)**.

CASINO COPPER AND GOLD

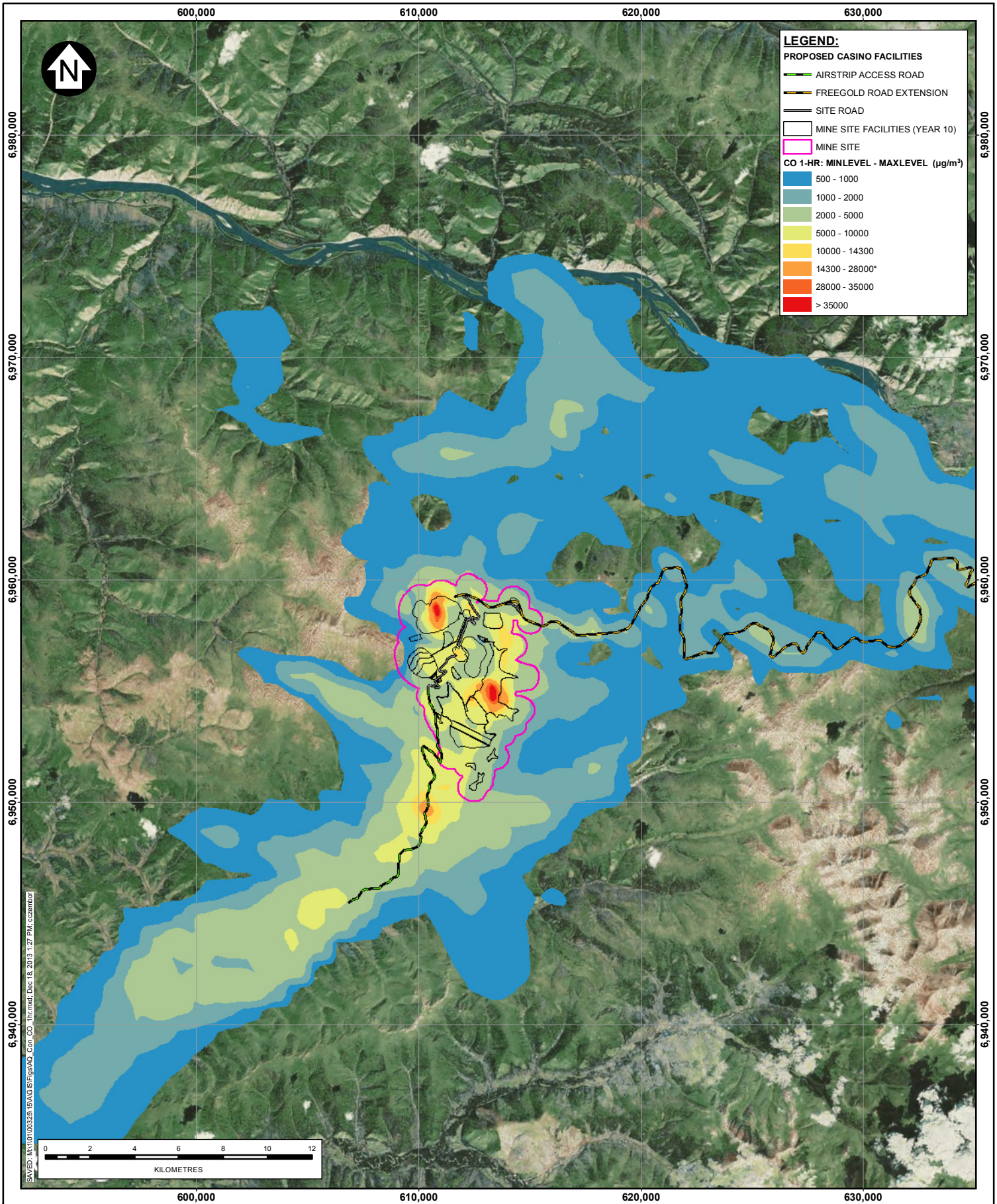
CASINO PROJECT

CONSTRUCTION NO_2 ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-6

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. CO 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **13 ppm (14,300 µg/m³)**.

CASINO COPPER AND GOLD

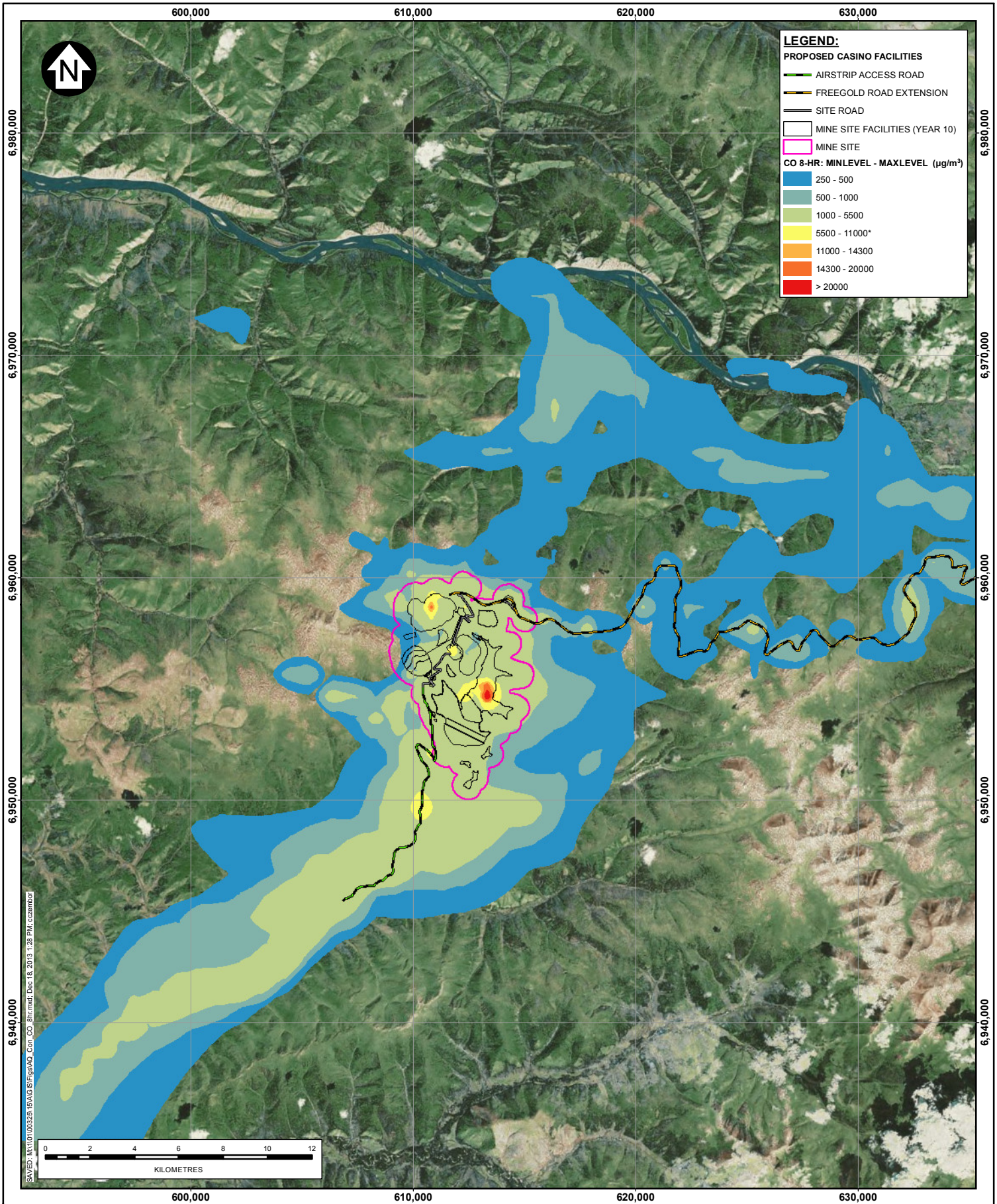
CASINO PROJECT

CONSTRUCTION CO 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-7

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. CO 8-HOUR AIR QUALITY STANDARD FOR YUKON IS **5 ppm (5,500 µg/m³)**.

CASINO COPPER AND GOLD

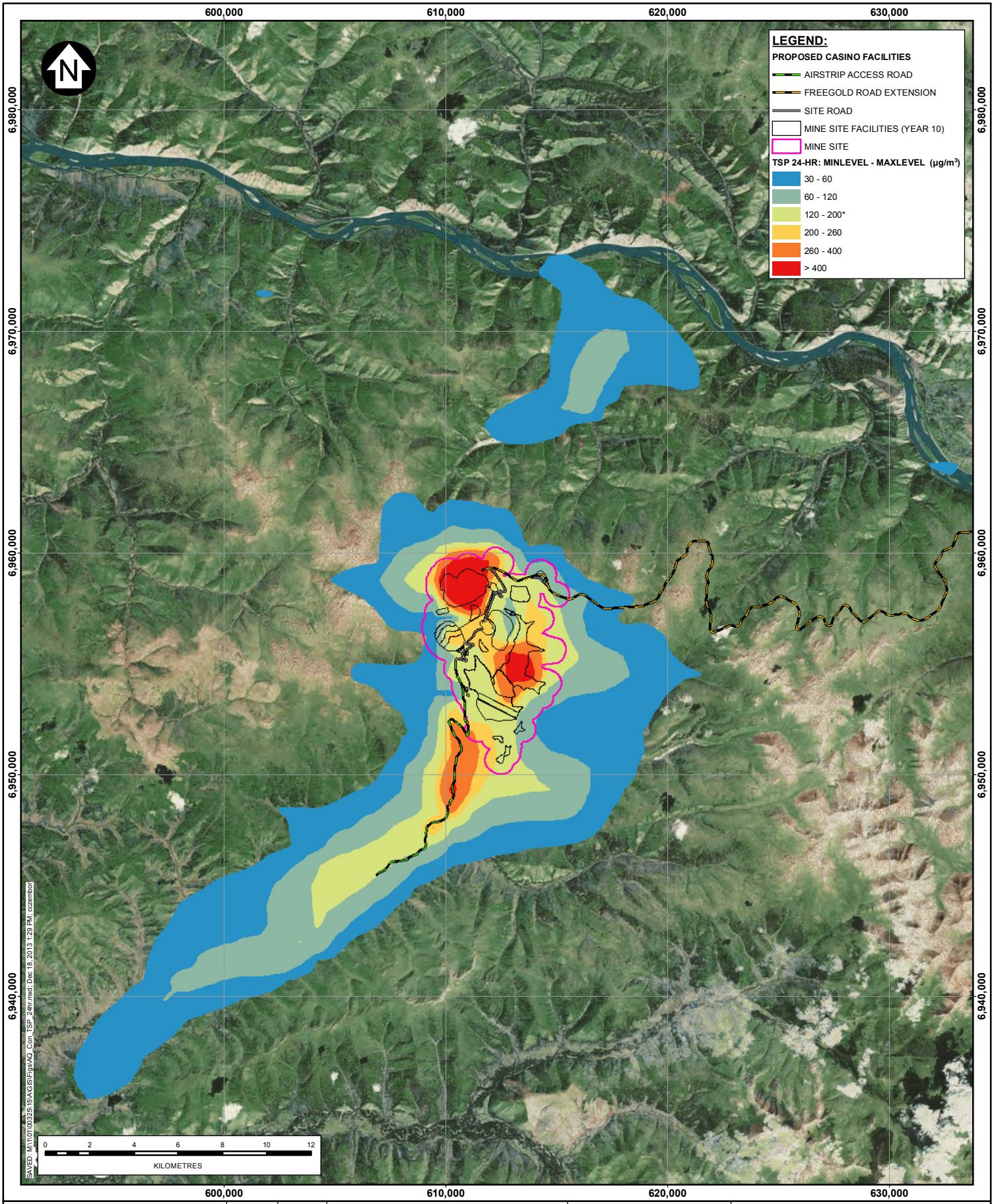
CASINO PROJECT

CONSTRUCTION CO 8-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-8

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NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. TSP 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **120 µg/m³**.

CASINO COPPER AND GOLD

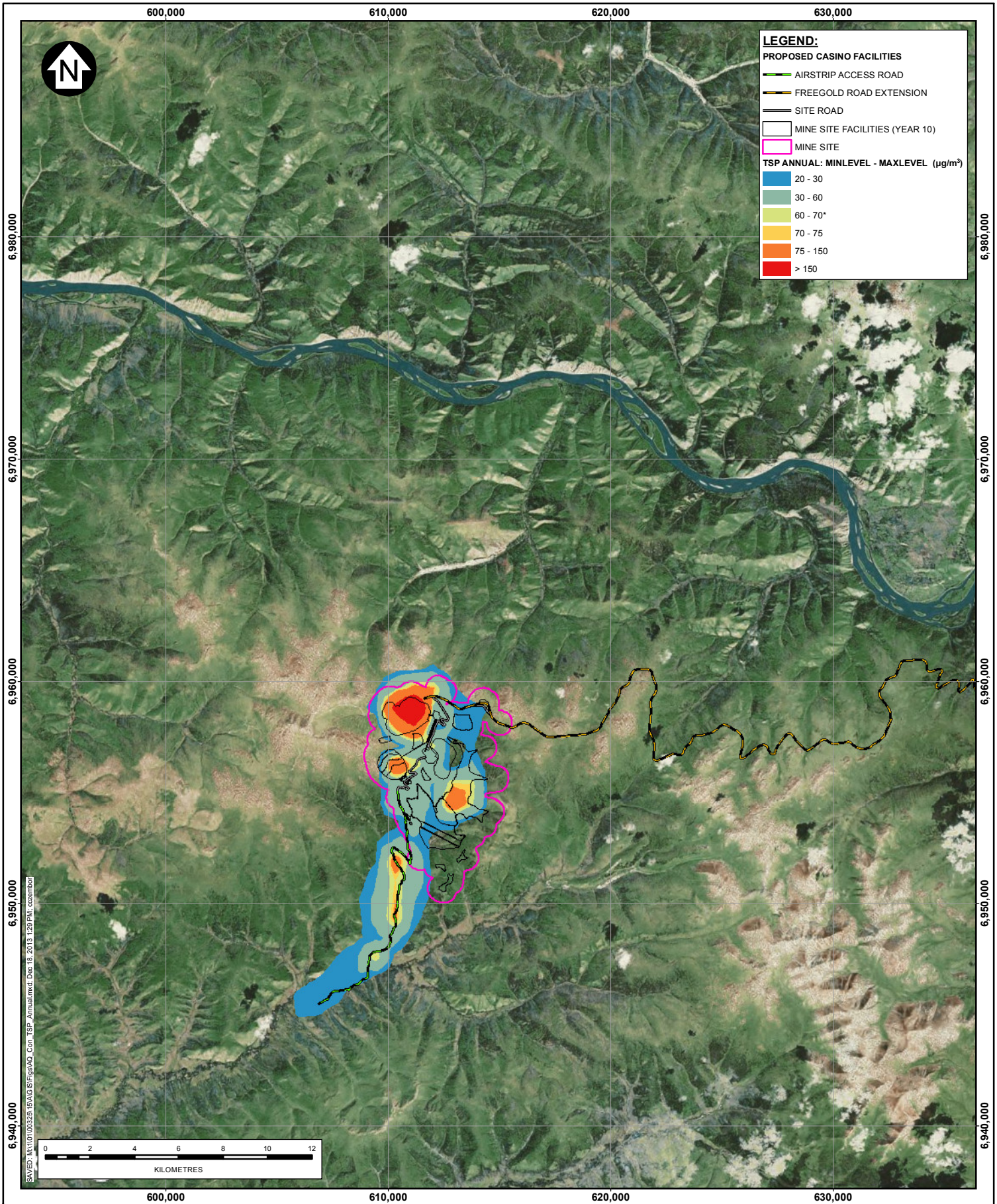
CASINO PROJECT

CONSTRUCTION TSP 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-9

REF 1

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NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. TSP ANNUAL AIR QUALITY STANDARD FOR YUKON IS **60 µg/m³**.

CASINO COPPER AND GOLD

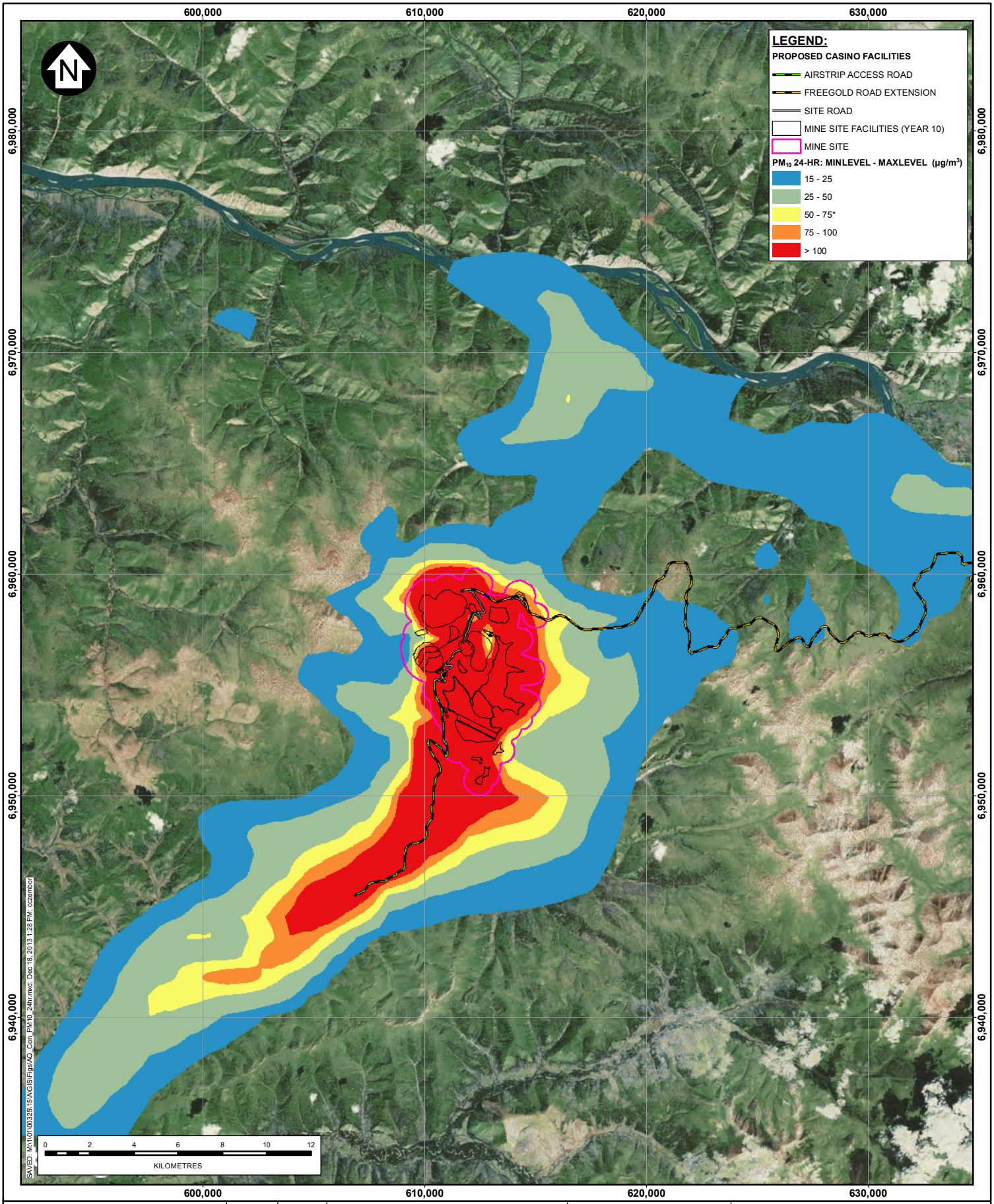
CONSTRUCTION TSP ANNUAL AVERAGE CONCENTRATIONS

CASINO PROJECT

FIGURE 8.4-10

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. PM_{10} 24-HOUR AIR QUALITY STANDARD FOR BC IS **50 µg/m³**.

CASINO COPPER AND GOLD

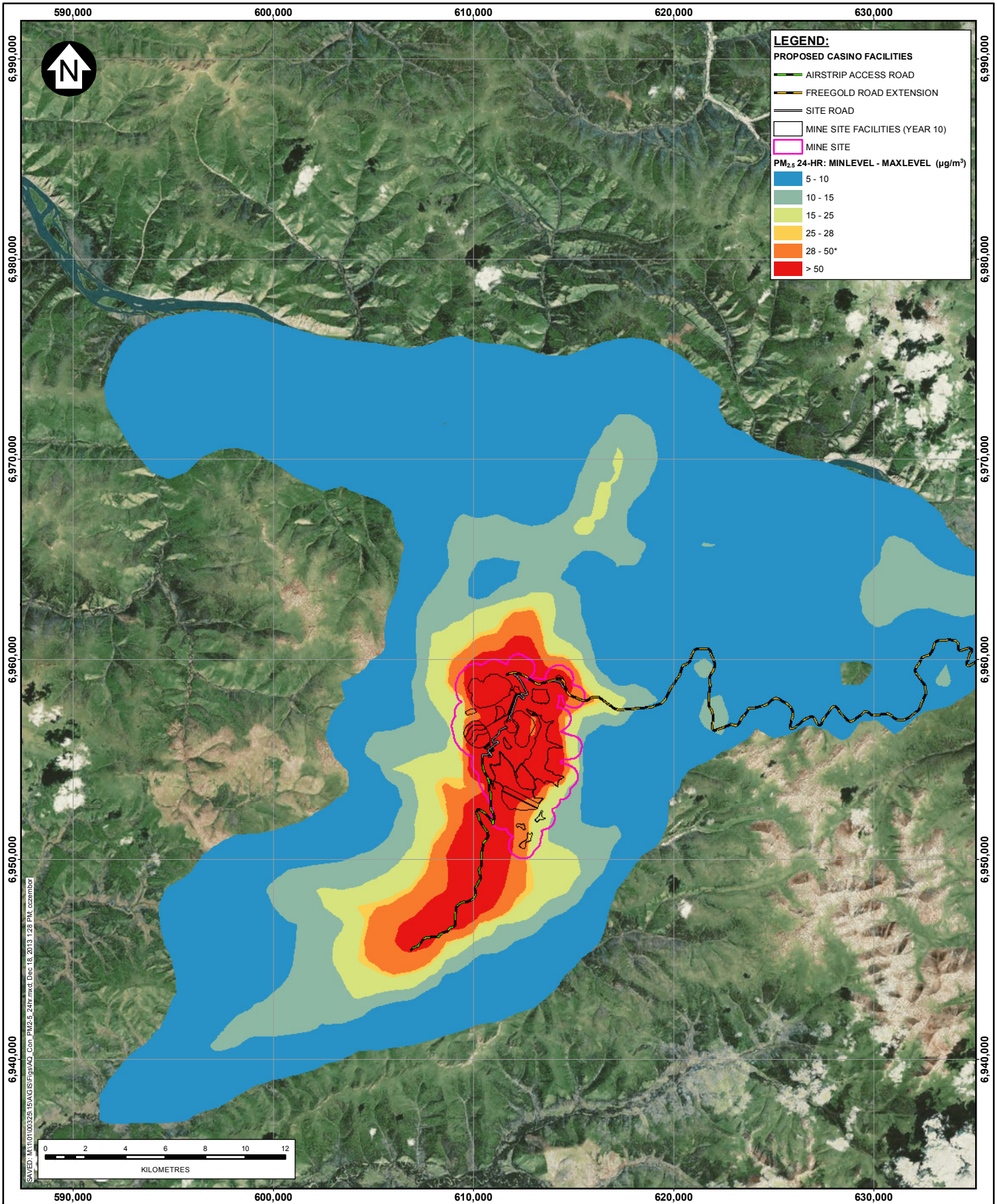
CASINO PROJECT

CONSTRUCTION PM_{10} 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-11

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. $PM_{2.5}$ 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **30 µg/m³**.

CASINO COPPER AND GOLD

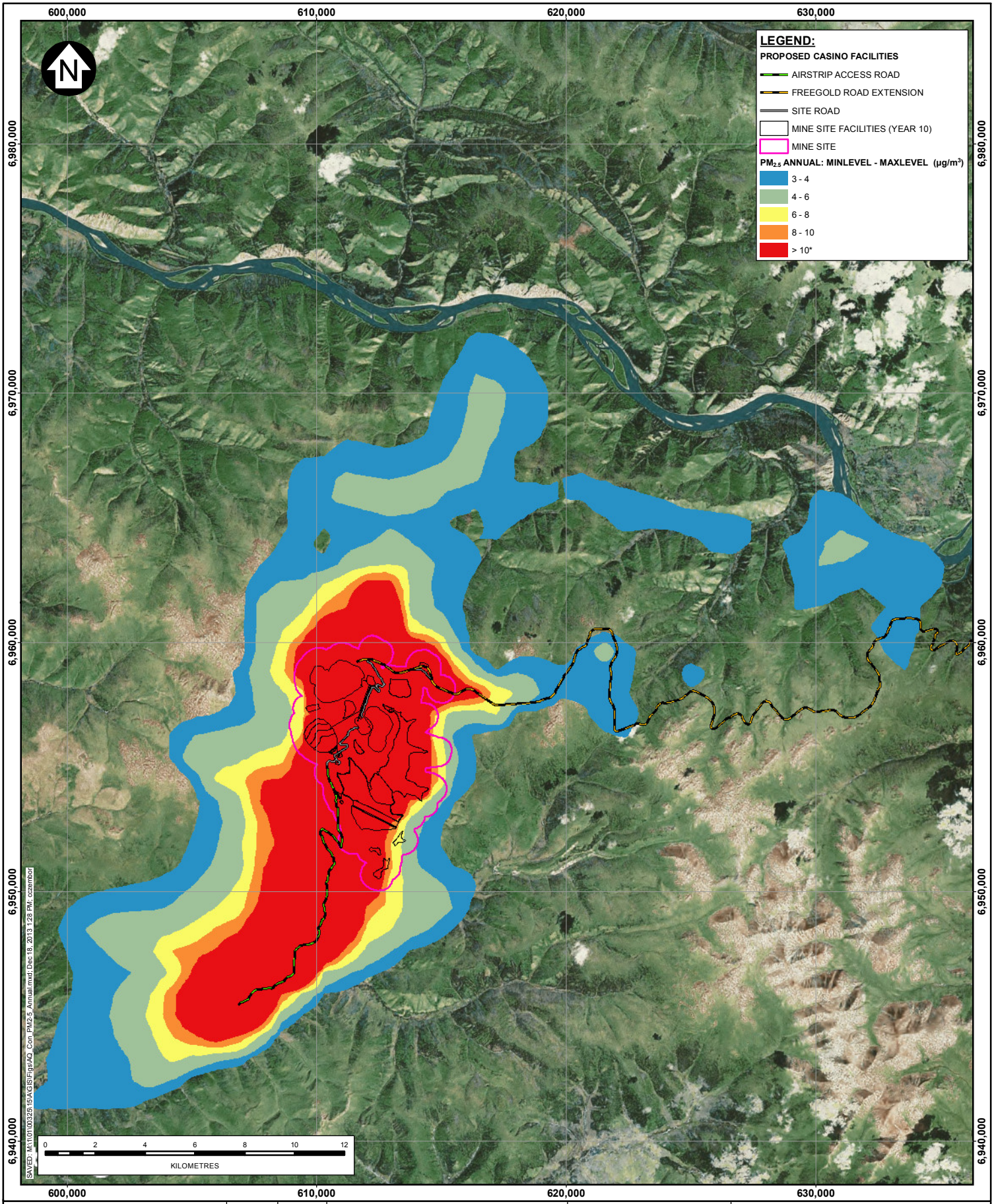
CASINO PROJECT

CONSTRUCTION $PM_{2.5}$ 24-HOUR MAXIMUM CONCENTRATIONS (98TH) PERCENTILE

FIGURE 8.4-12

REF 1

P/A VA101-325/15



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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. $PM_{2.5}$ ANNUAL AIR QUALITY STANDARD FOR CANADA IS **10 µg/m³**.

CASINO COPPER AND GOLD

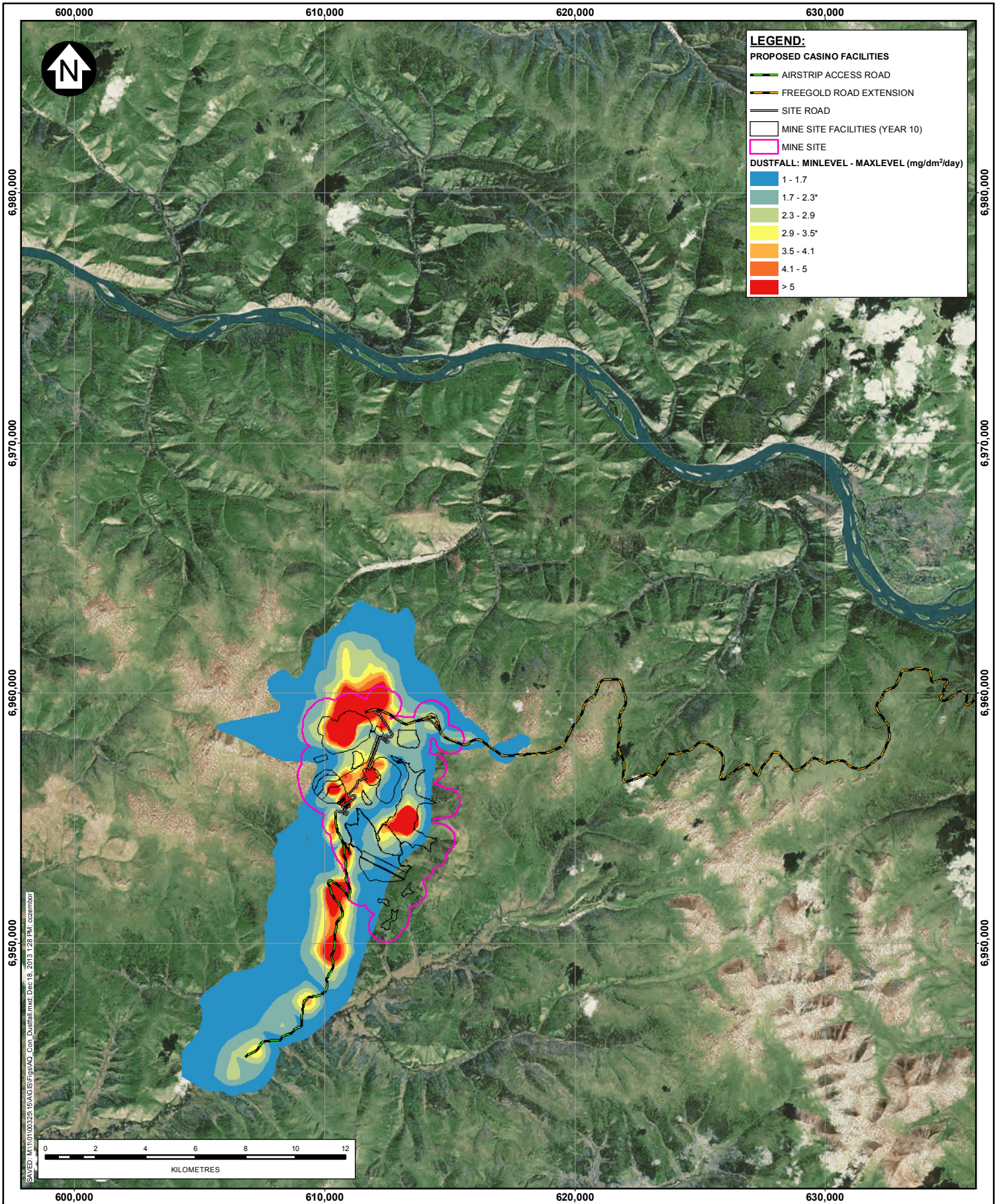
CASINO PROJECT

CONSTRUCTION $PM_{2.5}$ ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-13

REF 1

P/A VA101-325/15



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DATE	16DEC'13

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. DUSTFALL MONTHLY AIR QUALITY STANDARD FOR BC IS **1.7 mg/dm²/day (LOWER) - 2.9 mg/dm²/day (UPPER)**.

CASINO COPPER AND GOLD

CASINO PROJECT

CONSTRUCTION DUSTFALL AVERAGE DAILY DEPOSITION RATES

FIGURE 8.4-14

REF 1

P/A VA101-325/15

Operation Phase

In general, the dispersion modelling and predictions indicated that the Project Case for the Operation Phase of the Project will comply with the guidelines outlined in Table 8.4-1. A summary of the results is presented in Table 8.4-4.

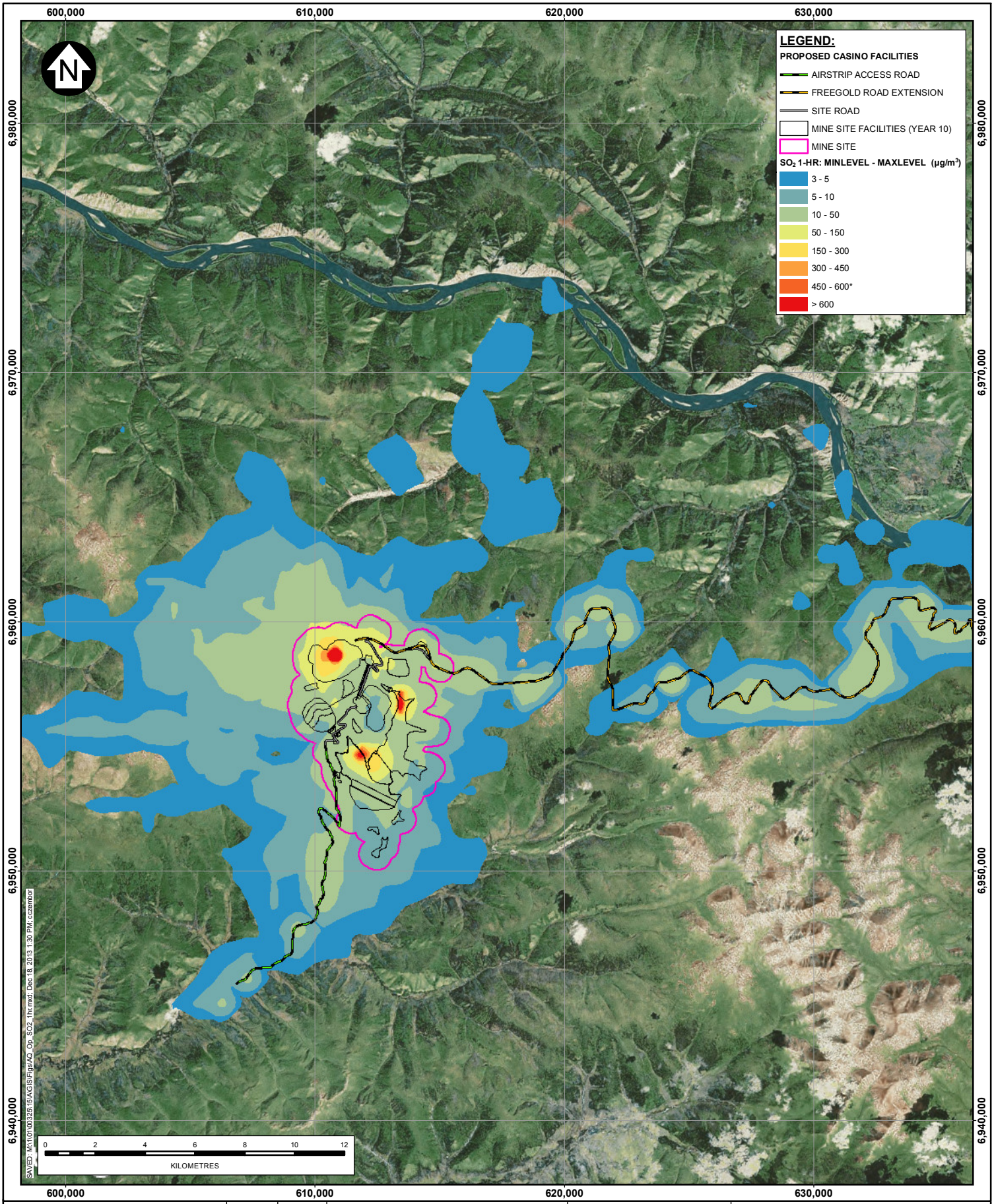
During the Operation Phase, the main contributors to emissions are the Power Plant, Open Pit activities, and Unpaved Roads. The concentrations in the LSA are shown on Figure 8.4-15 to Figure 8.4-28.

SO_2 and CO levels do not show any exceedances within the mine site and at the Freegold Road. NO_2 levels show exceedances throughout the mine site and extending out into portions of the Freegold Road immediately east of the mine site. This is due to the consumption of LNG at the power plant which is common at large gas-fired power plants.

TSP and dustfall levels show minor exceedances within the mine site but not at the Freegold Road. PM_{10} and $PM_{2.5}$ levels show exceedances throughout the mine site and extending out into portions of the Freegold Road immediately east of the mine site. This is due to the consumption of LNG at the power plant.

Table 8.4-4 Summary of Operation Phase Predictions

Air Contaminate	Averaging Period	Guideline	Predicted Air Quality	
			Casino Mine Site	Freegold Road
SO_2	1-hour	450 µg/m^3	Minor exceedances at Open Pit, north end of Waste Storage Area and Non-PAG Tailings Area.	Meets maximum 1-hour acceptable objective.
	24-hour	160 µg/m^3	Minor exceedances at Open Pit, north end of Waste Storage Area and Non-PAG Tailings Area.	Meets maximum 24-hour acceptable objective.
	Annual	25 µg/m^3	Minor exceedances at Open Pit, north end of Waste Storage Area and Non-PAG Tailings Area.	Meets annual average acceptable objective.
NO_2	1-hour	213 ppb (400 µg/m^3)	Exceedances seen throughout mine site.	Exceedances seen at western end of road near entrance to mine site.
	24-hour	106 ppb (200 µg/m^3)	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
	Annual	32 ppb (60 µg/m^3)	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
CO	1-hour	13,000 ppb (14,300 µg/m^3)	Exceedances at Open Pit, north end of Waste Storage Area and PAG and Non-PAG Tailings Area.	Meets maximum 1-hour acceptable objective.
	8-hour	5,000 ppb (5,500 µg/m^3)	Exceedances at Open Pit, north end of Waste Storage Area and PAG and Non-PAG Tailings Area.	Meets maximum 8-hour acceptable objective.
TSP	24-hour	120 µg/m^3 *	Exceedances at Open Pit, north end of Waste Storage Area and PAG and Non-PAG Tailings Area.	Meets maximum 24-hour acceptable objective.
	Annual	60 µg/m^3	Minor exceedances at Open Pit, north end of Waste Storage Area and PAG and Non-PAG Tailings Area.	Meets annual average acceptable objective.
PM_{10}	24-hour	50 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
$PM_{2.5}$	24-hour	30 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
	Annual	10 µg/m^3	Exceedances seen throughout mine site.	Minor exceedances seen at western end of road near entrance to mine site.
Dustfall	Annual	Residential: 1.7 mg/dm^2 Industrial: 2.9 mg/dm^2	Minor exceedances at Open Pit, north end of Waste Storage Area and Non-PAG Tailings Area.	Meets annual average acceptable objective.



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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **172 ppbv (~450 µg/m³)**.

CASINO COPPER AND GOLD

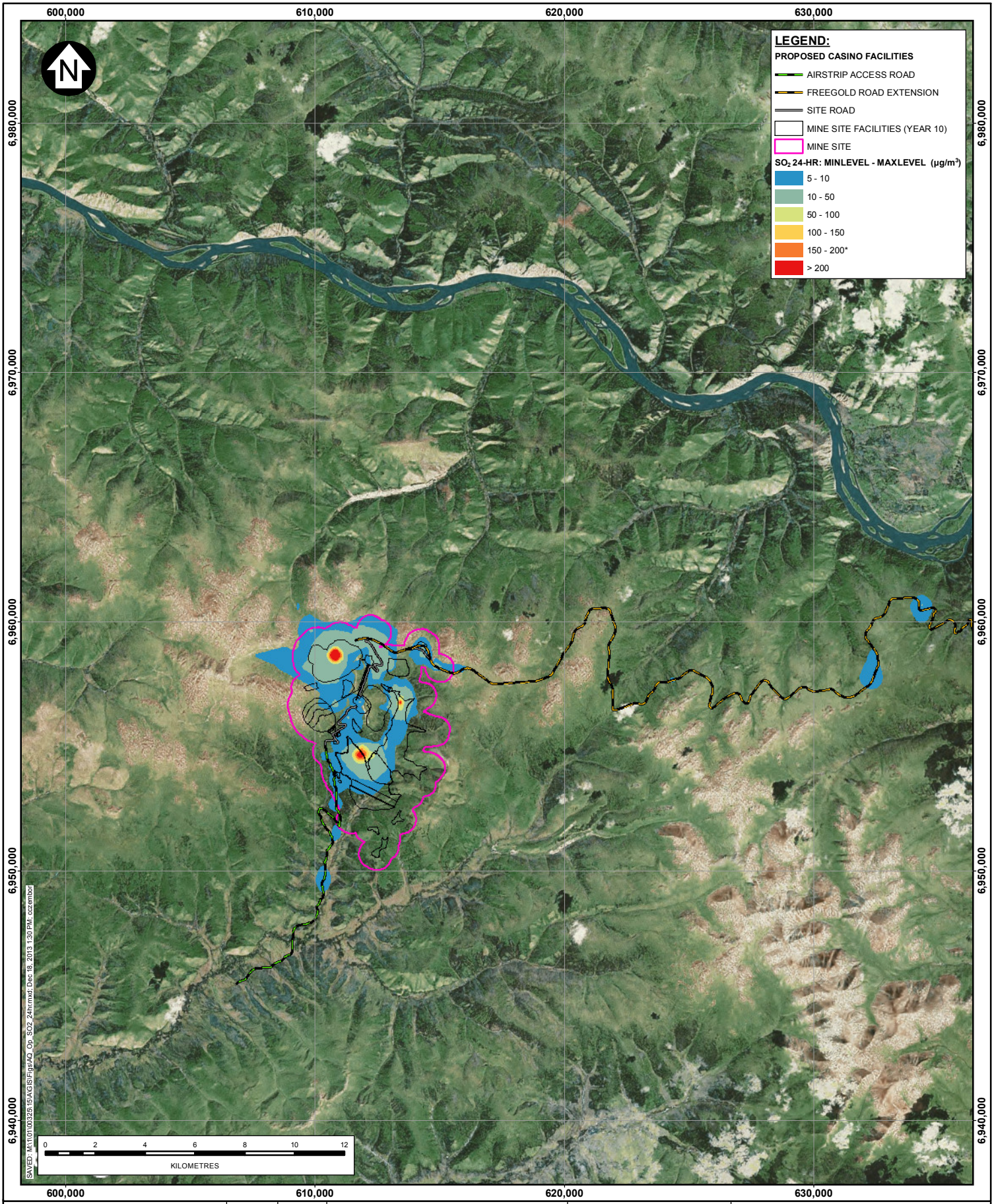
CASINO PROJECT

OPERATION SO_2 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-15

REF 1

P/A VA101-325/15



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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **57 ppbv (~160 µg/m³)**.

CASINO COPPER AND GOLD

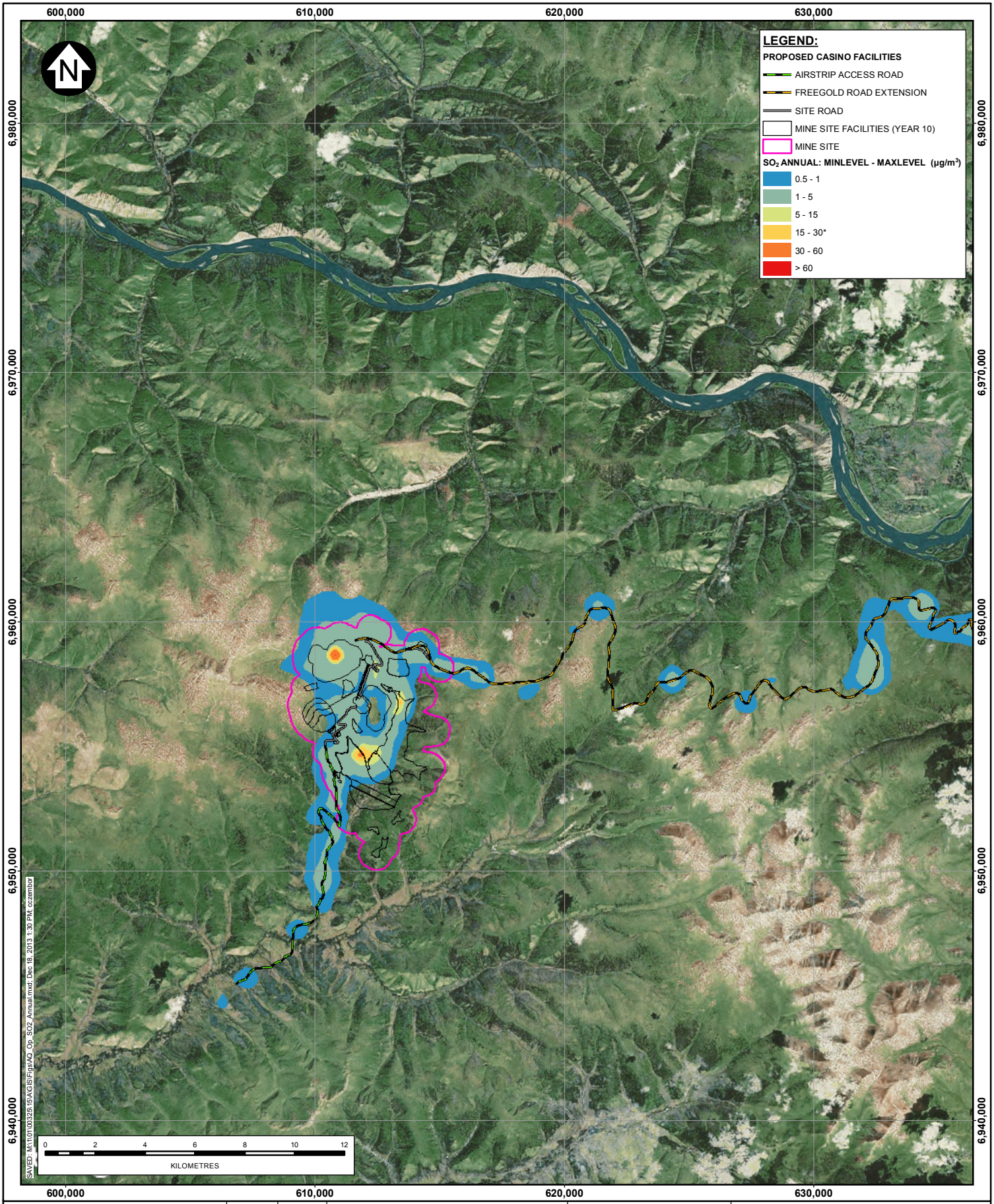
CASINO PROJECT

OPERATION SO_2 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-16

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. SO_2 ANNUAL AIR QUALITY STANDARD FOR YUKON IS **11 ppbv (~25 µg/m³)**.

CASINO COPPER AND GOLD

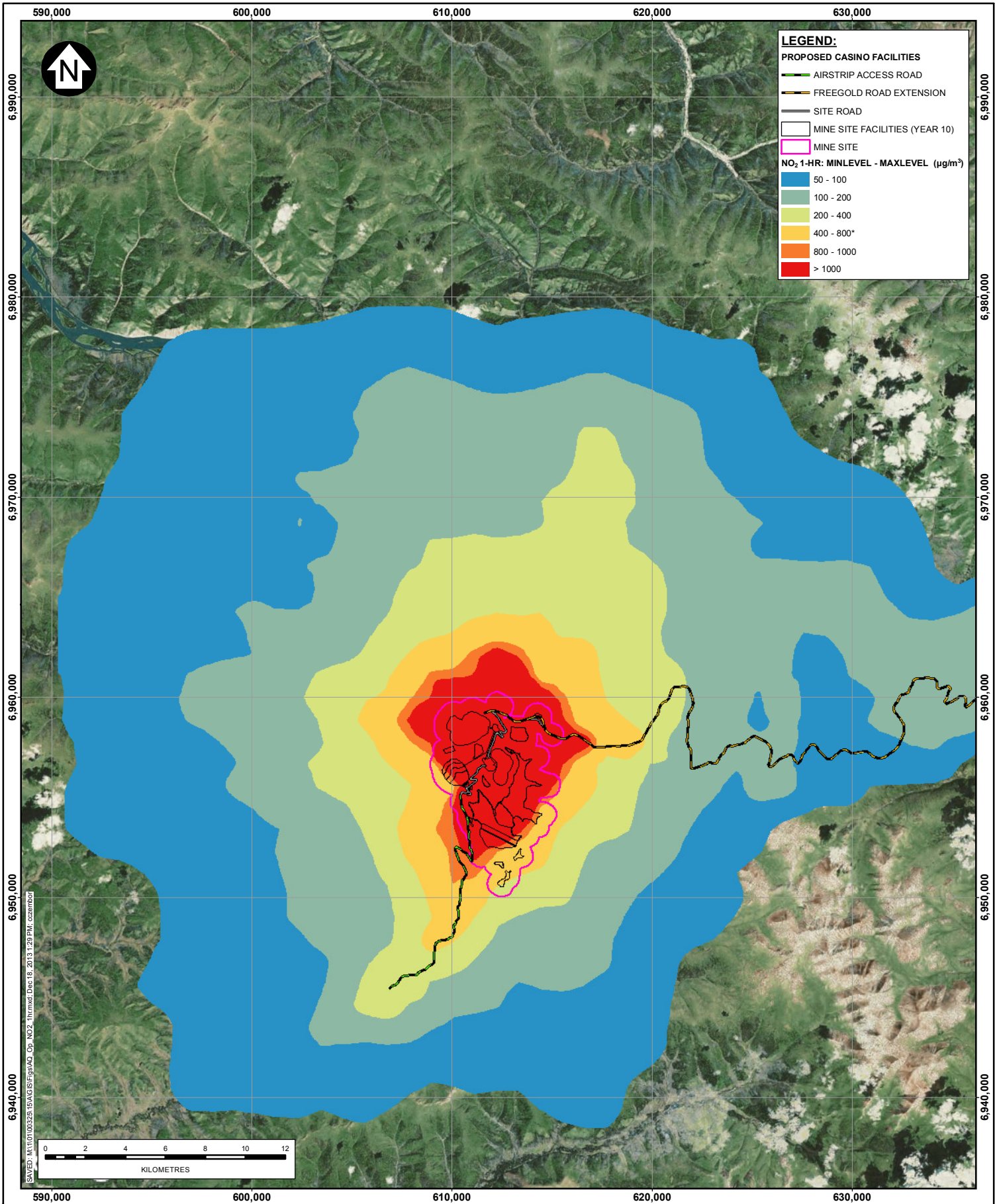
CASINO PROJECT

OPERATION SO_2 ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-17

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **213 ppbv (400 µg/m³)**.

CASINO COPPER AND GOLD

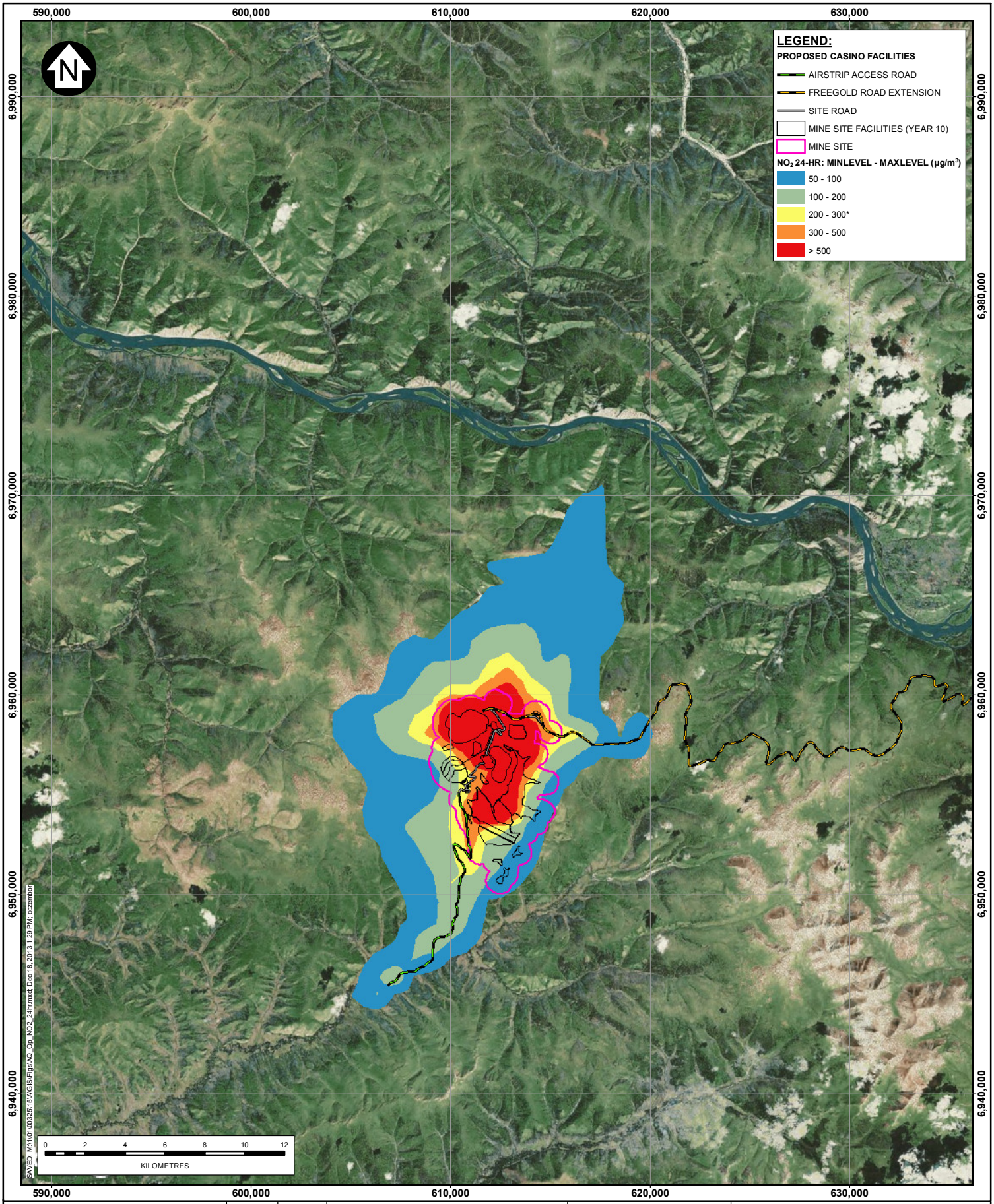
CASINO PROJECT

OPERATION NO_2 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-18

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **106 ppbv (200 µg/m³)**.

CASINO COPPER AND GOLD

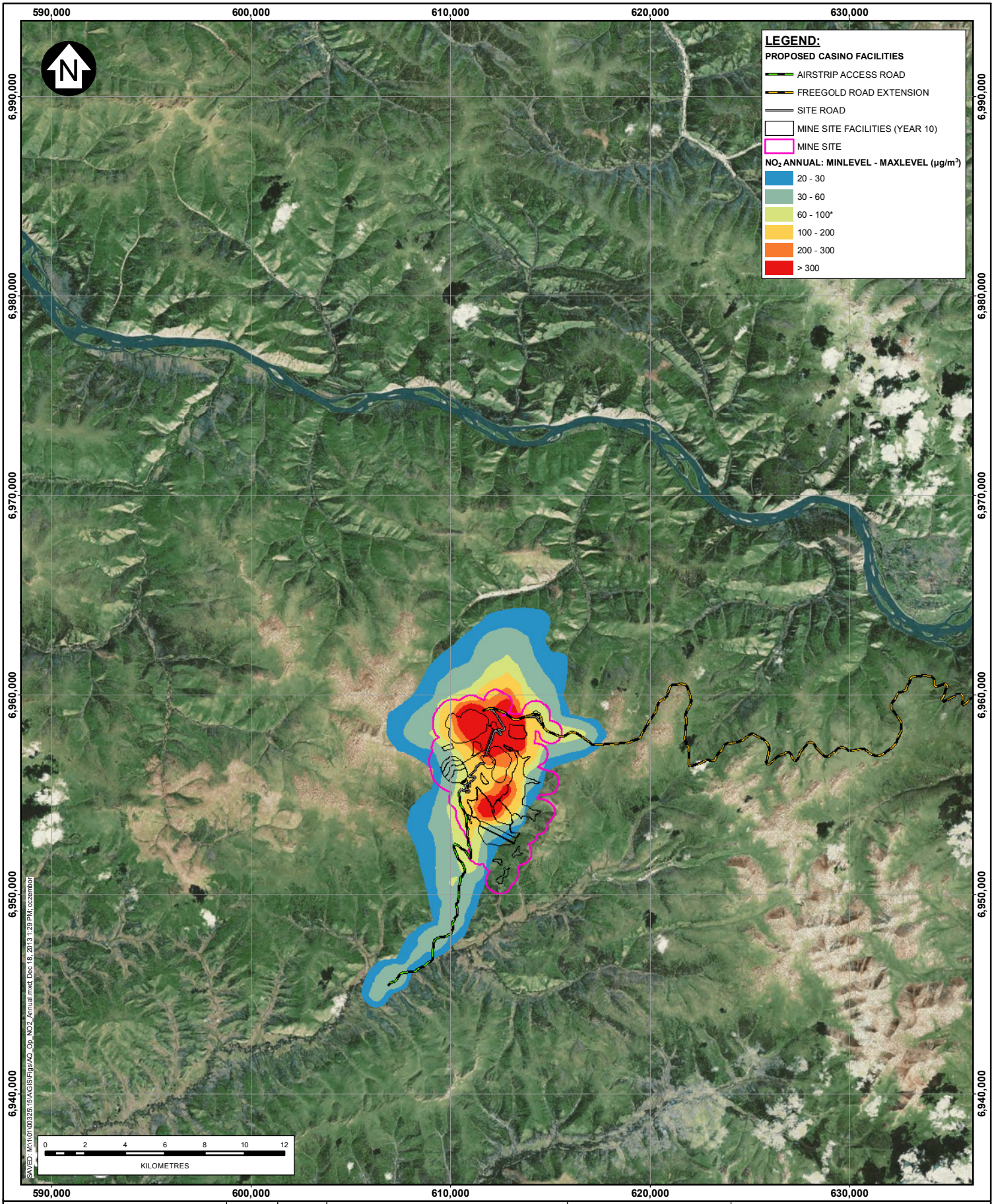
CASINO PROJECT

OPERATION NO_2 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-19

REF 1

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DATE	16DEC'13

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. NO_2 ANNUAL AIR QUALITY STANDARD FOR YUKON IS **32 ppbv (60 µg/m^3)**.

CASINO COPPER AND GOLD

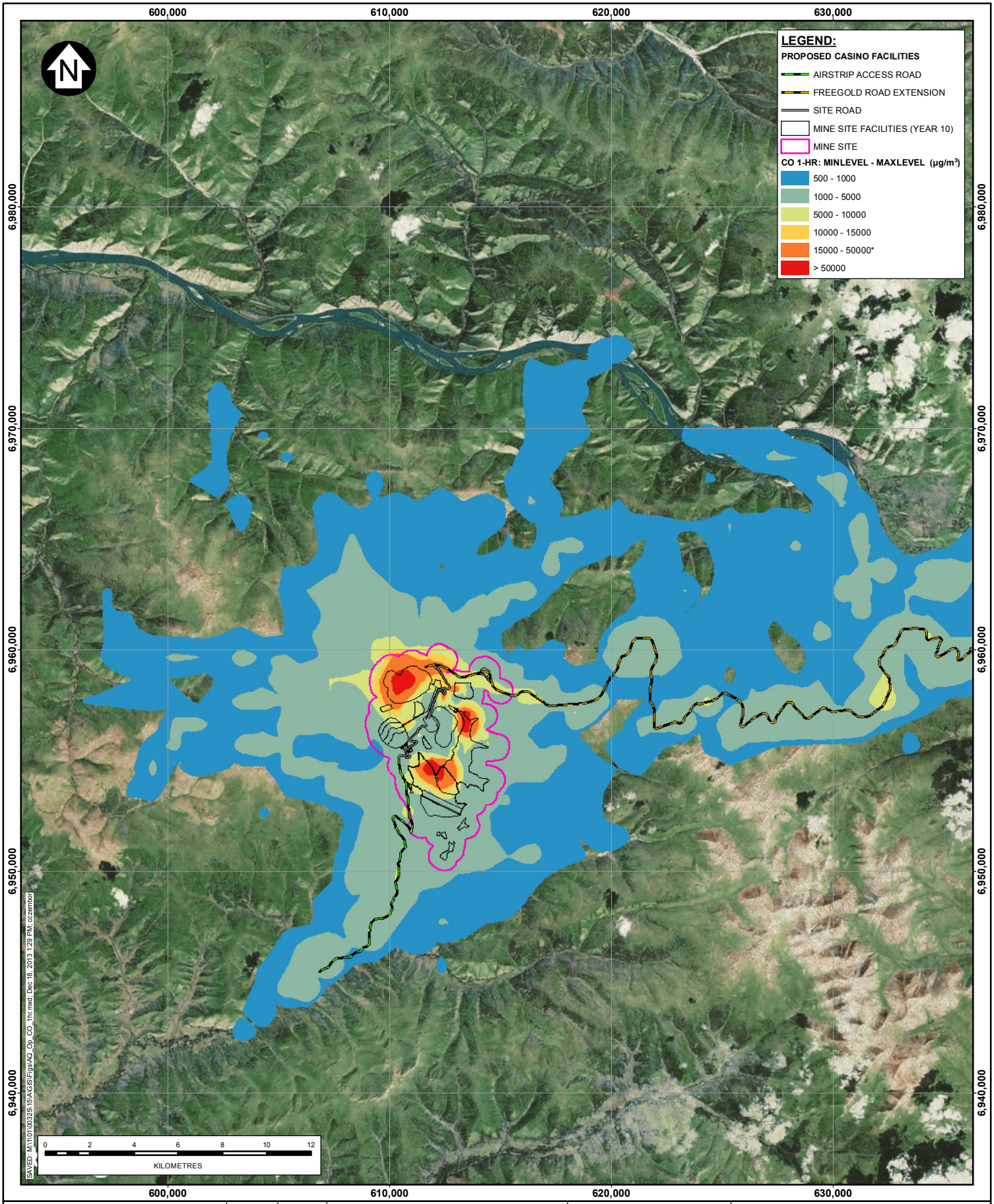
CASINO PROJECT

OPERATION NO_2 ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-20

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. CO 1-HOUR AIR QUALITY STANDARD FOR YUKON IS **13 ppm (14,300 µg/m³)**.

CASINO COPPER AND GOLD

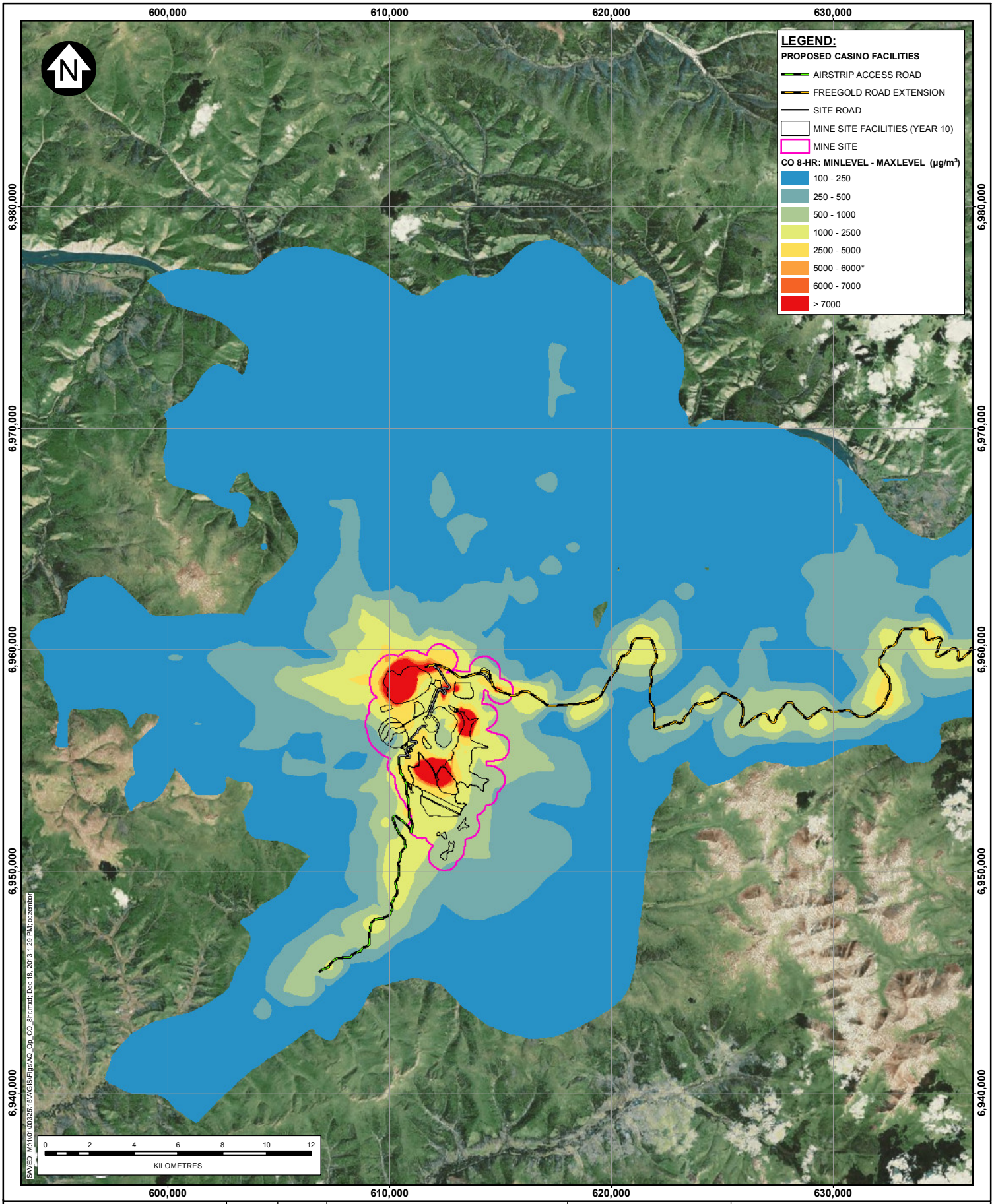
CASINO PROJECT

OPERATION CO 1-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-21

REF 1

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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. CO 8-HOUR AIR QUALITY STANDARD FOR YUKON IS **5 ppm (5,500 µg/m³)**.

CASINO COPPER AND GOLD

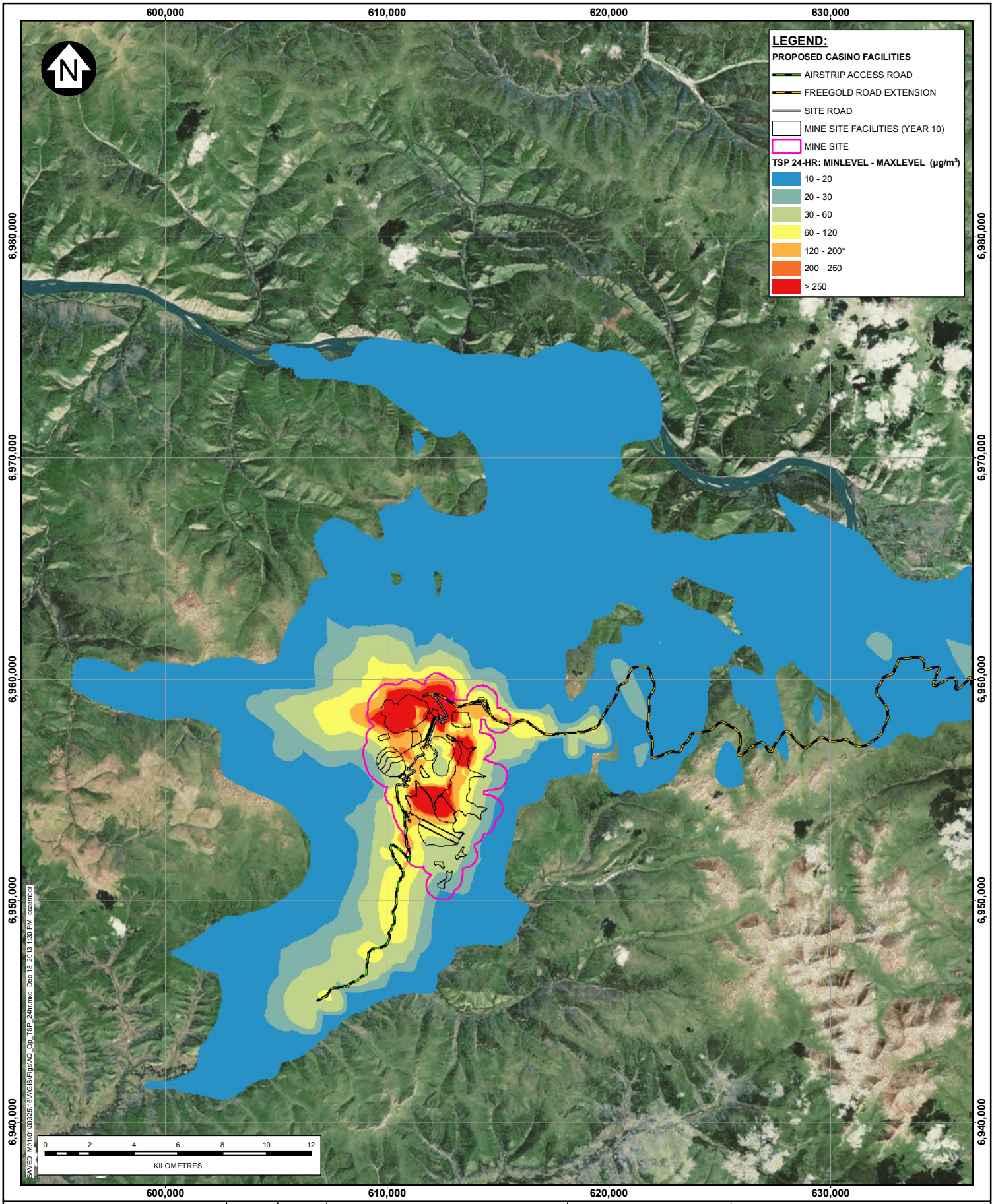
CASINO PROJECT

OPERATION CO 8-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-22

REF 1

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DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. TSP 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **120 µg/m³**.

CASINO COPPER AND GOLD

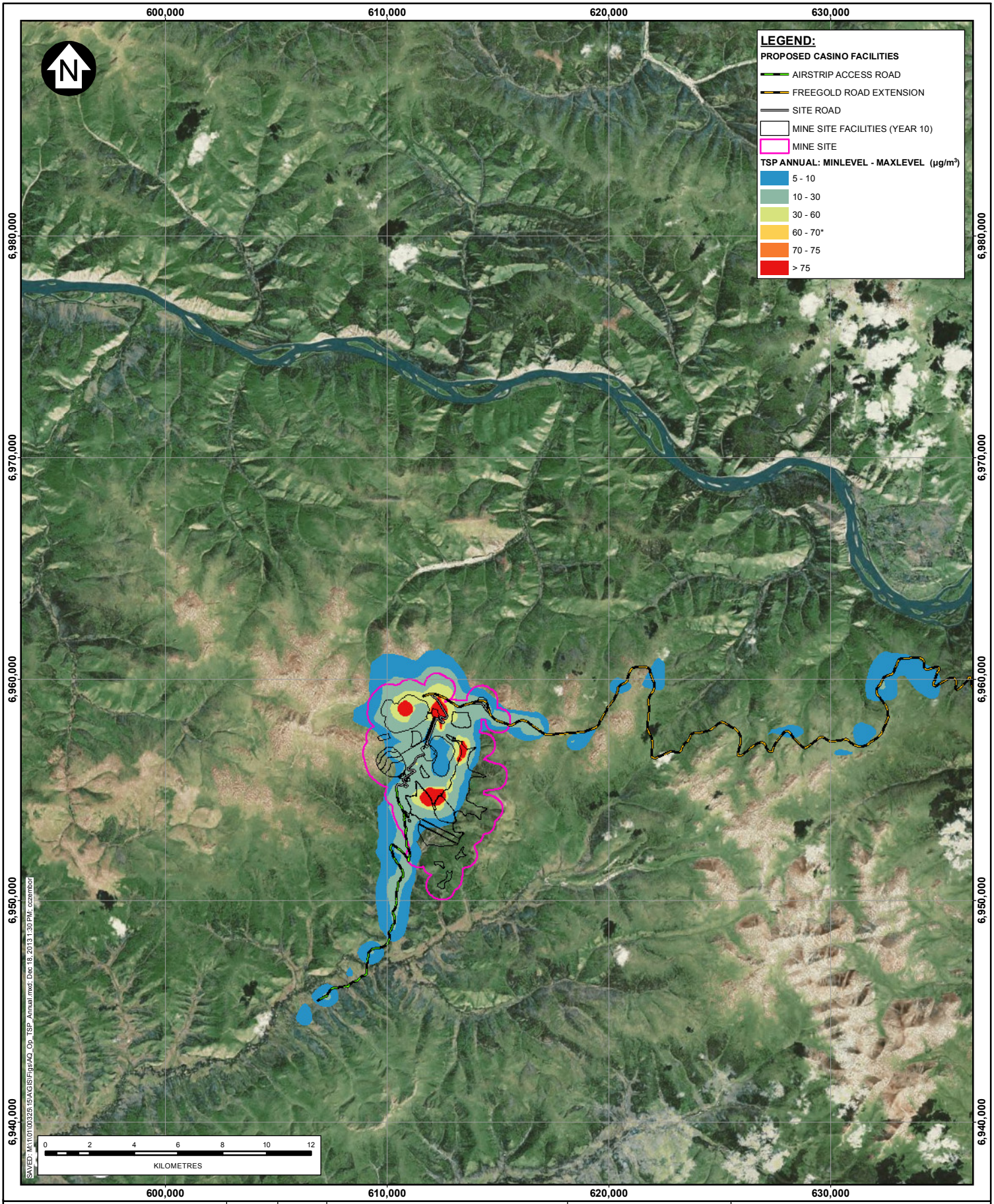
CASINO PROJECT

OPERATION TSP 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-23

REF 1

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DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. TSP ANNUAL AIR QUALITY STANDARD FOR YUKON IS **60 µg/m³**.

CASINO COPPER AND GOLD

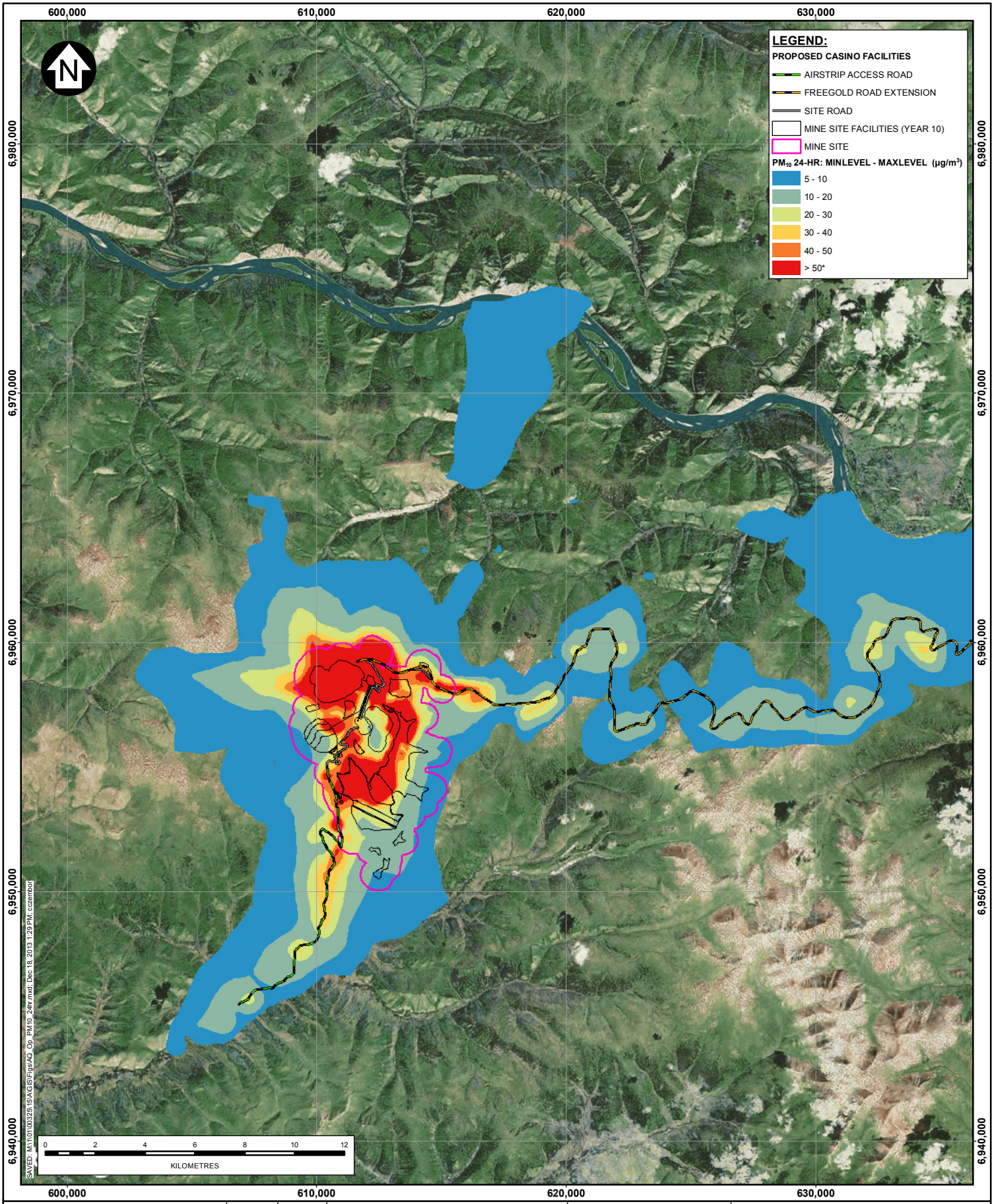
CASINO PROJECT

OPERATION TSP ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-24

REF 1

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DATE	16DEC'13

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. PM_{10} 24-HOUR AIR QUALITY STANDARD FOR BC IS **50 µg/m³**.

CASINO COPPER AND GOLD

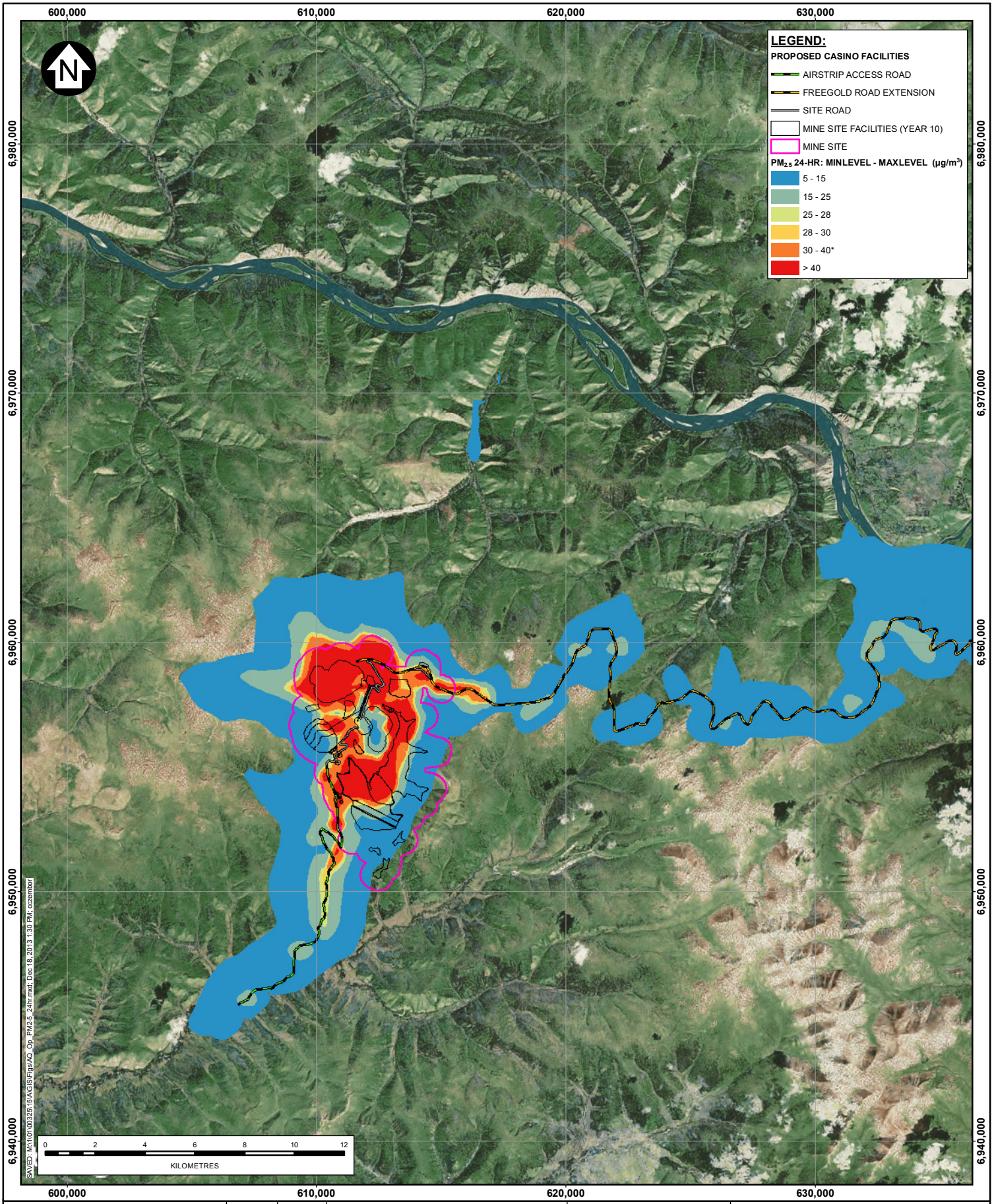
CASINO PROJECT

OPERATION PM_{10} 24-HOUR MAXIMUM CONCENTRATIONS

FIGURE 8.4-25

REF 1

P/A VA101-325/15



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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. $PM_{2.5}$ 24-HOUR AIR QUALITY STANDARD FOR YUKON IS **30 µg/m³**.

CASINO COPPER AND GOLD

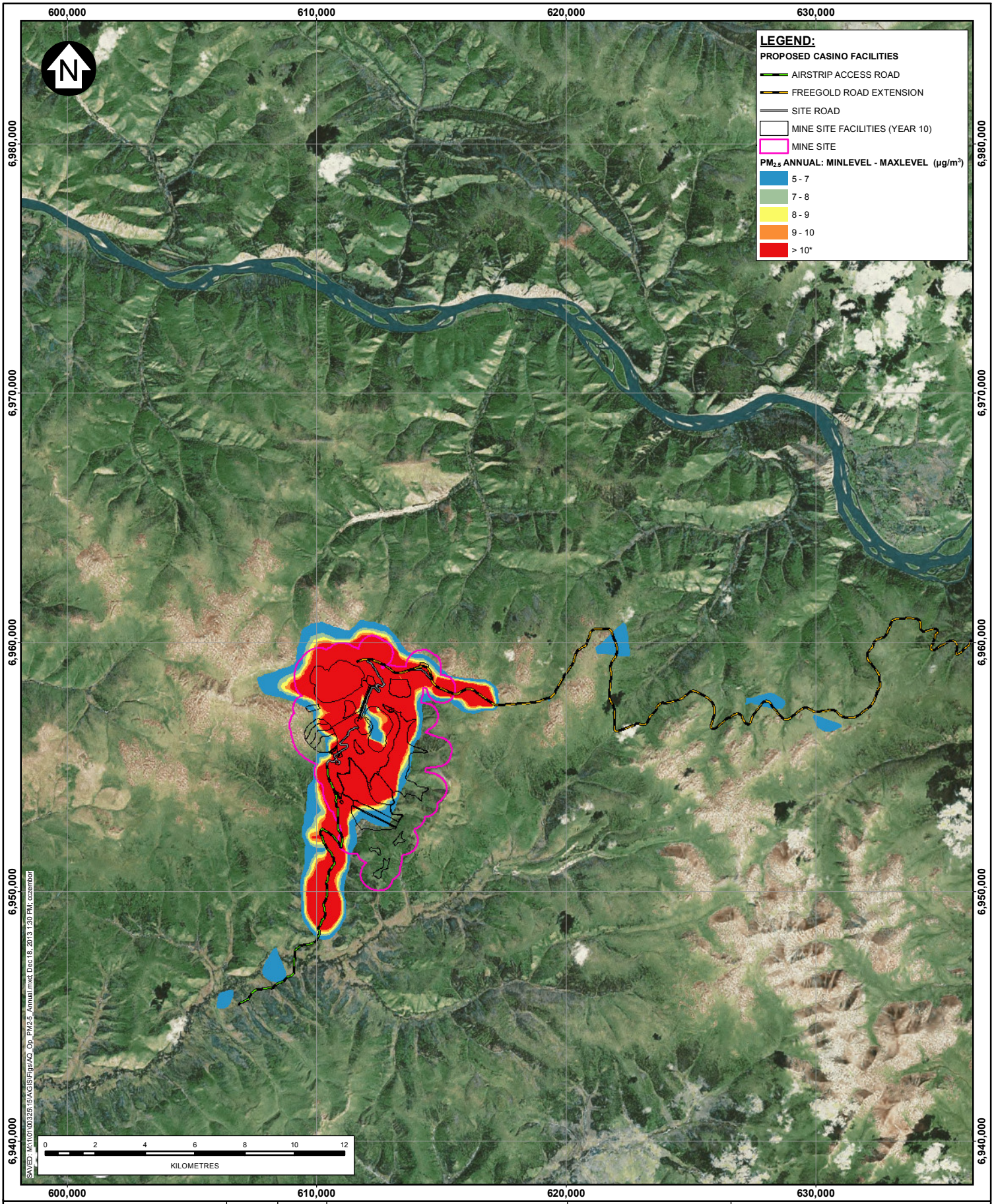
CASINO PROJECT

OPERATION $PM_{2.5}$ 24-HOUR MAXIMUM CONCENTRATIONS (98^{TH}) PERCENTILE

FIGURE 8.4-26

REF 1

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DATE	16DEC'13

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. $PM_{2.5}$ ANNUAL AIR QUALITY STANDARD FOR CANADA IS **10 µg/m³**.

CASINO COPPER AND GOLD

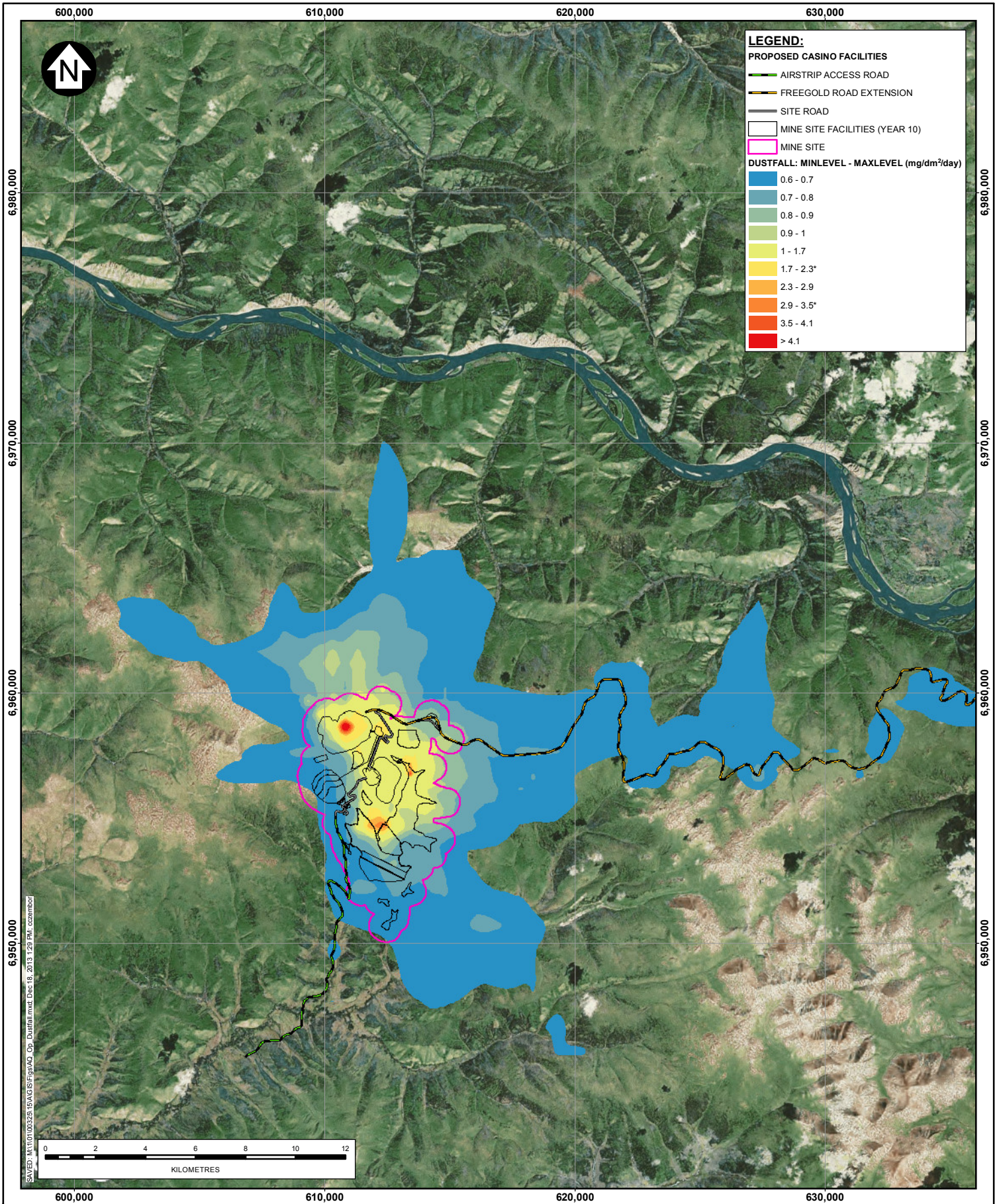
CASINO PROJECT

OPERATION $PM_{2.5}$ ANNUAL AVERAGE CONCENTRATIONS

FIGURE 8.4-27

REF 1

P/A VA101-325/15



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NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.
4. ASTERISK (*) IN LEGEND INDICATES AIR QUALITY STANDARD.
5. DUSTFALL MONTHLY AIR QUALITY STANDARD FOR BC IS **1.7 mg/dm²/day (LOWER) - 2.9 mg/dm²/day (UPPER)**.

CASINO COPPER AND GOLD

CASINO PROJECT

OPERATION DUSTFALL AVERAGE DAILY DEPOSITION RATES

FIGURE 8.4-28

REF 1

P/A VA101-325/15

8.4.1 Determination of Potential Interaction(s) Between the Project and the VC

As discussed in Section 4, the Project will consist of a copper, gold, silver, and molybdenum open pit mine that is anticipated to process on average 120,000 t/d of material over 22 years of full production. Additionally, the Project also includes several ancillary support facilities as well as the Freegold Road Upgrade and Extension.

An interactions table was completed to determine the main Casino Project components and activities that could have a potential interaction with air quality (Table 8.4-5). The potential effects were summarized for all phases of the Project, which were previously defined in Section 4. The Project components and activities that will potentially interact with air quality are carried forward into the effects assessment for air quality.

Table 8.4-5 Potential Interactions between the Project and Air Quality

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	Yes	C, O, CD	Construction air emissions, as well as heating and domestic waste incineration
Aggregate sources / Borrow Sites	Yes	C	Diesel equipment use and fugitive dust during construction
Airstrip and Airstrip Access Road	Yes	C, O, CD	Construction equipment emissions and fugitive dust during operation and construction
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	No	C, O	Does not emit air emissions
Concentrate Transport and Loading	Yes	O	Vehicle emissions during transportation and fugitive dust from unpaved roads
Concrete Batch Plant Operation	Yes	C, O	Fugitive dust during equipment operation
Contracted Employment	No	C, O, CD	Does not emit air emissions
Cyclone Sand Plant	Yes	C, O	Diesel equipment use and fugitive dust during construction and operations
Dismantling of Facilities	No	CD	Negligible amount of air emissions
Diversion of Canadian Creek	Yes	C, O	Diesel equipment use and fugitive dust during construction and operations
Drilling and Blasting	Yes	C, O	Air emissions during explosives detonations
Fish Habitat Compensation Construction	Yes	C, O	Diesel equipment use and fugitive dust during construction
Freegold Road Extension	Yes	C, O, CD	Diesel equipment use and fugitive dust during construction and operations
Freegold Road Upgrade	Yes	C, O, CD	Diesel equipment use and fugitive dust during construction
Fuel Storage and Distribution System	Yes	C, O	Diesel equipment use and fugitive dust during construction
Gold Extraction Plant / Oxide Ore Processing	Yes	C, O	Diesel consumption during construction and operations
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	Yes	C	Diesel equipment use and fugitive dust during construction

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (or Rationale for No Interaction)
Hazardous Materials Storage, Transport, and Disposal	Yes	C, O	Fuel use during transportation
Heap Leach Facility	Yes	C, O	Diesel equipment use and fugitive dust during construction
Heap Leach Pad	Yes	C, O	Diesel equipment use and fugitive dust during construction
Laydown Areas	Yes	C, O	Diesel equipment use and fugitive dust during construction
LNG Transport to site	Yes	C, O	Diesel equipment use and fugitive dust on unpaved roads
Main and Supplemental Power Plant (Gas Turbine and Diesel)	Yes	C, O	Air emissions associated with fuel combustion and typical construction emissions
Maximum Disturbance Area	No	C, O, CD	Does not emit air emissions
Mine Development	No	C, O, CD	Does not emit air emissions
Mine Staffing	No	C, O, CD	Does not emit air emissions
On-site equipment and vehicle use	Yes	C, O, CD	Air emissions associated with fuel combustion and typical construction emissions
Open Pit Mining	Yes	C, O	Air emissions associated with fuel combustion and fugitives on unpaved roads, emissions associated with drilling and blasting
Ore Conveyors	Yes	C, O	Construction-related air emissions and fugitive dust during operations
Ore Crushing	Yes	C, O	Construction-related air emissions and fugitive dust during operations
Ore Hauling	Yes	C, O	Construction-related air emissions, fuel combustion and fugitive dust from unpaved roads during operations
Ore Stockpiles	Yes	C, O	Construction-related air emissions and fugitive dust during operations
Processing Facilities for Sulphide Ore	Yes	O	Construction air emissions
Reagent Storage and Distribution	Yes	C, O	Construction air emissions
Site Reclamation / Re-Vegetation	No	O, CD	Does not emit air emissions
Site Security and Fencing	No	C, O, CD	Does not emit air emissions
Surface Water Management (Contact Water)	No	C, O, CD	Does not emit air emissions
Surface Water Management (Non-Contact Water)	No	C, O, CD	Does not emit air emissions
Tailings Management Facility	Yes	C, O, CD	Erosion-related fugitive emissions during construction and operations
Topsoil Stockpiles	Yes	C, O	Erosion-related fugitive emissions during construction and operations

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (or Rationale for No Interaction)
Traffic (Equipment and Materials to Site)	Yes	C, O, CD	Air emissions from fuel consumption and fugitive dust generation on unpaved roads
Waste management: garbage and sewage waste facilities	Yes	C, O	Incineration related emissions
Waste rock and Overburden Disposal	Yes	C, O	Diesel equipment use and fugitive dust
Water Supply	Yes	C, O, CD, PC	Diesel equipment use and fugitive dust during construction

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

The Project components and activities that are identified above as interacting with the Project will do so primarily through:

- Construction emissions;
- Power Generation;
- Blasting;
- Equipment use;
- Vehicle emissions; and
- Fugitive dust.

These mechanisms of interaction are expected to occur in the construction and Operation Phases of the Project. Table 8.4-6 describes the key indicators that would be affected and also details the potential effects. For air quality, potential effects are quantified solely in terms of guideline exceedances. In the case of the Casino Project, the guidelines of interest are the Yukon Ambient Air Quality Standards, which outline maximum concentrations of pollutants acceptable in ambient air throughout the Yukon Territory (Yukon Environment, 2010).

Potential air quality effects to workers at the mine site were not included in the assessment, because air quality at the mine site is subject to Yukon's *Occupational Health and Safety Act* (2006), rather than ambient air quality objectives. Additionally, the Casino Project mine site area is restricted access to the general public.

Table 8.4-6 Potential Effects on Air Quality

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, DC, PC)	Potential Effect	Direction
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for SO_2 at the mine site.	Adverse
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site.	Adverse
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for CO at the mine site.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Yukon Ambient Air Quality Standards for TSP at the mine site.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of BC Air Quality Objectives for dustfall at the mine site.	Adverse
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for SO_2 at the road.	Adverse
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	Adverse
Construction emissions, equipment use, vehicle emissions	Elevated Ambient Air Quality Concentrations	C, O	Exceedance of Yukon Ambient Air Quality Standards for CO at the road.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Yukon Ambient Air Quality Standards for TSP at the road.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	Adverse
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, DC, PC)	Potential Effect	Direction
Construction emissions, equipment use, fugitive dust	Increased Particulate Matter Deposition	C, O	Guideline exceedance of BC Air Quality Objectives for dustfall at the road.	Adverse
Construction emissions, equipment use, fugitive dust	Increased GHGs	C, O	Elevated levels in atmosphere compared to Yukon total greenhouse release statistics.	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

8.4.2 Identification of Mitigation Measures and Potential Residual Effects

CMC will institute mitigation measures to minimize the potential effects on air quality, as summarized in Table 8.4-7. These mitigation measures are summarized in Section 22 (Environmental Management Plans). Each mitigation measure has been assigned a rating for predicted effectiveness that has been based on professional literature as well as publically available information on similar projects.

Table 8.4-7 Identification of Mitigation Measures and Potential Residual Effects for Air Quality

Potential Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Exceedance of Yukon Ambient Air Quality Standards for SO_2 at the mine site.	Adverse	Adhere to *Occupational Health and Safety Act*	High	No
		Use ultra-low sulphur content fuel. Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance recommended by manufacturers.		
		Institute a policy for all equipment and vehicles to reduce and limit idling.		
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act*	Low	Yes
		Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.		
		Institute a policy for all equipment and vehicles to reduce and limit idling.		

Potential Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Exceedance of Yukon Ambient Air Quality Standards for CO at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act* Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance. Institute a policy for all equipment and vehicles to reduce and limit idling.	High	No
Exceedance of Yukon Ambient Air Quality Standards for TSP at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act* Cover or use water sprays at dust generating areas. Reduce drop heights for process plants.	High	No
Exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act* Cover or use water sprays at dust generating areas. Reduce drop heights for process plants.	Low	Yes
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act* Cover or use water sprays at dust generating areas. Reduce drop heights for process plants.	Low	Yes
Exceedance of BC Air Quality Objectives for dustfall at the mine site.	Adverse	Adherence to *Occupational Health and Safety Act* Cover or use water sprays at dust generating areas. Minimize wind exposure at conveyors, drop-off points and truck load/unload locations. Establish blasting procedures for open pit activities to minimize dust Reduce drop heights for process plants.	High	No
Exceedance of Yukon Ambient Air Quality Standards for SO_2 at the road.	Adverse	Use construction equipment that meets the latest applicable Canadian emissions standards.	High	No

Potential Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
		Ensure regular equipment maintenance.		
		Institute a policy for all equipment and vehicles to reduce and limit idling.		
		Use well maintained vehicles to minimize air emissions		
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	Adverse	Use construction equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.	Moderate	Yes
		Institute a policy for all equipment and vehicles to reduce and limit idling.		
		Use well maintained vehicles to minimize air emissions		
Exceedance of Yukon Ambient Air Quality Standards for CO at the road.	Adverse	Use construction equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.	High	No
		Institute a policy for all equipment and vehicles to reduce and limit idling.		
		Use well maintained vehicles to minimize air emissions		
Exceedance of Yukon Ambient Air Quality Standards for TSP at the road.	Adverse	Minimize land disturbance, grubbing and clearing activities	High	No
		Water unpaved portions of the road to minimize fugitive dust.		
Exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	Adverse	Minimize land disturbance, grubbing and clearing activities	Moderate	Yes
		Water unpaved portions of the road to minimize fugitive dust.		
Guideline exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	Adverse	Minimize land disturbance, grubbing and clearing activities	Moderate	Yes
		Water unpaved portions of the road to minimize fugitive dust.		
Exceedance of BC Air Quality Objectives for dustfall at the road.	Adverse	Minimize land disturbance, grubbing and clearing activities	High	No
		Utilize dust suppressants and watering along access corridors		

Potential Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
		and enforce speed limits.		
		Minimize wind exposure at conveyors, drop-off points and truck load/unload locations.		
		Enforce speed limits, staff training and road watering along truck hauling routes for mine site hauling		
		Water unpaved portions of the road to minimize fugitive dust.		
Contribute to global greenhouse gases.	Adverse	Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.	Moderate	Yes
		Institute a policy for all equipment and vehicles to reduce and limit idling.		

Notes
1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

8.4.3 Significance of Residual Effects

Residual effects are those that remain after mitigation measures (including compensation) have been applied. In accordance with Section 5, the residual effects on air quality were assessed based on eight rating criteria to determine the likelihood for a significant negative effect (Table 8.4-8).

Table 8.4-8 Determining Significance of Residual Effects for Air Quality

Criteria	Rating	VC Specific Definitions
Magnitude	Low	All levels are similar to baseline conditions or slightly higher.
	Medium	Increased levels within acceptable regulatory limits or objectives.
	High	Elevated levels with exceedances of regulatory limits or objectives.
Geographical Extent	Localized	Effect on Air Quality in Local Study Area.
	Widespread	Effect on Air Quality in Regional Study Area.
Duration	Short Term	Effect lasts for less than 3 years.
	Long Term	Effect lasts for more than 3 years but less than 25 years.
	Permanent	Effect does not change beyond lifespan of the Project.

Criteria	Rating	VC Specific Definitions
Frequency	Infrequent	Occurs occasionally or less than 1% of the time.
	Frequent	Occurs regularly.
Reversibility	Reversible	Area can return back to baseline conditions after cessation of the effect.
	Irreversible	Area cannot return back to baseline conditions after cessation of the effect.
Context	Low resilience	Air Quality as a whole is able to accommodate the change.
	High resilience	Air Quality as a whole cannot accommodate the change.
Probability of occurrence	Low	Effect is not likely to occur.
	High	Effect is highly likely to occur.

Each of the residual effects from Table 8.4-7 underwent a significance determination as shown in Table 8.4-9. The Casino Project is not likely to have significant negative residual effects on air quality after the implementation of mitigation measures, especially since all effects are reversible after the Operation Phase of the Project is complete.

Table 8.4-9 Significance of Residual Effects for Air Quality

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site.	Adverse	High	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site.	Adverse	Medium	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site.	Adverse	Medium	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	Adverse	High	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	Adverse	Low	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	Adverse	Low	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Contribution to global greenhouse gases	Adverse	Medium	Widespread	Long Term	Frequent	Reversible	High Resilience	High	Not Significant

8.4.4 Discussion of Significance

Based on the effects assessment, the Casino Project is not likely to have any significant adverse effects on air quality after the implementation of mitigation measures. This is summarized in Table 8.4-10. The level of confidence in the CALPUFF model is high. This is due to the fact that the model is based on worst-case scenarios, as well as that it takes multiple components into account, including physical and meteorological settings and air emission source characterizations. The data used was from the feasibility study (M3, 2013) which

represents the best and most accurate information available, especially as these data were integrated with site infrastructure details including open pit depth and tailings height.

Table 8.4-10 Summary of Residual Effects after Mitigation Measures

Potential Residual Effects	Direction	Significance	Level of Confidence
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site.	Adverse	Not Significant	High
Exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site.	Adverse	Not Significant	High
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site.	Adverse	Not Significant	High
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	Adverse	Not Significant	High
Exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	Adverse	Not Significant	High
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	Adverse	Not Significant	High
Elevated levels in atmosphere compared to national total greenhouse release statistics	Adverse	Not Significant	High

8.5 CUMULATIVE EFFECTS ASSESSMENT

The residual effects of the Casino project on air quality were assessed in relation to the residual effects of other past, present, and reasonably foreseeable projects and activities. These projects and activities are discussed in greater detail in Appendix 5B, and include quartz mines, mineral and placer claims, heritage sites, and registered outfitting and trapline concessions.

8.5.1 Identification of Other Projects or Activities

Table 8.5-1 contains the list of projects that were included in the cumulative effects assessment for air quality. Mineral and placer claims were not included in the cumulative effects assessment for air quality due to the lack of available information regarding expected air emissions. Heritage sites and registered outfitting and trapline concessions were also not included in the cumulative effects assessment as these activities do not generate air emissions. A list of past, present, and reasonably foreseeable quartz mines was analyzed to determine which projects could potentially interact with the residual effects on air quality from the Project to produce a cumulative effect. Projects located in the vicinity of the Freegold Road were selected for analysis as they could potentially share a spatial overlap with the Project. Of the three projects within the vicinity of the Freegold Road, two (Minto Copper Mine and Carmacks Copper Mine) were included in the cumulative effects assessment. The third project, the Mount Nansen Mine, was not included as this is a past project and that has undergone decommissioning and thus does not generate air emissions.

Table 8.5-1 Residual Effect Information for Other Projects or Activities – Air Quality

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Minto Copper Mine	Present	Project-related NO_2 emissions and elevated particulate matter deposition	No overlap in detectable emissions area; effect is confined to the project footprint	Mine is expected to operate until 2022
Carmacks Copper Mine	Likely Future	Potential for shared transportation corridor leading to increased NO_2 emissions and $PM_{2.5}$ deposition	Potential for overlap with Freegold Road Upgrade	Operations are expected to start in 2016 and last for at least 7 years

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

8.5.2 Interactions and Potential Cumulative Effects

The interaction matrix shown in Table 8.5-2 was used to determine whether any spatial or temporal overlap exists between the residual effects of the Project and the Minto Copper Mine and/or Carmacks Copper Mine.

Table 8.5-2 Cumulative Effects Assessment Interactions Matrix – Air Quality

Casino Project Residual Effect	Potential Spatial and Temporal Overlap	
	Minto Copper Mine	Carmacks Copper Mine
	Project-related NO_2 emissions and elevated particulate matter deposition	Potential for shared transportation corridor leading to increased NO_2 emissions and $PM_{2.5}$ deposition
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site.	NO	NO
Exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site.	NO	NO
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site.	NO	NO
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	YES	YES
Exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	YES	YES
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	YES	YES
Elevated levels in atmosphere compared to national total greenhouse release statistics	YES	YES

Note

1 YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

Neither of the two projects will overlap spatially with any of the residual effects seen at the Casino mine site. However, both spatial and temporal overlaps may occur at the Freegold Road Extension and Upgrade. This may lead to the potential cumulative effects described in Table 8.5-3. These effects are the same as the residual effects from the Project except that they would be seen beyond the Project area.

Table 8.5-3 Potential Cumulative Effects – Air Quality

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road.	Minto Copper Mine Carmacks Copper Mine	Exceedance of Yukon Ambient Air Quality Standards for NO_2
Exceedance of Canadian Air Quality Objectives for PM_{10} at the road.	Minto Copper Mine Carmacks Copper Mine	Exceedance of Canadian Air Quality Objectives for PM_{10}
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road.	Minto Copper Mine Carmacks Copper Mine	Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$
Elevated levels in atmosphere compared to national total greenhouse release statistics	Minto Copper Mine Carmacks Copper Mine	Elevated levels in atmosphere compared to national total greenhouse release statistics

8.5.3 Proposed Mitigation Measures and Potential Residual Cumulative Effects

As discussed in Section 5, the mitigation measures applied or recommended for potential cumulative effects may be considerably different than those applied to Project-specific effects. These mitigation measures often require regional stakeholder involvement to address complex regional cumulative effects.

The mitigation measures discussed in Table 8.5-4 primarily involve adhering to a Road Use Plan that minimizes potential guideline exceedances, while also conducting long-term monitoring for air quality at the Freegold Road.

Table 8.5-4 Additional Mitigation Measures and Residual Cumulative Effects – Air Quality

Potential Cumulative Effect	**Mitigation Measures for Project-Specific Effects**[1]	**Additional Mitigation**[2] (if possible)	**Effectiveness of Additional Mitigation Measure** (Low, Moderate, High, Unknown)	**Residual Cumulative Effect** (Yes/No)
Exceedance of Yukon Ambient Air Quality Standards for NO_2	Adhere to *Occupational Health and Safety Act*	Air Quality Monitoring Plan and Transport Management Plan	High	Yes
	Use construction and mining equipment that meets the latest applicable Canadian emission standards and ensure regular maintenance.			
	Institute a policy for all equipment and vehicles to reduce and limit idling.			
Exceedance of Canadian Air Quality Objectives for PM_{10}	Adhere to *Occupational Health and Safety Act*	Air Quality Monitoring Plan and Transport Management Plan	High	Yes
	Use construction and mining equipment that meets the latest applicable Canadian emission standards and ensure regular			

Potential Cumulative Effect	Mitigation Measures for Project-Specific Effects[1]	Additional Mitigation[2] (if possible)	Effectiveness of Additional Mitigation Measure (Low, Moderate, High, Unknown)	Residual Cumulative Effect (Yes/No)
	maintenance.			
	Cover or use water sprays at dust generating areas			
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$	Adhere to *Occupational Health and Safety Act*	Air Quality Monitoring Plan and Transport Management Plan	High	Yes
	Use construction and mining equipment that meets the latest applicable Canadian emission standards and ensure regular maintenance.			
	Cover or use water sprays at dust generating areas			
Elevated levels in atmosphere compared to national total greenhouse release statistics	Use construction and mining equipment that meets the latest applicable Canadian emission standards and ensure regular maintenance.	Air Quality Monitoring Plan and Transport Management Plan	High	Yes
	Institute a policy for all equipment and vehicles to reduce and limit idling.			

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

8.5.4 Significance of Residual Cumulative Effects

Residual cumulative effects are those that remain after mitigation measures have been applied. In accordance with Section 5, the residual cumulative effects on air quality were assessed based on eight rating criteria to determine the likelihood for a significant negative effect (Table 8.5-5). All residual cumulative effects are not likely to be significant as all are reversible after the Operation Phase ends. Additionally, the probability of occurrence is low as reasonably foreseeable projects may not have an effect that overlaps temporally or spatially with the Project.

Table 8.5-5 Significance of Residual Cumulative Effects – Air Quality

Residual Cumulative Effect	Predicted Degree of Effect After Additional Mitigation Measures								Significance of Residual Cumulative Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Exceedance of Yukon Ambient Air Quality Standards for NO_2	Adverse	High	Localized	Long Term	Frequent	Reversible	Low Resilience	Low	Not Significant
Exceedance of Canadian Air Quality Objectives for PM_{10}	Adverse	High	Localized	Long Term	Frequent	Reversible	Low Resilience	Low	Not Significant
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$	Adverse	High	Localize	Long Term	Frequent	Reversible	Low Resilience	Low	Not Significant
Elevated levels in atmosphere compared to national total greenhouse release statistics	Adverse	High	Widespread	Long Term	Frequent	Reversible	Low Resilience	Low	Not Significant

8.5.5 Discussion of Significance of Residual Cumulative Effects

Based on the cumulative effects assessment, the Casino Project is not likely to have any significant adverse effects on air quality after the implementation of mitigation measures. This is summarized in Table 8.5-6. The level of confidence in these predictions are moderate, given that detailed air quality emissions information does not exist for all past, present, and reasonably foreseeable projects.

Table 8.5-6 Summary of Residual Cumulative Effects – Air Quality

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Exceedance of Yukon Ambient Air Quality Standards for NO_2	Adverse	Not Significant	Moderate
Exceedance of Canadian Air Quality Objectives for PM_{10}	Adverse	Not Significant	Moderate
Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$	Adverse	Not Significant	Moderate
Elevated levels in atmosphere compared to national total greenhouse release statistics	Adverse	Not Significant	Moderate

8.6 SUMMARY AND CONCLUSIONS

Dispersion modelling was used to assess the potential effect of SO_2, NO_2, CO, TSP, PM_{10}, $PM_{2.5}$, and dustfall associated with the Casino Project on air quality. Concentrations of potential air contaminants were predicted for both the Casino mine site and the Freegold Road and potential effects were determined. CMC has proposed several mitigation measures that can minimize the potential effects of the Casino Project components and activities on air quality. Overall, the dispersion modelling results confirm compliance with Yukon Ambient Air Quality Standards or Canadian/BC Air Quality Guidelines for all parameters analyzed once mitigation measures are applied. Therefore, the Casino Project is not likely to have significant negative effects on air quality after the implementation of mitigation measures.

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9 – NOISE

9.1 INTRODUCTION

This section of the Proposal presents the baseline information on noise in the Casino Project area as well as an assessment of the potential environmental noise effects from the Casino Project components and activities. The assessment of noise will use measurements of average weighted sound levels (Leq) and A-weighted sound pressure (dBA), and adheres to the methodology outlined in Section 5 of the Proposal.

9.1.1 Regional Setting

The Casino Project is located in the Dawson Range Mountains of the Klondike Plateau, approximately 300 km northwest of Whitehorse. The Freegold Road Extension and proposed Freegold Road Upgrade extend for approximately 200 km southeast from the Project to the village of Carmacks. The Project is situated in the Casino Creek and Canadian Creek watersheds.

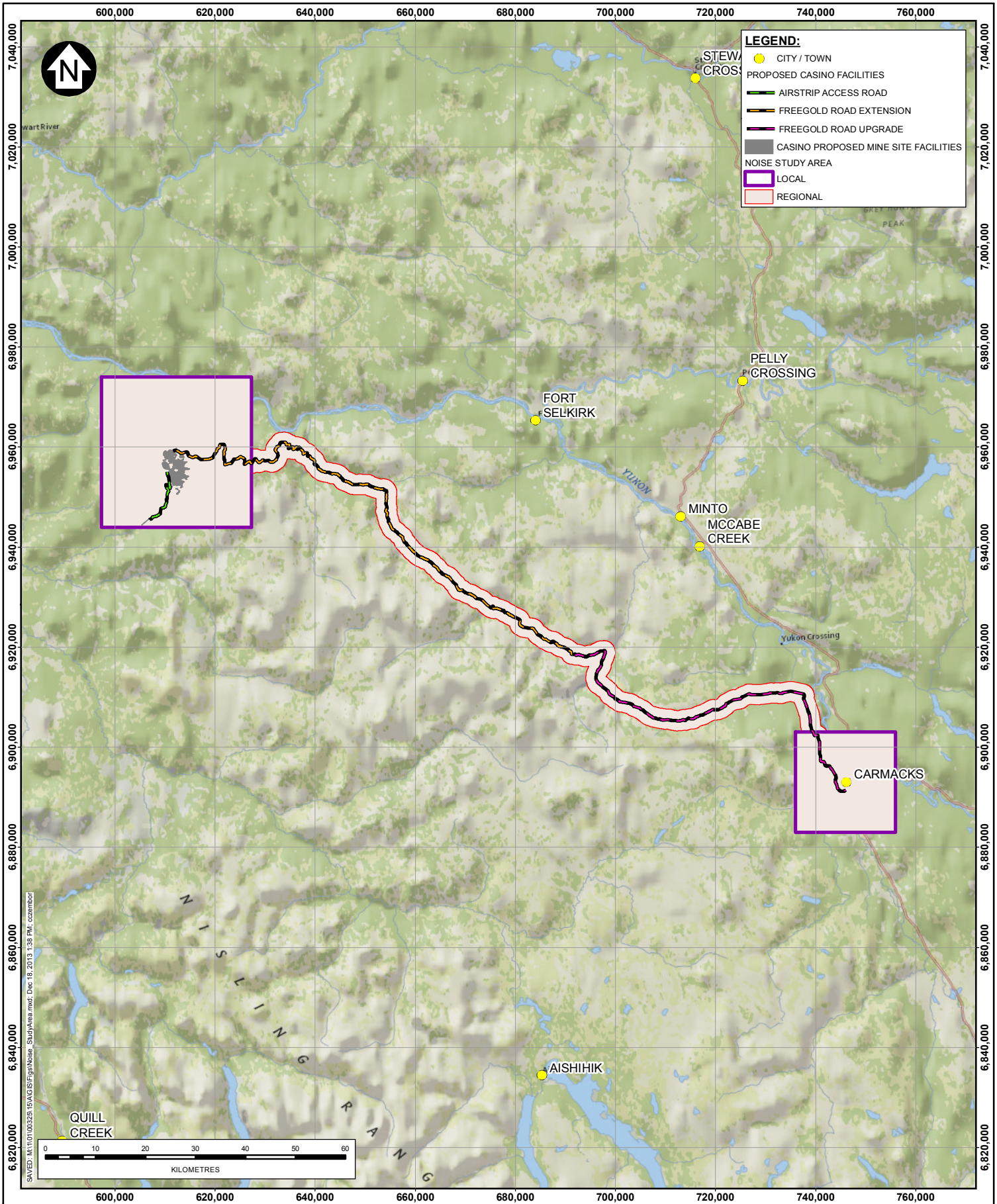
The Project is located within the Boreal Cordillera ecozone, which comprises much of the southern Yukon and a large portion of northern BC, and within the Klondike Plateau ecoregion. The Boreal Cordillera ecozone is broadly characterized by the presence of several mountain ranges, including the Dawson Range, that trend in the north-westerly direction and include extensive plateau regions. The elevation of the project area ranges from approximately 650 masl at the proposed airstrip location to 1,400 masl at Patton Hill.

9.1.2 Rationale for VC Selection

As mentioned in Section 5, Valued Environmental and Socio-economic Components (VCs) are broad components of the biophysical, ecosystem, and human environments that, if altered by the Project, would be of concern to First Nation citizens, regulatory agencies, resource managers, scientists, and members of the general public. Noise has been chosen as a VC because airborne sound and ground vibration propagation can potentially affect human health. Noise levels are important to individuals and wildlife for several reasons such as sleep disturbance and annoyance. The Noise VC will evaluate the worst case noise conditions by predicting future noise levels and will then suggest precautionary mitigation measures.

9.2 ASSESSMENT BOUNDARIES

The spatial boundaries for this VC consist of the areas where the Project is reasonably expected to have an effect on noise. The local study area (LSA) and regional study area (RSA) are shown on Figure 9.2-1 and are discussed in greater detail in the sections below.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	CC
DRAWN	CC
CHK'D	TO
APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE NATIONAL GEOGRAPHIC MAPPING, AE ENGINEERING.
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES

CASINO COPPER AND GOLD

CASINO PROJECT

REGIONAL AND LOCAL STUDY AREAS - NOISE

FIGURE 9.2-1

REF 1

P/A VA101-325/15

9.2.1 Local Study Area (LSA)

Mining activities at the Casino project mine site will generate noise. This has the ability to affect sensitive receptors in the surrounding area via airborne sound propagation. Sound propagation is dependent on the atmosphere as it can be affected by wind speed, wind direction, and relative humidity.

The main LSA (LSA 1) for the effects assessment on noise is the 30 km^2 area surrounding the mine site. This area is quadrilateral due to the nature of the modelling programs used. An additional LSA (LSA 2) consisting of the 20 km^2 area surrounding the village of Carmacks has also been included in the assessment to account for the sensitive receptors present in this area.

The LSAs that have been chosen are expected to encompass the areas where attenuation resulting from noise from the Casino Project has the potential to exceed a threshold.

9.2.2 Regional Study Area (RSA)

The RSA for the effects assessment on noise consists of LSA 1, LSA 2, and a 4 km buffer (2 km on each side) along the Freegold Road Upgrade and Extension. Although noise is not persistent in the atmosphere, this RSA is expected to encompass the area where attenuation will occur.

9.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project are provided in Section 4.

9.3 BASELINE CONDITIONS

This section summarizes baseline noise conditions, while greater detail can be found in Appendix 8B.

The measurable parameters used to establish baseline conditions were:

- Energy-equivalent sound levels (Leq), and
- A-weighted noise levels (dBA).

The mine site is located in an undisturbed environment so the sound and noise levels in the area are considered to be pristine at baseline. A noise measurement survey was conducted over a 22-hour period from August 25, 2011 to August 26, 2011 for residences along the Freegold Road near Carmacks. A Larson Davis 831 Sound Level Meter was used to determine ambient sound levels and was placed 30m from the road. The results were compared to the British Columbia Oil and Gas Commission's (OGC) published standards from March 2009 as the Yukon does not currently have any published noise guidelines or regulations (OGC, 2009) and there is no developed noise guideline for the mining industry. Audio recordings were also made during the noise survey in order to identify events that are not considered part of the normal ambient sound levels in the area, such as low-flying aircraft or field crew, in order to exclude them from the noise survey measurements.

Since noise levels typically vary over time, the Energy Equivalent Sound Level (Leq) is used as a descriptor of average sound levels. Permissible Sound Levels (PSL) were calculated by using the BC OGC guidelines as 45 dBA Leq at nighttime and 55 dBA at daytime at either the nearest noise receptor or 1.5 km from the facility boundary, whichever is closer to the anticipated noise source. The measured Leq values were split into daytime noise levels (L_{DAY}) and nighttime noise levels (L_{NIGHT}). The L_{DAY} is measured between the hours of 07:00 and 22:00 while L_{NIGHT} is measured between the hours of 22:00 and 07:00. The results are shown in Table 9.3-1.

Table 9.3-1 Hourly Noise Measurement Data

Time Period (hh:mm)	Sound Level Averaging Duration (hh:mm)	A-Weighted (dBA) Equivalent Sound Level (Leq)	A-Weighted (dBA) Statistical L90	Day/Night
13:00 – 14:00	1:00	41.8	40.3	Day
14:00 – 15:00	1:00	39.0	37.6	Day
15:00 – 16:00	1:00	42.8	40.8	Day
16:00 – 17:00	1:00	43.4	40.5	Day
17:00 – 18:00	0:55	42.4	37.0	Day
18:00 – 19:00	1:00	40.0	35.3	Day
19:00 – 20:00	1:00	37.5	34.2	Day
20:00 – 21:00	1:00	40.8	35.3	Day
21:00 – 22:00	1:00	40.3	33.4	Day
22:00 – 23:00	0:55	37.6	28.9	Night
23:00 – 0:00	1:00	33.4	28.4	Night
0:00 – 1:00	1:00	35.8	30.5	Night
1:00 – 2:00	1:00	30.3	28.8	Night
2:00 – 3:00	0:55	32.2	30.0	Night
3:00 – 4:00	1:00	32.4	29.9	Night
4:00 – 5:00	1:00	31.5	30.3	Night
5:00 – 6:00	1:00	34.6	32.9	Night
6:00 – 7:00	1:00	33.2	27.3	Night
7:00 – 8:00	1:00	35.3	29.6	Day
8:00 – 9:00	1:00	36.9	27.5	Day
9:00 – 10:00	1:00	34.4	23.6	Day
10:00 – 11:00	0:50	36.1	26.6	Day

The hourly Leq values ranged from 30.3 dBA to 43.4 dBA (Figure 9.3-1). The major noise sources were determined to be passing trucks (that were unrelated to the Project) and natural sounds generated by wind or wildlife. The average daytime noise levels were 40.3 dBA (A-weighted Leq) and 34.2 dBA (A-weighted L90: where L90 is the value that is exceeded 90% of the time) while the average nighttime noise levels were 33.9 dBA (A-weighted Leq) and 29.7 dBA (A-weighted L90). The excluded noise events are presented in Table 9.3-2.

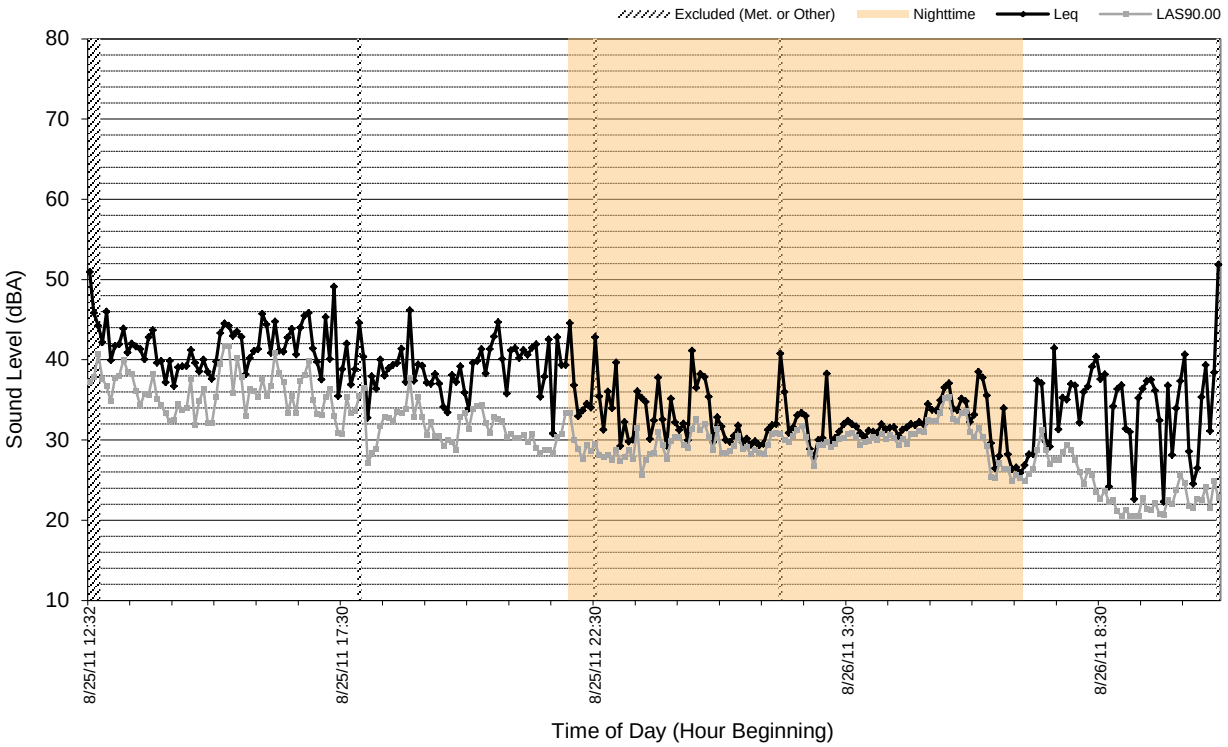


Figure 9.3-1 Equivalent Sound Level Data for the Casino Project

Table 9.3-2 Noise Measurement Exclusions

Date/Time	Leq	Description
8/25/2011 12:32	50.9	Technician Activity
8/25/2011 12:35	45.8	Technician Activity
8/25/2011 12:40	44.2	Hammering
8/25/2011 17:50	44.6	Aircraft
8/25/2011 22:30	42.8	Dog Barking
8/26/2011 02:10	40.7	Gunshot
8/26/2011 10:50	51.8	Technician Activity

Hourly temperature, relative humidity, hourly wind speed, and wind direction measurements were also measured at the meteorological station during the noise survey. The results are shown on Figure 9.3-2 and Figure 9.3-3. The temperature ranged from 4.1°C to 13.3°C, and relative humidity ranged from 61.2% to 81%. Wind speed ranged from 0.7m/s to 3.9 m/s, and wind direction ranged from 60.9° to 359.8°. All values lie within the acceptable ranges for conducting noise measurements.

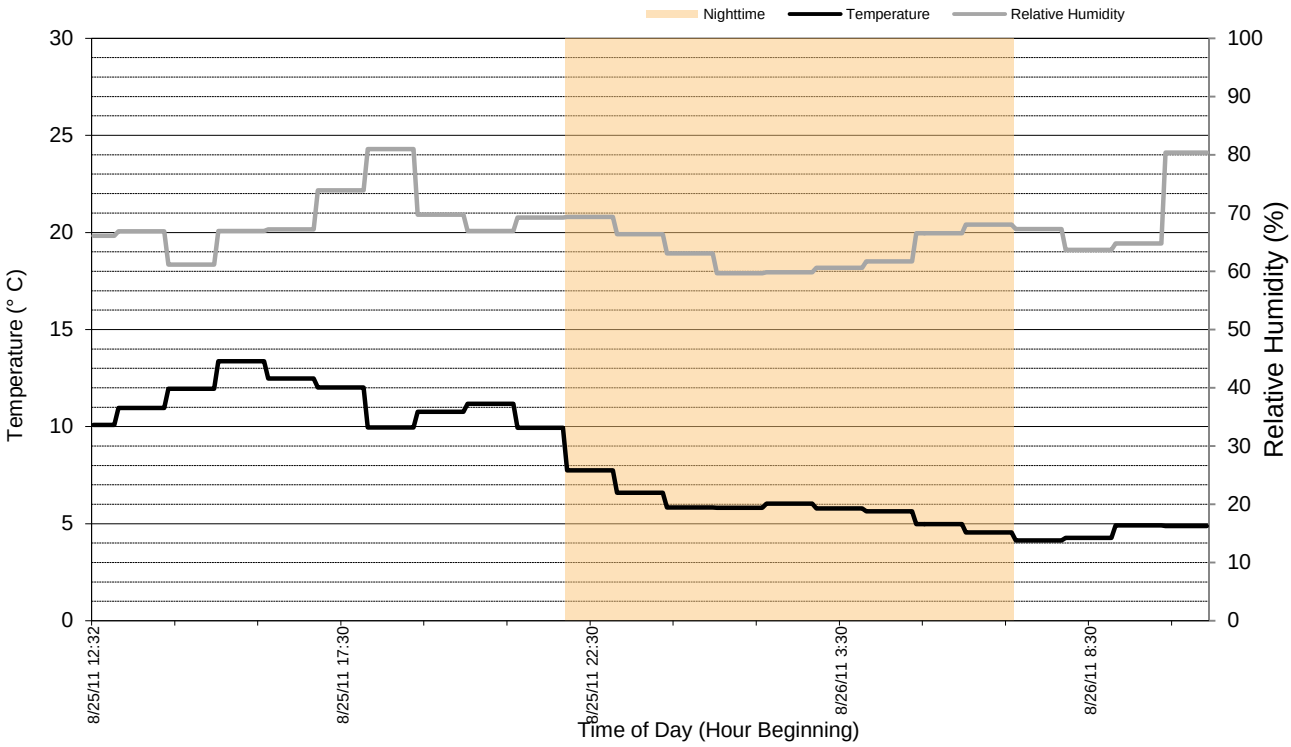


Figure 9.3-2 Hourly Temperature and Relative Humidity Measurements

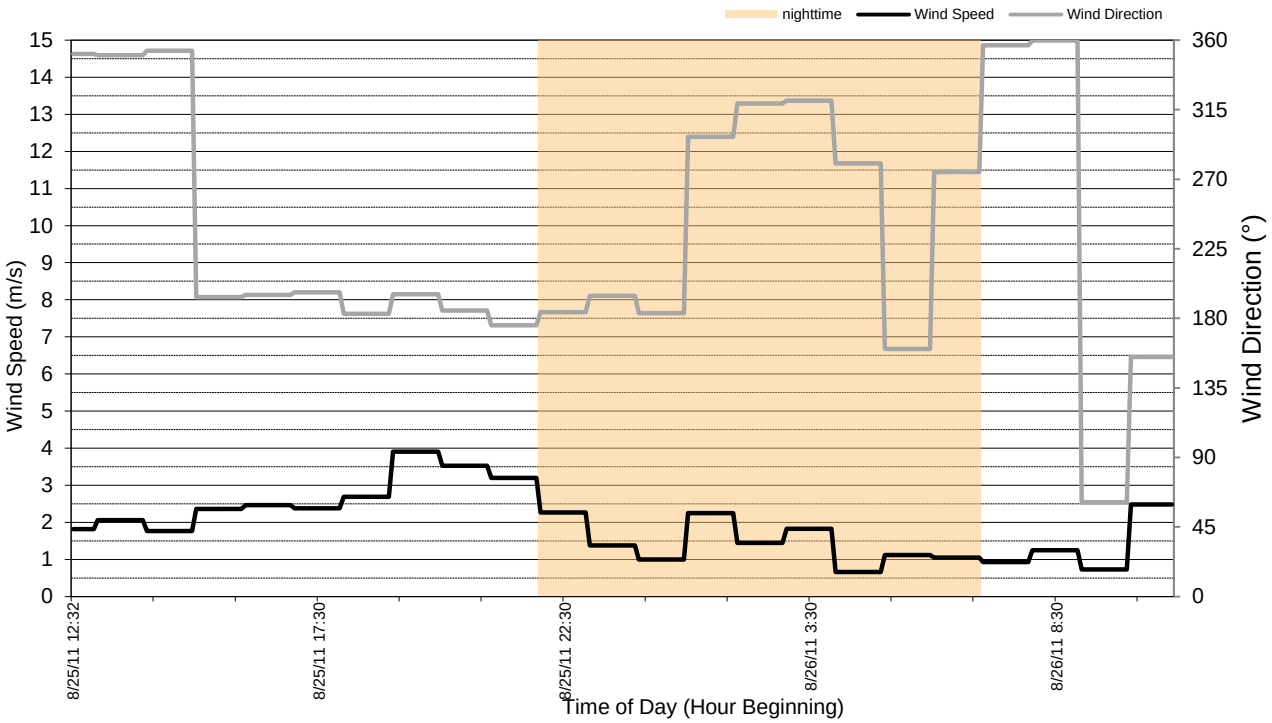


Figure 9.3-3 Hourly Wind Speed and Wind Direction Measurements

9.4 PROJECT-SPECIFIC EFFECTS

Mining equipment and transportation noise levels over the study area were predicted using the International Standards Organization's 9613-2:1996 (ISO 1996) and German Guideline for Noise Protection on Streets (RLS-90) for mine site and traffic predictions, respectively. The calculations were implemented by the outdoor sound propagation software Cadna/A. The L_{DAY} and L_{NIGHT} were both calculated based on noise sources described in the Casino Project Feasibility Study (M3 2013).The worst-case scenario was predicted by using the peak activity year which coincides with the maximum equipment use and mining fleet.

The model predictions were performed in octave bands as outdoor sound propagation is frequency dependent. Each point, line, and area noise source was assigned an octave spectrum. The modelling results are presented in A-weighted decibels to allow comparison with the evaluation criteria derived from OGC.

In general, outdoor sound propagation can be affected by sound attenuation mechanisms. These include physical barriers, such as buildings or terrain features, or other factors such as distance, temperature, relative humidity, and wind. The inputs to the noise model include:

- Estimated traffic on roads.
- Moving sound sources, which were modelled as line sources in anticipated areas such as vehicles operated in open pit and haul roads.
- Stationary sources such as crushers, conveyors, power plants, heat recovery steam generators,
- Off-site roads such as the Freegold Road and the road to the airstrip.

Sound contours were generated to present maximum noise levels during the highest activity year for construction and operations. Daytime and nighttime noise level contours were generated separately.

The worst case construction and operations noise scenarios were developed using the Project schedule (Section 4). For construction, noise predictions were carried out using expected noise emissions from the following Project components and activities derived from preliminary construction schedule at Year -1:

- Pioneering activities at major project components including the Open Pit, waste storage area, and Heap Leach Facility;
- Construction of main power plant, concentrator, tailings facility, and ancillary buildings;
- Auxiliary power plant; and
- Open Pit pre-production and traffic including hauling.

For operations, noise predictions were carried out using expected noise emissions from the following Project components and activities at Year 10:

- Open Pit activities;
- Truck loading and unloading, crushing, and conveying;
- Hauling;
- Workshops;
- Main power plant including the heat recovery steam generator;
- Auxiliary power plant;

- Ore transport;
- SAG and ball mills; and
- Off-road equipment.

Although most equipment that would be present within the mine site will not likely be operating continuously at maximum power, it was assumed for noise modelling purposes that they would be in order to predict maximum sound levels. The total sound pressure levels (dBA) of the equipment input to the noise model are shown in Table 9.4-1.

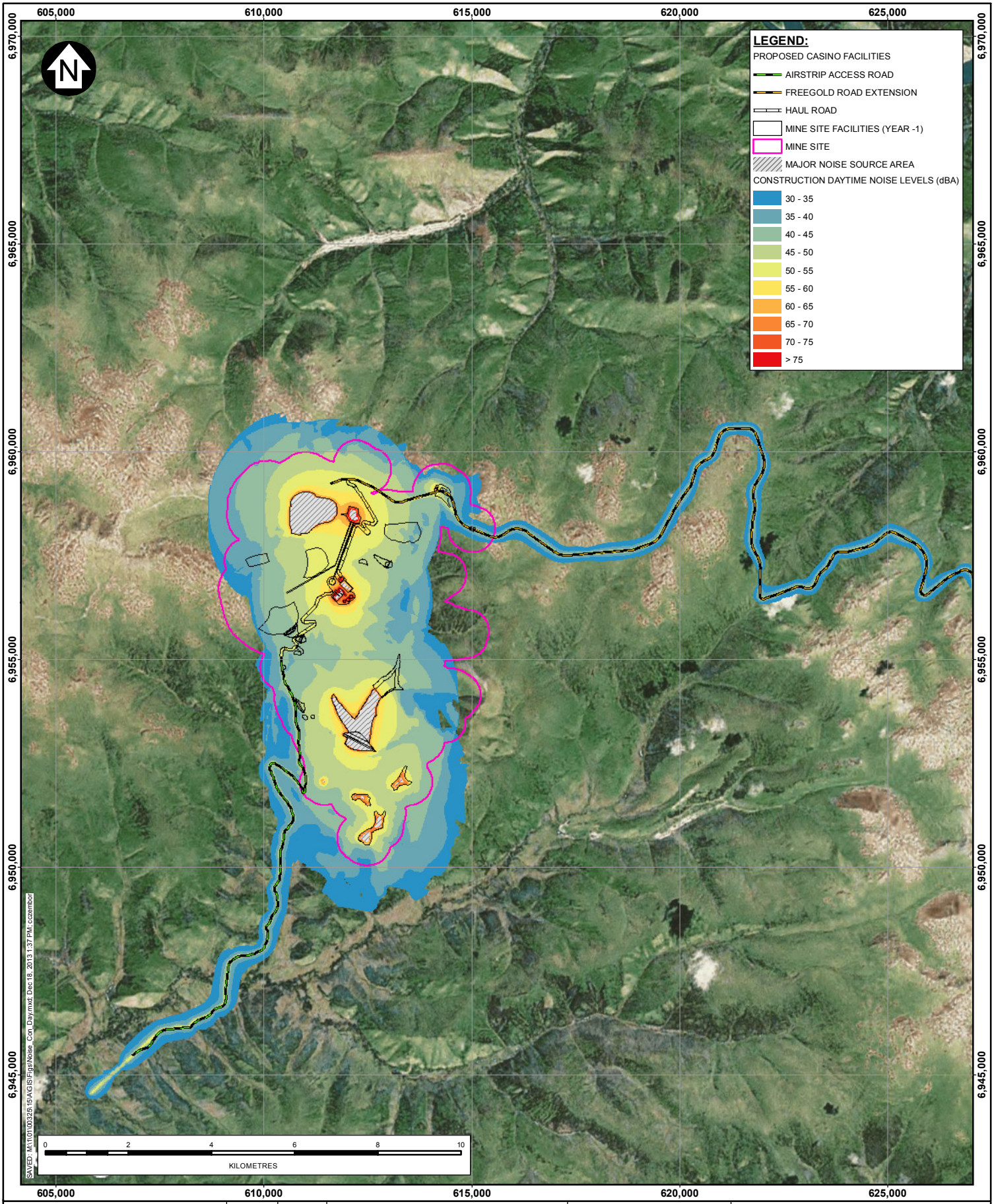
Table 9.4-1 Noise Sources During Construction and Operations Phases

Noise Source	Total Sound Pressure Level (dBA)	Source
Haul Truck	121.1	DEFRA 2006
Crushers	90.1	DEFRA 2006
Conveyor	90.1	DEFRA 2006
Screening	81.1	DEFRA 2006
Excavator	91.0	DEFRA 2006
Loader	89.9	DEFRA 2006
Dozer	80.1	DEFRA 2006
Grader	86.5	DEFRA 2006
Crane	66.6	DEFRA 2006
Mid-Size Loader	85.0	DEFRA 2006
Lighting Tower	65.5	DEFRA 2006
Gas Turbine	117.5	Qui Hansen 2012
Steam Generator	117.9	Qui Hansen 2012
SAG mill	117.5	VDI 2571
Ball Mill	117.9	VDI 2571
Auxiliary Diesel Generator	99.4	Qui Hansen 2012
Incinerator Fan	63.4	Qui Hansen 2012
Transformer	92.4	VDI 2571
Water Pump	88.2	Qui Hansen 2012
Workshop	93.2	VDI 2571

Noise modelling was completed for both construction and operations phases at LSA 1, which is the 30 km^2 area surrounding the mine site (Figure 9.2-1). The LSA 2, which consists of the Village of Carmacks, was not modelled as there are no mine operations here and mine-related traffic is not expected to pass through this area. Modelling was completed using the worst case scenario years, which was Year -1 for construction and Year 11 for operations. During the construction phase, the modelling results show that the predicted equivalent sound levels during daytime and nighttime show minor exceedances of the BC OGC guidelines within the mine site. This is shown in greater detail on Figure 9.4-1 and Figure 9.4-2. During the operations phase, the modelling results show that the predicted equivalent sound levels during daytime and nighttime show noise levels above the calculated PSL of the BC OGC guidelines within the mine site and a small portion of the surrounding area. However, the BC

OGC approach to noise assessment is receptor-based or a 1.5 km approach when there is no receptor near the site boundary. As a result, the predicted results, representing the worst case, are below guidelines at relevant locations. Health and safety codes and regulations apply for noise levels within the site boundary therefore it is not included in the noise assessment.

The results are shown in greater detail on Figure 9.4-3 and Figure 9.4-4. No guideline exceedances are observed at 1.5 kilometres and near the Freegold Road during either the construction or operation phase. The noise zone of influence during the operations phase is larger than the construction phase due to large stationary sources such as crushers, power plants, process plant and heavy traffic sounds associated with mining activities.



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APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.

CASINO COPPER AND GOLD

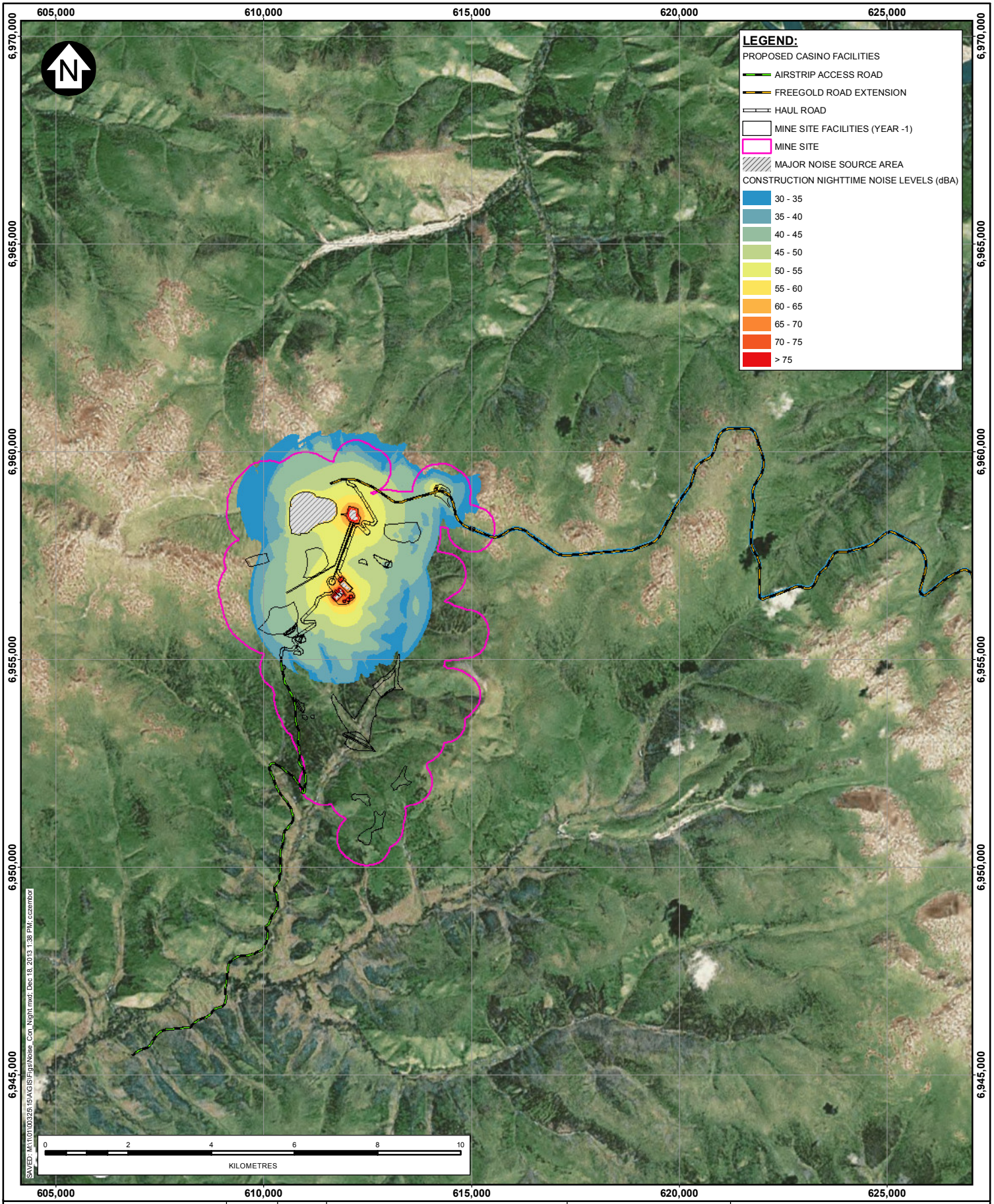
CASINO PROJECT

CONSTRUCTION MAXIMUM NOISE LEVELS DURING DAYTIME (dBA)

FIGURE 9.4-1

REF 1

P/A VA101-325/15



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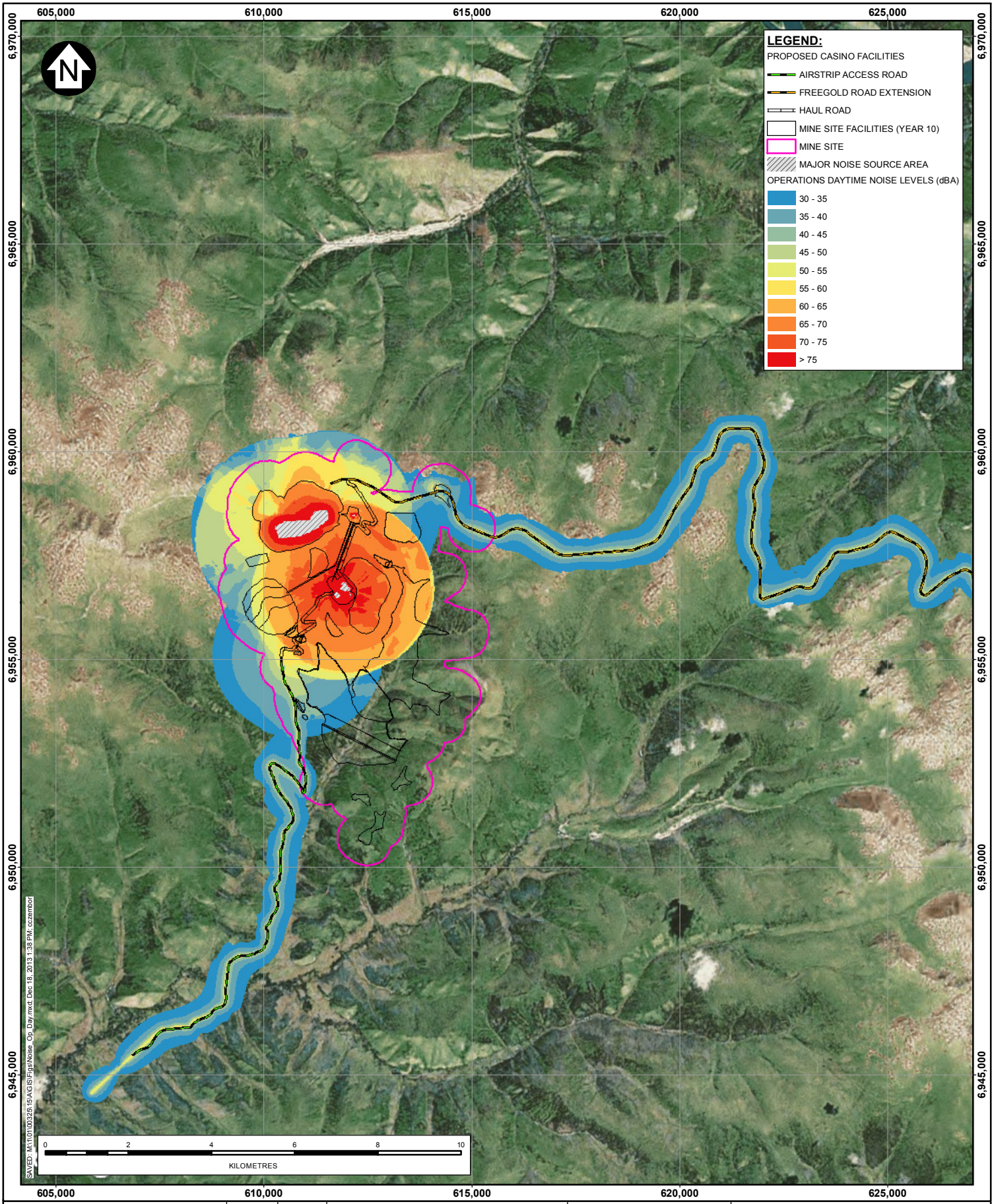
CASINO PROJECT

CONSTRUCTION MAXIMUM NOISE LEVELS DURING NIGHTTIME (dBA)

FIGURE 9.4-2

REF 1

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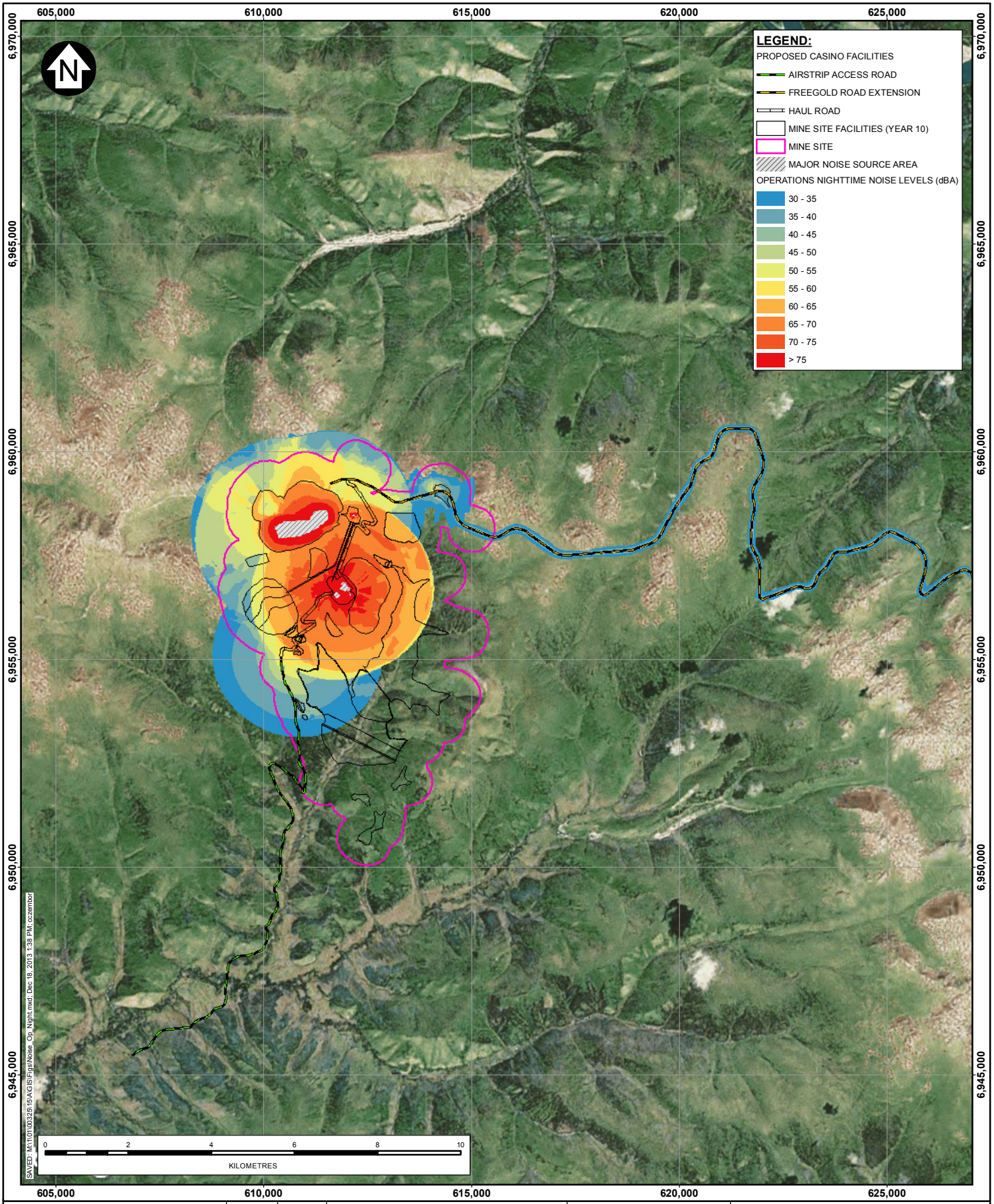
CASINO PROJECT

OPERATION MAXIMUM NOISE LEVELS DURING DAYTIME (dBA)

FIGURE 9.4-3

REF 1

P/A VA101-325/15



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NOTES:
1. BASE MAP: ESRI ARCGIS ONLINE BING MAPS.
2. PROJECTION: NAD 1983 UTM Zone 7N.
3. COORDINATE GRID: METRES.

CASINO COPPER AND GOLD

CASINO PROJECT

OPERATION MAXIMUM NOISE LEVELS DURING NIGHTTIME (dBA)

FIGURE 9.4-4

REF 1

P/A VA101-325/15

9.4.1 Determination of Potential Interaction(s) Between the Project and the VC

As discussed in Section 4, the Project will consist of a copper, gold, silver, and molybdenum open pit mine that is anticipated to process on average 120,000 t/d of material over 22 years of full production. Additionally, the Project also includes several ancillary support facilities as well as the Freegold Road Upgrade and Extension.

An interactions table was completed to determine the main Casino Project components and activities that could contribute to noise effects (Table 9.4-2). The potential effects were summarized for all phases of the Project. The Project components and activities that will potentially contribute to noise effects were carried forward into the effects assessment for noise.

Table 9.4-2 Potential Interactions between the Project and Noise

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (Or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	Yes	C, O, CD	Construction-related noise
Aggregate sources / Borrow Sites	Yes	C	Construction-related noise
Airstrip and Airstrip Access Road	Yes	C, O, CD	Occasional plane and helicopter fly-overs and landing noise
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	Yes	C, O	Noise due to construction equipment use
Concentrate Transport and Loading	Yes	O	Vehicle noise
Concrete Batch Plant Operation	Yes	C, O	Unit construction noise and operation noise
Contracted Employment	No	C, O, CD	Not a source of noise
Cyclone Sand Plant	Yes	C, O	Construction-related noise
Dismantling of Facilities	Yes	CD	Noise during dismantling
Diversion of Canadian Creek	Yes	C, O	Construction-related noise
Drilling and Blasting	Yes	C, O	Noise during drilling and blasting
Fish Habitat Compensation Construction	Yes	C, O	Construction-related noise
Freegold Road Extension	Yes	C, O, CD	Construction-related noise
Freegold Road Upgrade	Yes	C, O, CD	Construction-related noise
Fuel Storage and Distribution System	Yes	C, O	Construction- and operation-related noise
Gold Extraction Plant / Oxide Ore Processing	Yes	C, O	Construction-related noise
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	Yes	C	Construction-related noise
Hazardous Materials Storage, Transport, and Disposal	Yes	C, O	Transportation-related noise such as loading, unloading and traffic

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (Or Rationale for No Interaction)
Heap Leach Facility	Yes	C, O	Noise during equipment use
Heap Leach Pad	Yes	C, O	Noise during equipment use
Laydown Areas	No	C, O	Not a source of noise
LNG Transport to site	Yes	C, O	Transportation-related noise such as loading, unloading, and traffic
Main and Supplemental Power Plant (Gas Turbine and Diesel)	Yes	C, O	Noise during installation and operation
Maximum Disturbance Area	No	C, O, CD	Not a source of noise
Mine Development	No	C, O, CD	Not a source of noise
Mine Staffing	No	C, O, CD	Not a source of noise
On-site equipment and vehicle use	Yes	C, O, CD	Noise during equipment use
Open Pit Mining	Yes	C, O	Noise during equipment use, pioneering activities, in-pit hauling, loading, unloading, drilling and blasting
Ore Conveyors	Yes	C, O	Installation- and operation-related noise
Ore Crushing	Yes	C, O	Installation- and operation-related noise
Ore Hauling	Yes	C, O	Construction- and traffic-related noise
Ore Stockpiles	No	C, O	Not a source of noise
Processing Facilities for Sulphide Ore	Yes	O	Installation and other construction-related noise
Reagent Storage and Distribution	Yes	C, O	Installation and other construction-related noise
Site Reclamation / Re-Vegetation	Yes	O, CD	Construction-related noise
Site Security and Fencing	Yes	C, O, CD	Construction-related noise
Surface Water Management (Contact Water)	Yes	C, O, CD	Construction-related noise
Surface Water Management (Non-Contact Water)	Yes	C, O, CD	Construction-related noise
Tailings Management Facility	Yes	C, O, CD	Construction-related noise
Topsoil Stockpiles	Yes	C, O	Construction-related noise
Traffic (Equipment and Materials to Site)	Yes	C, O, CD	Vehicle noise
Waste management: garbage and sewage waste facilities	Yes	C, O	Construction-related noise
Waste rock and Overburden Disposal	Yes	C, O	Construction-related noise
Water Supply	Yes	C, O,	Construction-related noise

Project Components and Activities	Potential Interaction (Y/N)	Project Phase	Mechanism of Interaction (Or Rationale for No Interaction)
		CD, PC	

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

The Project components and activities that are identified above as interacting with the Project will do so primarily during the construction phase as well as the operations phase via equipment use and vehicle-related noise. Table 9.4-3 describes the key indicators that would be affected and also details the potential effects. For noise, potential effects are quantified solely in terms of OGC guideline comparisons.

Table 9.4-3 Potential Effects on Noise

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC	Potential Effect	Direction
Construction-related noise at the road and mine site	Elevated Sound Levels	C, O, CD	Exceedance of OGC guidelines during construction	Adverse
Operations-related noise at the mine site	Elevated Sound Levels	O	Exceedance of OGC guidelines during operations	Adverse
Noise during drilling and blasting	Elevated Sound Levels	C, O	Exceedance of OGC guidelines during operations	Adverse
Vehicular noise at the road	Elevated Sound Levels	C, O, CD	Exceedance of OGC guidelines during construction and operations	Adverse
Transportation-related noise such as loading, unloading, and traffic at the road and mine site	Elevated Sound Levels	C, O	Exceedance of OGC guidelines during operations	Adverse
Occasional plane and helicopter fly-overs and landing noise at the airstrip	Elevated Sound Levels	C, O, CD	Exceedance of OGC guidelines during operations	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

9.4.2 Identification of Mitigation Measures and Potential Residual Effects

CMC will institute mitigation measures to minimize the potential effects of elevated noise, as summarized in Table 9.4-4. Each mitigation measure has been assigned a rating for predicted effectiveness that has been based on professional literature as well as publically available information on similar projects. Yukon Occupational Health Regulations include noise control in the mine site, thus mitigations for workers are not part of this study.

Table 9.4-4 Identification of Mitigation Measures and Potential Residual Effects for Air Quality

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Increase in baseline noise level conditions during construction	C, O, CD	Adverse	Ensure regular equipment maintenance, including lubrication and replacement of parts.	Moderate	Yes
			Keep noisy equipment inside of buildings and sheds whenever possible.	High	
			Equipment will be operated with covers, shields, and hoods if provided by their manufacturer.	Moderate	
			Site workers will be trained in proper machine use and maintenance.	Moderate	
Increase in baseline noise level conditions during operations	O	Adverse	Ensure regular equipment maintenance, including lubrication and replacement of parts by following manufacturer's recommendations.	Moderate	Yes
			Keep noisy equipment inside of buildings and sheds whenever possible.	High	
			Adhere to a blasting plan developed by an explosives contractor that implements controlled blasting procedures.	High	
			Optimisation of blasting operations by licensed staff which maximise localised rock breakage within the ore body of interest, while minimising non-productive noise, vibration and flyrock effects.	High	
			Impose speed limits for all vehicles.	Moderate	
			Institute a policy for all equipment and vehicles to reduce and limit idling.	Moderate	
			Wherever practicable, noisy equipment will be located near ground level to minimize noise propagation.		

Notes

1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

9.4.3 Significance of Residual Effects

Residual effects are those that remain after mitigation measures have been applied. In accordance with Section 5, the residual effects on noise were assessed based on eight rating criteria to determine the likelihood for a significant adverse effect (Table 9.4-5).

Table 9.4-5 Determining Significance of Residual Effects for Noise

Criteria	Rating	VC Specific Definitions
Magnitude	Low	Noise levels are similar to baseline conditions or slightly higher.
	Medium	Noise levels are increased but still within acceptable regulatory limits or objectives.
	High	Noise levels are increased and exceed regulatory limits or objectives.
Geographical Extent	Localized	Effect on Noise is limited to the LSA.
	Widespread	Effect on Noise is limited to the RSA.
Duration	Short Term	Effect lasts for less than 3 years.
	Long Term	Effect lasts for greater than 3 years but less than 25 years.
	Permanent	Effect does not change beyond lifespan of the Project.
Frequency	Infrequent	Occurs occasionally or less than 1% of the time.
	Frequent	Occurs regularly.
Reversibility	Reversible	Noise levels will return to baseline conditions after Project closure.
	Irreversible	Noise levels will remain elevated after Project closure.
Context	Low resilience	Noise as a whole is able to accommodate the change.
	High resilience	Noise as a whole cannot accommodate the change.
Probability of occurrence	Low	Effect is not likely to occur.
	High	Effect is likely to occur.

Each of the residual effects from Table 9.4-4 underwent a significance determination as shown in Table 9.4-6. The Casino Project is not likely to have significant negative residual effects on noise after the implementation of mitigation measures, especially since all effects are localized to the LSA and reversible after the cessation of the operations phase of the Project.

Table 9.4-6 Significance of Residual Effects for Noise

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Increase in baseline noise level conditions during construction	Adverse	Medium	Localized	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
Increase in baseline noise level conditions during operations	Adverse	Medium	Localized	Long Term	Infrequent	Reversible	High Resilience	High	Not Significant

9.4.4 Discussion of Significance

Based on the effects assessment, the Casino Project is not likely to have any significant adverse effects on ambient noise levels after the implementation of mitigation measures. This is summarized in Table 9.4-7. The levels of confidence in these predictions are high as the Cadna/A outdoor sound propagation and RLP 90 model is a strong model for predicting outdoor noise sources and traffic. The worst case years were modelled and major noise sources (such as open pit activities and stationary equipment) were considered in order to determine peak activity levels.

Table 9.4-7 Summary of Residual Effects after Mitigation Measures

Potential Residual Effect	Direction	Significance	Level of Confidence
Increase in baseline noise level conditions during construction	Adverse	Not Significant	High
Increase in baseline noise level conditions during operations	Adverse	Not Significant	High

9.5 CUMULATIVE EFFECTS ASSESSMENT

9.5.1 Introduction

The residual noise effects of the Casino Project were assessed in relation to the residual effects of other past, present, and reasonably foreseeable projects and activities. These projects and activities are discussed in greater detail in Appendix 5B, and include quartz mines, mineral and placer claims, heritage sites, and registered outfitting and trapline concessions.

9.5.2 Identification of other Projects or Activities

Table 9.5-1 contains the list of projects that were included in the cumulative effects assessment for noise. Mineral and placer claims were not included in the cumulative effects assessment for noise due to the lack of available information regarding expected sound levels. Heritage sites and registered outfitting and trapline concessions were also excluded in the cumulative effects assessment as these activities do not generate significant amounts of noise. A list of past, present, and reasonably foreseeable quartz mines was analyzed to determine which

projects could potentially interact with the residual effects on noise from the Project to produce a cumulative effect. Projects located in the vicinity of the Freegold Road were selected for analysis as they could potentially share a spatial overlap with the Project. Of the three projects within the vicinity of the Freegold Road, two (Minto Copper Mine and Carmacks Copper Mine) were included in the cumulative effects assessment. The third project, the Mount Nansen Mine, was not included as this is a past project that has undergone decommissioning and thus does not generate noise.

Table 9.5-1 Residual Effect Information for Other Projects or Activities – Noise

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Minto Copper Mine	Present	Potential for overlap with Freegold Road resulting in increased noise levels	No overlap with Casino Project footprint or Freegold Road	Mine is expected to operate until 2022
Carmacks Copper Mine	Likely Future	Potential for shared transportation corridor resulting in increased noise levels	Potential for overlap with Freegold Road Upgrade	Operations are expected to start in 2016 and last for at least 7 years

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

9.5.3 Interactions and Potential Cumulative Effects

The interaction matrix shown in Table 9.5-2 was used to determine whether any spatial or temporal overlap exists between the residual effects of the Project and the Minto Copper Mine and/or Carmacks Copper Mine.

Table 9.5-2 Cumulative Effects Assessment Interactions Matrix – Noise

Casino Project Residual Effect	Potential Spatial and Temporal Overlap	
	Minto Copper Mine	Carmacks Copper Mine
	Potential for overlap with Freegold Road resulting in increased noise levels	Potential for shared transportation corridor resulting in increased noise levels
Increase in baseline noise level conditions during construction	YES	YES
Increase in baseline noise level conditions during operations	YES	YES

As shown, both projects assessed will overlap spatially and/or temporally with the Casino Project. This is due to their close proximity to the Freegold Road, as well as the overlap in the years of operation of all projects. This may lead to the potential cumulative effect described in Table 9.5-3. Similar to the Project's residual effects, the cumulative residual effect would be an exceedance of OGC guidelines at the Freegold Road.

Table 9.5-3 Potential Cumulative Effects – Noise

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Increase in baseline noise level conditions during construction	Minto Copper Mine Carmacks Copper Mine	Exceedance of OGC guidelines at the Freegold Road
Increase in baseline noise level conditions during operations	Minto Copper Mine Carmacks Copper Mine	Exceedance of OGC guidelines at the Freegold Road

9.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

As discussed in Section 5, the mitigation measures applied or recommended for potential cumulative effects may be considerably different than those applied to Project-specific effects. These mitigation measures often require regional stakeholder involvement to address complex regional cumulative effects.

The mitigation measures discussed in Table 9.5-4 primarily involve adhering to a Road Use Plan that minimizes potential noise exceedances, while also monitoring for noise exceedances at the Freegold Road.

Table 9.5-4 Additional Mitigation Measures and Residual Cumulative Effects – Noise

Potential Cumulative Effect	**Mitigation Measures for Project-Specific Effects**[1]	**Additional Mitigation**[2] (if possible)	**Effectiveness of Additional Mitigation Measure** (Low, Moderate, High, Unknown)	**Residual Cumulative Effect** (Yes/No)
Exceedance of OGC guidelines	Road Use Plan	Noise Monitoring or modelling if receptors exist at affected areas	High	No

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

9.5.5 Significance of Residual Cumulative Effects

Residual cumulative effects are those that remain after mitigation measures have been applied. Since no residual cumulative effects are anticipated, a significance determination was not necessary.

9.5.6 Discussion of Significance of Residual Cumulative Effects

As discussed in Section 9.5.5, no residual cumulative effects are anticipated.

9.6 SUMMARY AND CONCLUSIONS

The noise effects assessment for the Casino Project includes baseline daytime and nighttime noise data, as well as predictions derived from Cadna/A outdoor sound propagation modelling. As Yukon does not have any established environmental noise standards or guidelines, the BC OGC noise control guidelines for operating plants were used as performance targets for noise at the Project. Sound modelling was used to predict noise levels and potential effects were determined. CMC has proposed several mitigation measures that can minimize the potential effects of the Casino Project components and activities on noise. Overall, the modelling results

confirm compliance with BC OGC Guidelines once mitigation measures are applied. Therefore, the Casino Project is not likely to have significant negative effects on noise after the implementation of mitigation measures.

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10 – FISH AND AQUATIC RESOURCES

10.1 INTRODUCTION

10.1.1 Regional Setting

The federal *Fisheries Act* provides the legislative basis for the protection of fish and fish habitat throughout Canada. In Yukon, Fisheries and Oceans Canada (DFO) is the primary guardian of freshwater and marine fish habitat conservation and protection, and principally responsible for implementation and enforcement of *Fisheries Act* policy. Habitat is defined as ""spawning grounds and nursery, rearing, food supply and migration areas on which fish depend on directly or indirectly in order to carry out their life processes." All fish are protected at varying life stages from eggs, spawn, spat, and juveniles, to adult fish. The Policy for the Management of Fish Habitat (1986) outlines DFO's objectives in administering the *Fisheries Act*, and emphasizes the long-term goal of Net Gain in productive capacity of fish habitats in order to achieve the underlying principle of "No Net Loss".

The *Fisheries Act* outlines several regulations which may restrict or alter project activities:

- Sections 20-22: Fish Passage;
- Section 30: Fish Guard or Screen;
- Section 32: Destruction of Fish;
- Section 35: Harmful Alteration, Disruption, or Destruction of Fish Habitat (HADD); and
- Section 36: Deleterious discharges.

Mitigation measures and adherence to DFO guidelines (e.g., Freshwater Intake End-of-Pipe Fish Screen Guidelines) will ensure regulatory compliance for the majority of project activities. However, authorizations under *Fisheries Act* Section 35(2) will be required where a HADD is unavoidable following the exhaustion of all alternative options for re-design, re-location and mitigation. In anticipation of required habitat loss, a Fish Habitat Compensation Plan (Appendix 10C) has been developed to achieve DFO's guiding principle of "No Net Loss".

Fisheries management, such as setting harvesting quotas, issuing fishing licenses, and conducting stock assessments is jointly managed by the territorial and federal governments, with freshwater fisheries falling under the jurisdiction of the Fish and Wildlife branch of Environment Yukon, and anadromous and marine fisheries under the federal Fisheries and Oceans Canada (DFO). The management of Yukon River salmon is further regulated by two specialized non-governmental advisory bodies, the trans-boundary Yukon River Panel and the territorial Yukon Salmon Committee. Both advisory bodies provide recommendations to DFO regarding stock preservation, habitat conservation and the enhancement of renewable resource economies. The great emphasis on Yukon River salmon management derives from the species' ecological, cultural and economic value to its residents. As many Yukon salmon populations are in decline or stable yet well below historical levels, the protection and enhancement of freshwater habitats which support critical life stages is increasingly important.

While the *Species at Risk Act* is applicable in Yukon, there are no fish species currently listed on Schedules 1 or 2 of the *Act* within the territory. Under the *Act*, species must be elevated to a Schedule 1 status to warrant legal protection (GoC 2013).

The fish and aquatic resources effects assessment has been completed during a time of transition for environmental legislation in Canada. In this proposal, terminology relating to *Fisheries Act* policy is consistent with the older version of the *Act*, as the new provisions did not come into force until November 25, 2013, and as a

consequence have yet to be widely implemented. New and forthcoming fisheries protection provisions relevant to this proposal include amendments to Section 35 of the *Fisheries Act*, and to the supporting Fish Habitat Compensation Guide. The updated policy will support DFO's new focus on avoiding "Serious Harm to Fish", and the framework for offsetting any residual serious harm to fish.

Under the new provisions, the Casino Project will still require a *Fisheries Act* authorization and outlined plan to compensate for impacts, although the focus will be re-directed at maintaining or enhancing the ongoing productivity and sustainability of commercial, recreational and Aboriginal fisheries. Fish that support the productivity of commercial, recreational and Aboriginal fisheries are also covered under the *Act*, which includes any fish species with demonstrable effects on fisheries production including but not exclusively limited to prey species. A habitat-based model will still be an acceptable approach to calculating productivity, and may be overly conservative for large-scale projects such as Casino where there is a large impacted habitat area containing low fisheries productivity. However, more flexibility is offered by the new fisheries productivity offsetting guide which identifies several alternative means for maintaining productivity when a habitat-based compensation approach is determined to be less effective (DFO 2013).

10.1.2 Rationale for VC Selection

The Fish and Aquatic Resources VC assesses the potential effects of the proposed Project on aquatic habitat loss and alteration, and lethal and sub-lethal impacts on fish and other aquatic organisms within the LSA. Primary and secondary producers such as periphyton and benthic invertebrates are key components of the aquatic food web foundation, providing food sources for higher trophic levels (e.g., fish and birds), and are useful as indicators of overall aquatic health due to their relatively long-lived and sedentary life histories. Fish have ecological, cultural, recreational and commercial value as they support various fisheries, and constitute a fundamental role in aquatic ecosystem functioning. The protection of fish and fish habitat is built into the environmental legislation of the *Fisheries Act*, which ensures that project activities do not impact the overall productive capacity of fish habitat. The key indicators selected to assess fish and aquatic resources are fish habitat, and fish and aquatic organism health.

10.2 ASSESSMENT BOUNDARIES

10.2.1 Local Study Area (LSA)

The Local Study Area (LSA) for the fish and aquatic resources of the Casino Project includes the direct footprint of the proposed Project mine and near-field affected areas which have the potential to be affected by the Project (Figure 10.3-1). The LSA is defined by the boundaries of the two watersheds surrounding the Project deposit (also known as Patton Hill): the Britannia Creek watershed to the north and the Casino Creek watershed to the south. The LSA also includes a 5 km-long reach of Dip Creek downstream of its confluence with Casino Creek, several Dip Creek tributaries within the airstrip and airstrip access road footprint, and several watersheds along the Freegold Road corridor which extends from the Village of Carmacks to the Casino Project area. The LSA surrounding the airstrip, airstrip access road, and Freegold access road is defined as 100 m upstream and 1000 m downstream of any stream crossing.

Most of the proposed mine infrastructure will be in the Casino Creek watershed, with some (e.g., the northern corner of the open pit) found within the Britannia Creek watershed. The northern part of the LSA is drained by Britannia Creek and its main tributary, Canadian Creek, which flow northward into the Yukon River. The southern part of the property is drained by Casino Creek which flows south to Dip Creek and thence to the Yukon River via the Klotassin, Donjek and White rivers. The Freegold Road corridor crosses several major and minor watersheds,

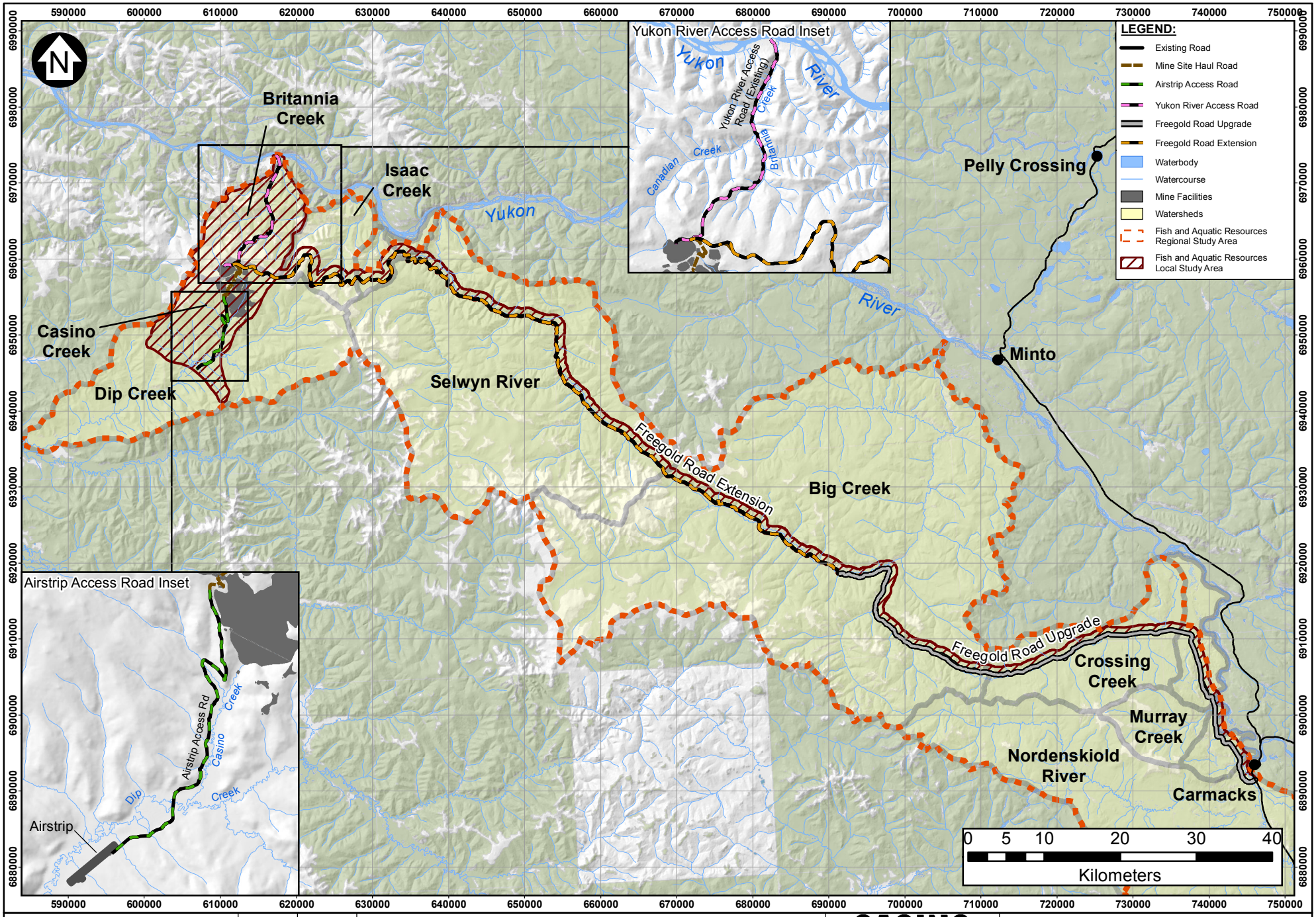
beginning with the Nordenskiold River just west of Carmacks, followed by Murray Creek, Crossing Creek, Big Creek, Selwyn River including Hayes Creek, and Isaac Creek.

10.2.2 Regional Study Area (RSA)

The fish and aquatic resources Regional Study Area (RSA) was defined as the LSA plus adjacent areas that have the potential to experience either indirect (mid-to-far field), or cumulative effects due to interactions with other projects (Figure 10.2-1). Indirect effects may occur in Dip Creek, both upstream of the Casino Creek confluence, and downstream to the Klotassin River. Cumulative effects along the road corridor may occur in several watersheds including Isaac Creek, Selwyn River including Hayes Creek, Big Creek, Crossing Creek, Murray Creek and the Nordenskiold River.

10.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment are defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project is provided in Section 4.



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	A.Murdoch
APP'D	A. Murdoch
REV	R. Palmer
DATE	4Sept'13

NOTES:

1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:650,000

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Fish and Aquatic Resources Regional and Local Study Area

FIGURE 10.2.1

REF

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10.3 BASELINE CONDITIONS

Detailed baseline information is contained in the Fish and Aquatic Resources Baseline (Appendix 10A), and in the Freegold Road and Airstrip Fish and Aquatic Resources Baseline (Appendix 10B). Summaries of these two baseline reports are provided below.

Casino Mine Site Baseline Study

Fish and aquatic resource studies were conducted from 2008 to 2013 at 29 fish sampling sites, 18 fish habitat sites, and 14 benthic invertebrate and periphyton sites throughout the Project LSA (Figure 10.3-1). The six seasonal assessments were completed during July and September of 2008, August 2009, August 2010, August and September 2011, July and September 2012, and June and July 2013. Sites were concentrated in the Casino Creek and Britannia Creek watersheds as they have the potential to be directly affected by the Project.

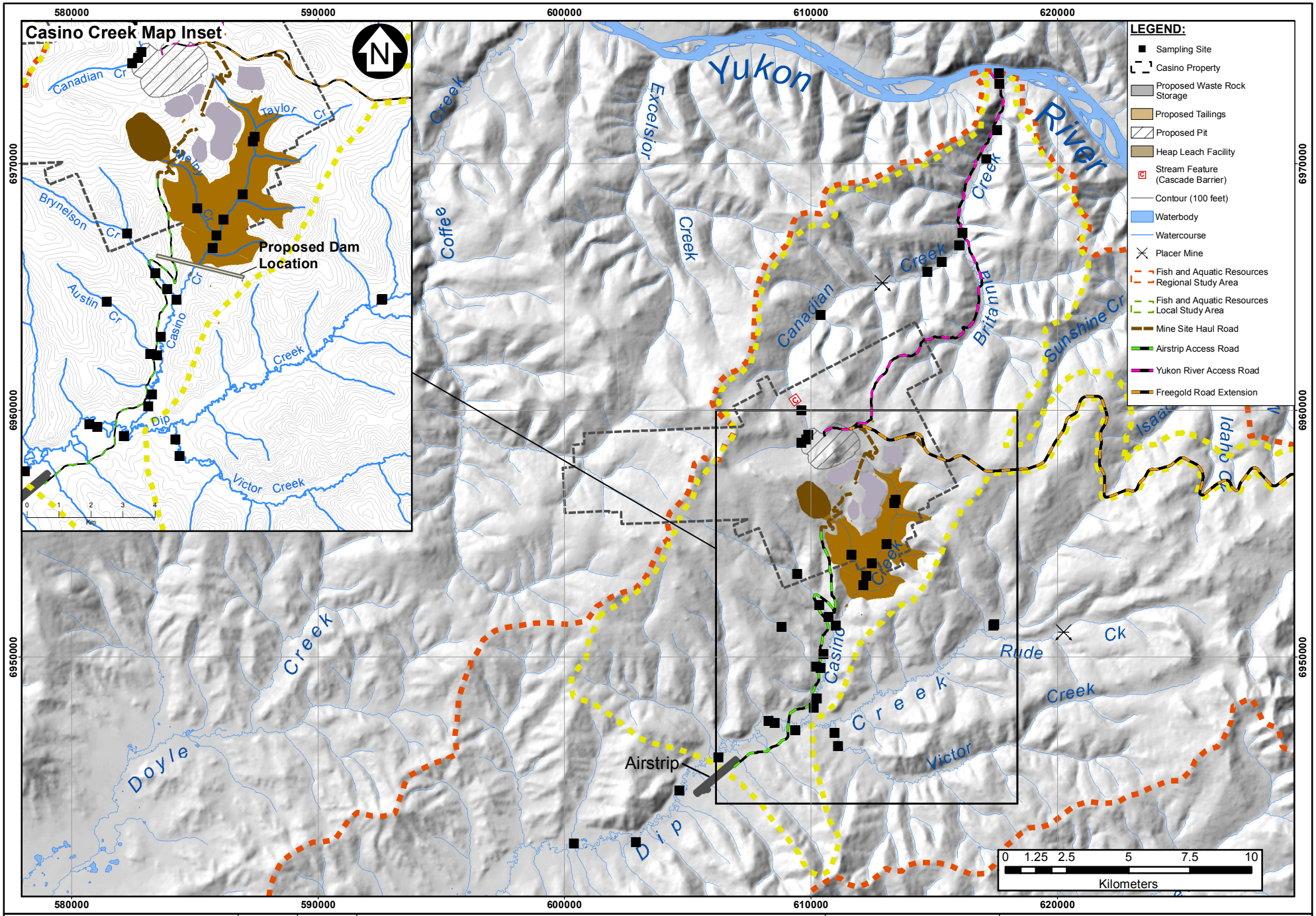
Backpack electrofishing and minnow trapping were the primary fish sampling methods used. At each site, individual fish data (species, length, weight) were collected to infer fish community composition, relative abundance, and life history use. Ageing structures (e.g., scales, otoliths) and fish tissues were sub-sampled and analyzed to determine fish ages and baseline metal concentrations of resident fish species. Multi-year Chinook salmon spawning surveys were completed in the Dip and Britannia Creek watersheds. Fish habitat in the Project area was surveyed and analyzed relative to the potential for supporting rearing, spawning and overwintering activities of local fish species. To further characterize local fisheries, benthic invertebrate and periphyton studies were conducted to assess the primary productivity, community characteristics, and overall aquatic ecosystem health in the Project area.

Benthic invertebrate communities in the Casino Creek watershed generally displayed lower densities, richness, diversity, and Ephemeroptera-Plecoptera-Trichoptera (EPT) abundances, relative to other watersheds in the Project area. Sites in the upper watershed had particularly low values when compared to lower Casino Creek or to reference areas of upper Dip Creek, and were likely due to a combination of cold water temperatures, high velocities, and poor water quality as a result of anthropogenic and natural acid rock drainage (ARD) from Meloy Creek and Proctor Gulch. Similarly, sites in upper Casino Creek displayed low periphyton densities and taxonomic richness in comparison to lower Casino Creek, or to reference areas of upper Dip Creek. Further, periphyton diversity values were significantly lower in Casino Creek in comparison to Britannia Creek, with the lowest values observed in the upper watershed. Notably, future monitoring will focus on comparing Dip Creek reference areas to the near-field site in lower Casino Creek, as sites in the upper watershed will be displaced following project construction of the tailings management facility. Accordingly, baseline periphyton and benthic invertebrate communities were similar in Dip Creek reference areas to lower Casino Creek, thus facilitating the future assessment of potential impacts. Benthic invertebrate community trends within sites in the Britannia Creek watershed often differed from Dip and Casino Creeks, with the more upstream sites exhibiting higher taxonomic richness, EPT abundance and diversity in comparison to downstream sites. Similarly, periphyton communities in the upper watershed demonstrated higher diversity values, although at lower densities. The greater taxonomic diversity and abundances observed in the upstream reaches of the Britannia Creek watershed may relate to disturbances associated with recent (1996-2002) placer mining in lower Canadian Creek.

Slimy sculpin (*Cottus cognat*us) and Arctic grayling (*Thymallus arcticus*) were the most dominant species captured, with low numbers of burbot (*Lota lota*) and round whitefish (*Prosopium cylindraceum*) also present in the lower watersheds. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were captured in lower Britannia Creek in 2009 and 2011 near the Yukon River confluence. Sampling of Dip Creek from 2008-2013 by AECOM and PECG yielded no juvenile Chinook salmon, however, historical documentation of juveniles in the lower to mid reaches, and the more recent capture of a single juvenile by Summit (2012) indicates that Dip Creek may provide occasional habitat for low abundances of juvenile Chinook. No Chinook salmon have been captured either recently or historically within Casino Creek. No Chinook salmon spawning was observed in either watershed despite multi-year surveying. No species at risk were caught within the Project study area.

Four years of fish sampling in upper Casino Creek included 11,904 seconds (s) of electrofishing effort and 1,255 hours (h) of minnow trapping, with a total catch of 14 Arctic grayling within reach 2. A medium gradient (8-10%) cascade marks the reach break between reaches 2 and 3, and likely constitutes a high-flow barrier to fish migration in most years. Accordingly, fish sampling over three years yielded no fish in reach 3. However, in 2013 four Arctic grayling were captured within 250 metres (m) of the cascade during exceptionally clear and low flow conditions. No fish were caught in the small (<1 m channel width) upper Casino Creek tributary, Meloy Creek. Fish abundance was higher in the lower watershed, with catch-per-unit-efforts (CPUEs) of 0.5 and 0.9 fish/100s of electrofishing in Brynelson and lower Casino Creeks, respectively. The fish communities were dominated by slimy sculpin (71-89%) followed by Arctic grayling (10-29%). Downstream of Casino Creek, relative fish abundance and community diversity further increased within Dip Creek, with the most downstream site (F20) exhibiting the highest CPUE of any site in the project area at 4.5 fish/100s of electrofishing.

Within the Britannia Creek watershed, site Y1 located proximate to the Yukon River had the second highest CPUE in the project area at 4.4 fish/100s of electrofishing. The fish community at Y1 was comprised of slimy sculpin (64%), juvenile Chinook salmon (34%), and Arctic grayling (2%). At sites upstream of Y1, only Arctic grayling were captured. In the three reaches of Canadian Creek, fish were caught only in the lower two reaches. A 20% gradient probable fish barrier was located at the junction of reaches 2 and 3, and prohibited fish from moving further upstream.



PREPARED BY:

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

DESIGNED	D. Turner
DRAWN	D. Turner
CHK'D	A. Murdoch
APP'D	A. Murdoch
REV	R. Palmer
DATE	5Nov'13

NOTES:

1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:200,000

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Fish and Aquatic Resources Sampling Sites

FIGURE 10.3.1

REF REPORT 1

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Three years of sampling yielded a CPUE of 0.8 fish/100s electrofishing at the Victor Creek reference site, where the community was predominantly slimy sculpin (88%). However, no fish were caught in 2012 at this site. A site in the upper Coffee Creek watershed was added to the baseline program in 2012 to supplement Victor Creek as a reference site. Two years of sampling yielded a total of 12 Arctic grayling and one round whitefish at a rate of 0.8 fish per 100s of electrofishing effort.

Statistical testing indicated that length-weight relationships of Arctic grayling did not vary among watersheds. The majority of Arctic grayling captured in the project study area were greater than 125 mm in length, and thus represented age classes 1+. Sizes corresponding to probable young-of-the-year (<70 mm) were only observed in Dip Creek below its confluence with Casino Creek, and at site Y1 on Britannia Creek. The lack of young-of-the-year rearing in the majority of the Project area suggests that Arctic grayling spawning activities are correspondingly minimal. Habitat survey results were consistent with fish sampling results, as the potential for spawning habitat throughout the Project area was mostly rated none to poor, with some moderate spawning potential identified in Dip and Britannia Creeks, as well as in reach 1 of Casino Creek. Reference to the habitat suitability maps produced by the Yukon Mining Secretariat indicates that watercourses within the Project area do not support spawning activities or provide critical migratory corridors for spawning Chinook salmon.

Rearing habitat was the most common habitat type identified in the Project area, with most sites having rankings from moderate to good. Poor rearing habitat quality was documented in upper Casino Creek and in reach 1 of Brynelson Creek, and was mainly attributed to a lack of potential fish resting or protective locations. In particular, upper Casino Creek had several long medium gradient (5-11%) cascades comprised of a number of potential flow-regulated barriers hindering both juvenile and adult rearing activities. Fish habitat suitability maps from the Yukon Mining Secretariat were in accordance with baseline study results, with Casino, Canadian and Victor Creeks designated as low suitability areas unlikely to support juvenile Chinook rearing. Further, habitat supporting juvenile Chinook rearing activities was most probable in the lower Britannia Creek watershed, and in the lowest 10 km of Dip Creek.

Due to the lack of deep pools and the noted occurrence of anchor ice around the Project area, the potential for overwintering habitat was generally sparse. Areas of exception included Dip Creek at F14 and Victor Creek which were deeper and wider channels and are less likely to freeze to bottom.

Tissue samples from slimy sculpin in Britannia Creek demonstrated the highest metal concentrations with significantly greater aluminum, arsenic, cadmium, iron, lead, nickel and selenium concentrations compared to the other watersheds sampled. As all slimy sculpins analyzed from Britannia Creek were captured adjacent to the Yukon River confluence, higher metal loading was likely due to the influence of Yukon River back-watering in addition to the potential for small-scale movements (<100 m) between the two environments. The second overall highest tissue metal concentrations in the study area were observed in Casino Creek, where sculpins had significantly higher arsenic, cadmium, copper and lead concentrations in comparison to sculpins from Dip and/or Victor Creeks. These results were consistent with water and sediment quality studies which have documented consistently poor water quality in Casino Creek as a result of local sources of natural acid rock drainage (ARD) which enter the upper watershed via Proctor Gulch and Meloy Creek. Mean selenium concentrations in slimy sculpin tissues in Britannia and Victor Creeks exceeded the selenium guidelines for the protection of freshwater aquatic life. Mean estimated methylmercury concentrations exceeded the guideline for the protection of fish-eating (piscivorous) wildlife in all watersheds.

Freegold and Airstrip Access Road Baseline Study

The objective of the fish and aquatic resource baseline investigation was to characterize aquatic habitat at each watercourse crossing, and to determine fish bearing status (i.e., fish bearing or non-fish bearing) in support of the design and permitting of each aquatic habitat crossing.

The fish and aquatic resource studies were conducted in 2010, 2011 and 2013 at 61 locations along the Freegold Road Upgrade section, at 95 locations along the Freegold Road Extension and at 12 locations for the Airstrip Access Road (the "Casino Roads"). These assessments were conducted within the local study area and included the following watersheds: Big Creek, Selwyn River, Hayes Creek, Crossing Creek, Murray Creek, Isaac Creek, Mascot Creek, Dip Creek, the Nordenskiold River and Yukon Tributaries.

The type of fish species present and their general distribution within the study area is already well known. Within the watersheds crossed by the Casino Roads, Chinook salmon, chum salmon (*Oncorhynchus keta*), Arctic grayling, slimy sculpin, and round whitefish are known to be present. The study area contains very few lakes and therefore, overwintering habitat is primarily constrained to large groundwater fed rivers or small, deep pools. Many of these watercourses also provide critical spawning, rearing or overwintering habitat for known fish species. In addition, many of these watersheds have been previously disturbed by placer mining, quartz mining, and road crossings, and as a result may contain artificial barriers to fish movement.

The presence or absence of fish within each watercourse crossed by the Casino Roads was confirmed using: (1) a desktop GIS based assessment of stream gradients and barriers; (2) field investigations at all crossings to confirm channel gradient, location of barriers, flow regime, and site conditions; and (3) fish sampling at select watercourses where fish absence could not be confirmed based on habitat conditions alone.

Studies showed that the Freegold Road Upgrade had 22 fish bearing streams, the Freegold Road Extension had 56 fish bearing streams, and the Airstrip Access Road had six fish bearing streams. Fish sampling efforts were primarily targeted towards major watercourse crossings and smaller channels where the fish-bearing status could not be confirmed based on the desktop assessment and field investigations.

Rearing habitat was the most common habitat type identified in the Project area, with most low gradient (<5%), higher order watercourses having rankings from moderate to good. Poor rearing habitat quality was documented in many small tributaries with some watercourses only containing seasonal or connecting habitat.

Due to the lack of deep pools and the frequent occurrence of intermittent or ephemeral streams in the study area, the potential for overwintering habitat was generally sparse. This limits productivity in many small watercourses and suggests that many creeks in the study area may not provide critical habitat required for sustaining fish populations. Areas of exception included Big Creek, Hayes Creek, Selwyn River, Dip Creek and the Nordenskiold River. Smaller tributaries such as Bow Creek, Seymour Creek (downstream of the confluence with Bow Creek), Murray Creek, Apex Creek, and Brynelson Creek were also identified as having the potential to provide good overwintering habitat.

10.4 PROJECT-SPECIFIC EFFECTS

10.4.1 Project Interactions and Potential Effects

Several project components and activities were identified as having potential interactions with fish and aquatic resources in the LSA (Table 10.4-1). These include the Canadian Creek diversion and eventual decommissioning, construction of the airstrip and access roads, fish habitat compensation, mine development (increased fishing access), and the construction, operations, and decommissioning of the TMF. In addition, air quality effects due to

emissions and dustfall are assessed as a single component incorporating several project components and activities including blasting, ore conveying, crushing and hauling, on-site equipment and vehicle use and traffic along the access roads.

The majority of project components and activities have no anticipated interaction with fish and aquatic resources as they are well removed (≥30 m) from any nearby watercourses. Further, the potential risk of an interaction will be effectively mitigated with the implementation of best management practices such as erosion and sediment control measures, site water management, and proper storage and handling of equipment and fuel as outlined in the accompanying Erosion and Sediment Control Plan, Water Management Plan, and Environmental Management Plan.

Potential impacts were sub-divided into three categories for discussion: habitat loss and alteration, lethal effects on fish and aquatic organisms, and sub-lethal effects on fish and aquatic organisms. Within each section, impacts were further assessed by each project component and phase. All potential project effects were compiled within this framework (Table 10.4-2), assessed for residual impacts following mitigation and compensation measures (Section 10.4.3), and determined for significance (Section 10.4.4).

Table 10.4-1 Potential Interactions between the Project and Fish and Aquatic Resources

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	N	≥30 m away from nearest watercourse
Aggregate sources / Borrow Sites	C,	N	≥30 m away from nearest watercourse
Airstrip and Airstrip Access Road	C, O, CD,	Y	Stream infilling and riparian habitat removal In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors) Increased erosion and sedimentation in the Casino and Dip Creek drainages Metal leaching/Acid rock drainage (ML/ARD) Dust, emissions and road runoff from vehicle traffic Change in habitat productive capacity
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O,	N	≥30 m away from nearest watercourse
Concentrate Transport and Loading	O,	N	≥30 m away from nearest watercourse, or, addressed in Casino Emergency Response Plan (Appendix 22C)

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Concrete Batch Plant Operation	C, O,	N	An interaction is not anticipated because all contact water will be collected and directed into the TMF
Contracted Employment	C, O, CD,	N	An interaction is not anticipated with contracted employment
Cyclone Sand Plant	C, O,	N	≥30 m away from nearest watercourse
Dismantling of Facilities	CD,	N	≥30 m away from nearest watercourse
Diversion of Canadian Creek	C,O	Y	Stream infilling and riparian habitat loss within the open pit footprint Decommissioning of Canadian Creek diversion during closure, upstream flows re-directed into the open pit Increased erosion and sedimentation into Canadian Creek Surface drainage lost to the open pit during operations Change in habitat productive capacity
Drilling and Blasting	C,O	Y	Shockwaves and vibrations Blasting residues Dust created from construction blasting
Fish Habitat Compensation Construction	C,O	Y	Stream diversion into historic Britannia Creek Increased erosion and sedimentation at compensation construction sites In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors) Change in habitat productive capacity
Freegold Road Extension	C,O, CD	Y	Stream infilling and riparian habitat removal In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors) Increased erosion and sedimentation at road crossings Dust, emissions and road runoff from vehicle traffic Metal leaching/Acid rock drainage (ML/ARD) Change in habitat productive capacity

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Freegold Road Upgrade	C,O, CD	Y	Stream infilling and riparian habitat removal In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors) Increased erosion and sedimentation at road crossings Dust, emissions and road runoff from vehicle traffic Metal leaching/Acid rock drainage (ML/ARD) Change in habitat productive capacity
Fuel Storage and Distribution System	C,O	N	≥30 m away from nearest watercourse, or, addressed in Casino Emergency Response Plan (Appendix 22C)
Gold Extraction Plant / Oxide Ore Processing	C,O	N	≥30 m away from nearest watercourse
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C	N	≥30 m away from nearest watercourse
Hazardous Materials Storage, Transport, and Disposal	C,O	N	≥30 m away from nearest watercourse
Heap Leach Facility	C,O	N	≥30 m away from nearest watercourse
Heap Leach Pad	C,O	N	≥30 m away from nearest watercourse
Laydown Areas	C,O	N	≥30 m away from nearest watercourse
LNG Transport to site	C,O	Y	Dust, emissions and road runoff
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C,O	N	≥30 m away from nearest watercourse
Maximum Disturbance Area	C,O, CD	N	An interaction is not anticipated with the project footprint as a whole
Mine Development	C,O, CD	Y	Increased recreational fishing access
Mine Staffing	C,O, CD	N	An interaction is not anticipated with mine staffing
On-site equipment and vehicle use	C,O, CD	Y	Dust, emissions and road runoff
Open Pit Mining	C,O	N	All effluent will be conveyed to the TMF and will not enter nearby watercourses
Ore Conveyors	C,O	Y	Dust created from ore on overland transfer conveyors
Ore Crushing	C,O	Y	Dust created from the crushing of ore

Project Components and Activities	**Project Phase (C, O, CD, PC)**	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Ore Hauling	C,O	Y	Dust created from the transport of ore on roads
Ore Stockpiles	C,O	N	≥30 m away from nearest watercourse
Processing Facilities for Sulphide Ore	O	N	An interaction is not anticipated because all mine contact water will be directed into the TMF
Reagent Storage and Distribution	C,O	N	≥30 m away from nearest watercourse
Site Reclamation / Re-Vegetation	O, CD	N	An interaction is not anticipated with reclamation activities
Site Security and Fencing	C,O, CD	N	An interaction is not anticipated with security and fencing
Surface Water Management (Contact Water)	C,O, CD	N	All contact water will be directed to the TMF
Surface Water Management (Non-Contact Water)	C,O, CD	N	All drainage entering watercourses will be un-altered with the exception of the Canadian Creek diversion
Tailings Management Facility	C,O, CD	Y	In-stream and riparian habitat loss within TMF footprint Loss of downstream transport of flow, nutrients, food, and woody debris to lower Casino Creek Increased erosion and sedimentation into Casino Creek In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors) Augmentation of flows due to the closure spillway TMF pond seepage to lower Casino Creek Change in habitat productive capacity
Topsoil Stockpiles	C,O	N	≥30 m away from nearest watercourse
Traffic (Equipment and Materials to Site)	C,O, CD	Y	Dust, emissions and road runoff
Waste management: garbage and sewage waste facilities	C,O	N	≥30 m away from nearest watercourse
Waste rock and Overburden Disposal	C,O	N	An interaction is not anticipated because all waste rock and overburden will be disposed

Project Components and Activities	Project Phase (C, O, CD, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
			in the TMF
Water Supply	C,O, CD, PC	N	Initial water supply is within TMF footprint Long-term supply is from a riverbank caisson and radial well system adjacent to the Yukon River Extraction of groundwater will have a negligible impact on the Yukon River water table The water pipeline will be above ground following the existing Yukon River access corridor There will be no in-stream construction Construction within riparian areas will adhere to DFO operational statements

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Table 10.4-2 Potential Effects on Fish and Aquatic Resources

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
Augmentation of flows due to the TMF closure spillway	Fish Habitat	C,O, CD	Change in hydrology	Adverse
		C,O, CD	Change in stream morphology	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Change in water quality	Adverse
		C,O, CD	Change in stream temperature	Adverse
Blasting residues	Fish and Aquatic Organism Health	C,O	Lethal effects on fish and aquatic organisms due to blasting residue contamination	Adverse
		C,O	Sub-lethal impacts on aquatic biota due to blasting residue contamination	Adverse
Change in habitat productive capacity	Fish and Aquatic Organism Health	C,O	Sub-lethal effects on fish and aquatic organisms throughout the LSA	Adverse
Decommissioning of Canadian Creek diversion	Fish Habitat	C,O	Non-fish-bearing habitat loss (e.g., nutrients, food) in upper Canadian Creek	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
during closure, upstream flows re-directed into the open pit		C,O	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek	Adverse
	Fish and Aquatic Organism Health	C,O	Direct mortality of periphyton, benthic invertebrates, and fish eggs	Adverse
Dust, emissions and road runoff	Fish Habitat	C, O, CD,	Habitat degradation	Adverse
	Fish and Aquatic Organism Health	C, O, CD,	Lethal or sub-lethal effects on fish and aquatic organisms due to contamination	Adverse
Increased recreational fishing access	Fish and Aquatic Organism Health	C,O, CD	Increased fishing pressure on local fish populations	Adverse
Increased erosion and sedimentation due to construction activities and stream bank alteration	Fish Habitat	C,O, CD	Habitat loss and alteration	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Lethal effects on fish and aquatic organisms	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Sub-lethal effects on fish and aquatic organisms	Adverse
In-stream construction (de-watering, water extraction, use of heavy machinery, noise, tremors)	Fish and Aquatic Organism Health	C,O, CD	Lethal effects on fish and aquatic organisms such as trampling by heavy machinery, impingement or entrainment during water extraction, and stranding during de-watering	Adverse
		C,O, CD	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms	Adverse
Loss of downstream transport of flow, nutrients, food, and woody debris to lower Casino Creek	Fish Habitat	C,O, CD	Reduced stream flows, nutrients, food, woody debris in lower Casino Creek	Adverse
	Fish Habitat	C,O, CD	Change in water temperature in lower Casino Creek	Adverse
	Fish Habitat	C,O, CD	Change in stream morphology in lower Casino Creek	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to reduction of wetted habitat area	Adverse
Metal leaching/Acid Rock Drainage (ML/ARD)	Fish and Aquatic Organism Health	C,O, CD	Lethal effects on fish and aquatic organisms	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Sub-lethal effects on fish and aquatic organisms	Adverse
Shockwaves and vibrations	Fish and Aquatic Organism Health	C,O	Mortality of fish and incubating fish eggs	Adverse
		C,O	Sub-lethal impacts (e.g., stress, habitat avoidance) on fish and incubating fish eggs	Adverse
Stream diversion	Fish Habitat	C,O	Fish-bearing in-stream and riparian	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
into historic Britannia Creek for fish habitat compensation			habitat loss in lower Britannia Creek	
Stream infilling and riparian habitat removal	Fish Habitat	C,O, CD	Non-fish-bearing in-stream habitat loss and riparian habitat loss at airstrip access road crossings	Adverse
	Fish Habitat	C,O, CD	Fish-bearing in-stream and riparian habitat loss due to airstrip diversion channel	Adverse
	Fish Habitat	C,O, CD	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings	Adverse
	Fish Habitat	C,O, CD	Fish-bearing and non-fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek	Adverse
	Fish Habitat	C,O, CD	Non-fish-bearing in-stream and riparian habitat loss within the open pit footprint in upper Canadian Creek	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Direct mortality of periphyton, benthic invertebrates, and fish eggs	Adverse
Surface drainage lost to the open pit during operations	Fish Habitat	C,O	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek	Adverse
TMF pond seepage to lower Casino Creek	Fish Habitat	C,O, CD	Increased flows at closure/post-closure	Adverse
	Fish and Aquatic Organism Health	C,O, CD	Change in water quality in lower Casino Creek	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

10.4.1.1 Habitat Loss and Alteration

Habitat loss was identified at several locations throughout the LSA, both within the project footprint and due to habitat isolation of upstream areas. Potential habitat alterations included changes in stream flow, stream temperature, channel morphology, and availability of nutrients, food, and structural habitat for fish and aquatic organisms. Although changes in water quality may be considered a chemical habitat alteration, these effects are addressed within the subsequent sections for lethal and sub-lethal impacts as there is no impact on physical habitat.

Fish Habitat is protected under Section 35 of the federal *Fisheries Act*, which prohibits the harmful alteration, disruption, or destruction of fish habitat (HADD) unless under authorization by DFO. Any authorized HADD must be compensated elsewhere to achieve DFO's guiding principle of "No Net Loss" in the productive capacity of fish habitat (DFO 1986).

A total of seven project components were assessed for potential habitat loss and alterations:

1. **Air Quality (Dustfall from blasting, ore transport and vehicle use)**

Project activities such as blasting, ore conveying, crushing and hauling, on-site equipment and vehicle use and traffic along the access roads have the potential to affect air quality and subsequently surface water quality from atmospheric deposition. The air dispersion model CALPUFF was used to assess potential effects to air quality and rates of particulate and acid deposition at the mine site, with detailed model results found in Section 8. The CALPUFF model showed that the dispersion of dust and emissions from project activities around the mine site and along the Freegold access road mainly affect upper Canadian Creek and Casino Creek. Very minor air quality effects were detected in discontinuous locations along the approximately last 8 to 30 km of the Freegold access road; these potential effects were considered to be negligible and were not assessed further.

The potential for dust deposition and impacts on surface water quality are assessed in detail in 7.4.5.2. Effects on habitat may include increased TSS, homogenization of stream bed features, reduced pool depths, and decreased habitat quality and quantity for periphyton and benthic invertebrate communities.

2. **Airstrip and Airstrip Access Road**

Construction:

General:

Construction of the airstrip and access road will require the clearing and grubbing of vegetation, the installation of culverts and bridges along the 14 km-long access road, and the construction of the airstrip and associated facilities. The 2000 m-long airstrip will be located in the Dip Creek valley approximately 12 km southwest of the mine site. The airstrip will intersect a small fish-bearing drainage, which will be diverted upstream of the airstrip and flow around it in a southwest direction towards Dip Creek. The airstrip access road will be a 5 m-wide single-lane gravel road with a design speed of 30 km/h running from the airstrip up the Casino Creek valley to the mine site. The airstrip access road will require the construction of six clear-span bridges over Dip, Brynelson and the remaining fish-bearing creeks, and four major culverts in non-fish-bearing watercourses.

There will be a temporary alteration of stream habitat during construction activities. Potential impacts may include an increase in localized sedimentation, reduced fish access, clearing of riparian vegetation, and the removal of in-stream cover such as boulders, large woody debris or in-stream vegetation.

Airstrip:

Within the single fish-bearing drainage intersecting the airstrip, there will be a permanent loss of fish-bearing habitat within and downstream of the airstrip (Table 10.4-3). Periphyton and benthic invertebrate communities will experience direct habitat loss along the 1006 m length of lost habitat. The proposed airstrip diversion channel will provide connectivity to habitat upstream of the airstrip, and will provide new habitat offsetting the local habitat loss. Furthermore, the diversion will occur upstream of the airstrip, reducing the potential for chemical run-off and siltation into nearby watercourses.

Airstrip Access Road:
As clear-span bridges will be installed on all fish-bearing creeks, only non-fish-bearing aquatic habitat will be lost along the access road due to culvert installations (Table 10.4-3, Table 10.4-4). In addition, riparian habitat loss and alteration will occur adjacent to both fish-bearing and non-fish-bearing crossings.

The modification of riparian habitat may de-stabilize stream banks and elevate levels of total suspended solids and turbidity in the stream. Other potential effects from riparian habitat loss include a slightly lowered capacity for stream temperature regulation, reduced quantities of in-stream cover, and lowered nutrient and food inputs into the stream. However, new crossing structures will provide temperature regulation and cover, offsetting the loss of riparian habitat.

Operations:

During operations there is the potential for runoff (sediment, road salts) and airborne dust from vehicle traffic to alter nearby watercourses. Potential impacts on habitat following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2. Siltation may homogenize stream bed features, reduce pool depths, and decrease habitat quality for periphyton and benthic invertebrate communities.

Closure:

The airstrip will not be decommissioned at closure, as it is replacing an existing seasonal facility. Thus, potential impacts on aquatic biota are predicted to be similar to those discussed in operations, albeit at a smaller scale.

Table 10.4-3 Estimated In-stream Fish Habitat Loss

Watercourse or Project Component Area	Impacted Stream Length (m)		Impacted Stream Area (m^2)[a]		Impacted Modeled Area (m^2)[b]	
	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing
Total Habitat Loss within project footprint						
Lower Britannia	1,405	0	9,535	0	2,384[e]	n/a
Upper Canadian	0	3,483	0	17,415	n/a	n/a
Upper Casino[c]	15,819	11,012	43,428	14,377	10,600[e]	n/a
Freegold Extension	0	1,031	0	787	n/a	n/a
Freegold Upgrade	0	30	6[d]	24	6[f]	n/a
Airstrip	1,006	0	1,509	0	1,509[f]	n/a
Airstrip Access Road	0	91	0	54	n/a	n/a
Wetted Habitat Loss due to stream flow reductions						
Lower Canadian	7,000	0	801	0	299[h]	n/a
Lower Casino[g]	6,500	0	1,438	0	3,157[h]	n/a
Dip	8,500	0	2,342	0	1,001[h]	n/a
Total	**40,230**	**15,647**	**59,059**	**32,657**	**18,956***	**n/a**

[a]Areas experiencing total habitat loss were obtained from a combination of field and 1:50,000 GIS base mapping measurements. Areas experiencing wetted habitat loss were obtained from in-stream flow modelling results, where the total change in rearing habitat was used as it represented the median loss of habitat for the entire ice-free season (May 15 – September 30)

[b]All Modeled values are obtained from Physical Habitat Simulation (PHABSIM) and Habitat Evaluation Procedure (HEP) procedures described in Normandeau and PECG 2013, and PECG and Normandeau 2013a, b

[c]Upper Casino Creek encompasses all reaches and tributaries upstream of its confluence with Brynelson Creek. This includes Meloy Creek, three unnamed tributaries, Taylor Creek, and Proctor Gulch. A detailed breakdown of the estimated stream lengths and areas for each segment is reported in Table 3-7 of the Fish Habitat Compensation Report (Appendix 10C)

[d]Habitat loss from the Nordenskiold Bridge pier

[e]HEP modelling used to calculate total habitat loss (Normandeau and PECG 2013, PECG and Normandeau 2013b)

[f]No modeled value available as there were no habitat limitation criteria identified

[g]Lower Casino Creek consists of reach 1 up to its confluence with Brynelson Creek

[h]PHABSIM used to calculate the change in 'usable' Arctic grayling wetted habitat. Habitat loss was divided by project phase, with the maximum values by phase reported here (Normandeau and PECG 2013, PECG and Normandeau 2013a)

*Denotes final HADD value

Table 10.4-4 Estimated Riparian Habitat Loss

Watercourse	Impacted Stream Length (m)		Impacted Riparian Area (m^2)		
	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing	Total Area
Britannia	1,405	0	52,860	0	52,860
Upper Canadian	0	3,483	0	34,830	34,830
Upper Casino	15,819	11,012	233,030	110,120	393,150
Freegold Extension	1,077*	1,031	32,310	10,310	42,620
Freegold Upgrade	180	30	5,400	300	5,700
Airstrip	1,006	0	30,180	0	30,180
Airstrip Access Road	73*	91	2,190	455	2,645
		Total	**355,970**	**156,015**	**511,985**

Riparian habitat setbacks were 30 m for Chinook salmon fish-bearing stream sections, 15 m for non-Chinook salmon fish-bearing streams, and 5 m for non-fish-bearing streams, Meloy Creek, and Casino Creek upstream of the reach 2/3 break. Asterisks (*) denote that only riparian habitat was impacted due to the installation of clear-span bridges on fish-bearing crossings.

3. Canadian Creek Diversion

Construction – Operations (Year 10):

Development of the open pit during construction through to year 10 of operations will be far removed from the watershed (≥30 m), and thus will have no interaction with aquatic habitat.

Operations (Years 10-22):

The Canadian Creek diversion around the open pit will be constructed in year 10 of operations. The upper section of Canadian Creek is non-fish bearing, with an identified high gradient (>20%) cascade barrier located approximately 1.2 km downstream of the proposed diversion. Thus, there will be no fish-bearing habitat loss due to the diversion of Canadian Creek.

The construction of the new 1129 m-long diversion channel will create a temporary reduction of non-fish bearing habitat as new riparian vegetation, periphyton, and benthic invertebrate communities are established within the diversion channel. Further, as the loss of channel length following the diversion is 1399 m, there will be a minor net deficit of stream length of 270 m. The reduction of habitat productive capacity within the upper watershed will subsequently reduce the downstream transport of nutrients (e.g., detritus), food (e.g., terrestrial and aquatic insects), and structural habitat (e.g., sediment, woody debris). Stream temperatures may be slightly elevated following the reduction of temperature-regulating riparian vegetation. Further, temporary in-stream construction may increase sedimentation, and reduce in-stream habitat and riparian vegetation due to clearing activities. Increased sediment loads into Canadian Creek may homogenize stream bed features, and decrease habitat availability for benthic invertebrates and periphyton.

While the majority of flows will still be conveyed to lower Canadian Creek, a small percentage of surface run-off will directly enter the open pit instead of naturally draining into the creek. Predicted flow reductions relative to

baseline values for lower Canadian Creek will vary from 5-7% and 1-15% in the summer and winter months, respectively (Table 10.4-5). Reductions in stream summer flows equate to very low reductions in the availability of wetted habitat, with mean wetted depths and widths decreasing by approximately 2% and 1%, respectively. Notably, the net reduction in total wetted area in lower Canadian Creek will be 254m^2, which represents a negligible (0.7%) decrease relative to pre-construction values. Further, the impact on potential overwintering habitat is expected to be minimal, as baseline winter flows were extremely low, as was the availability of deep pools that did not freeze to bottom (Appendix 10A).

Flow contributions from Britannia Creek upstream of the Canadian Creek confluence will aid in buffering flow reductions in lower Britannia Creek. Directly below its confluence with Canadian Creek, the projected mean annual reduction is a 3% decline from baseline flows. The flow reduction differential between baseline and operational flows is expected to continually decrease with increasing downstream distance and as flows near the Yukon River.

In addition to calculating the projected change in total wetted area, in-stream flow modelling was carried out to determine the change in 'usable' habitat area based on the habitat requirements (e.g., preferred depth, velocity, and substrate) of Arctic grayling. The predicted change in usable fish habitat was assessed using a Physical Habitat Simulation (PHABSIM) method in Canadian Creek downstream of the diversion influence (Refer to details in PECG and Normandeau 2013a). In lower Canadian Creek, usable habitat for Arctic grayling rearing increased under the new flow regime for all life stages with the exception of spawning habitat, which demonstrated a minor loss of 52m^2 or 2.4% of the total available spawning habitat.

Due to slightly lowered flows, there is the potential for minor effects on stream morphological processes, available in-stream cover, stream temperatures, and the production of periphyton and benthic invertebrate communities. In addition, diminished velocities may further reduce the downstream conveyance of nutrients (e.g., detritus), food (e.g., terrestrial and aquatic insects), and structural habitat (e.g., sediment, woody debris).

Closure, Decommissioning, and Post-Closure:

During closure, the Canadian Creek diversion will be decommissioned, allowing headwaters to drain directly into the open pit. Temporary impacts due to construction activities will be similar to those discussed during diversion construction, such as increased sedimentation and potential reductions in riparian vegetation and in-stream habitat. Non-fish bearing aquatic habitat supporting riparian vegetation, benthic invertebrate, and periphyton communities will be permanently lost within the Project footprint (17,415 m^2 of in-stream habitat, 34,830 m^2 of riparian habitat; Table 10.4-3 and Table 10.4-4), subsequently reducing the downstream transport of nutrients (e.g., detritus), food (e.g., terrestrial and aquatic insects), and structural habitat (e.g., sediment, woody debris).

Predicted flow reductions relative to baseline values for lower Canadian Creek vary from 12-21% and 3-13% in the summer and winter months, respectively (Table 10.4-5). Reductions in stream summer flows equate to very low reductions in the availability of wetted habitat, with mean wetted depths and widths decreasing by approximately 4% and 2%, respectively. Notably, the net reduction in total wetted area in lower Canadian Creek will be 801m^2, which represents a minor (2%) decrease relative to pre-construction values. As in operations, the impact on potential overwintering habitat during closure is predicted to be minimal.

Flow contributions from Britannia Creek upstream of the Canadian Creek confluence will aid in buffering flow reductions in lower Britannia Creek. Directly below its confluence with Canadian Creek, the projected mean annual reduction is a 9% decline from baseline flows (Table 10.4-5). The flow reduction differential between baseline and closure flows is expected to continually decrease with increasing downstream distance, with minor effects anticipated as flows near the Yukon River.

As in operations, the predicted change in usable fish habitat was assessed under closure flow conditions using a PHABSIM model (PECG and Normandeau 2013a). In lower Canadian Creek, usable habitat for Arctic grayling juvenile and fry rearing increased under the new flow regime, while a small decreases were observed for adult rearing (59 m^2 or 0.6%) and spawning habitat (240 m^2 or 11%).

While lowered flows have the potential to facilitate reductions in submerged protective cover (e.g., overhanging vegetation, large woody debris, deep pools, undercut banks), alter stream morphological processes (e.g., bank erosion, flushing flows, maintenance of scouring pools and undercut banks), and elevate the risk for habitat isolation during low-flow months, impacts will likely be minor based on the small projected decrease in wetted habitat volume. Other potential impacts following reduced flows from Canadian Creek headwaters include water temperature increases, and changes in creek primary and secondary production. However, the direction and magnitude of these potential effects on periphyton and benthic invertebrate communities are difficult to predict due to the number of factors involved (e.g., lowered flows, temperature increases, altered channel morphology) and the uncertainty surrounding their potential interactions.

Post-closure, the pit lake will be full and overflow will drain naturally through the TMF wetland area prior to entering the TMF pond. No effluent seepage will enter the Canadian Creek drainage.

Table 10.4-5 Estimated Reductions in Flow and Wetted Area from Baseline Conditions

Watercourse	Project Phase	Change in flow (%)[a]			Mean change in total wetted area (%)[b]	Mean change in wetted width (%)[b]	Mean change in wetted depth (%)[b]
		Mean Peak flows (May)	Mean Summer flows (June - October)	Mean Winter flows (November - April)			
Lower Casino Creek	Construction	-44%	-60%	-68%	-5%	-4%	-18%
	Operations	-44%	-60%	-66%	-5%	-4%	-18%
	Closure	25%	-18%	-49%	-1%	-0.6%	-3%
	Post-closure	25%	3%	-49%	1%	0.5%	3%
Dip Creek	Construction	-12%	-14%	-24%	-3%	-2%	-3%
	Operations	-12%	-14%	-23%	-3%	-2%	-3%
	Closure	7%	1%	-19%	0%	-1%	-1%
	Post-closure	7%	1%	-19%	0%	0%	0%
Lower Canadian Creek	Construction	0%	0%	0%	0%	0%	0%
	Operations	-6%	-6%	-9%	-1%	-1%	-2%
	Closure	-17%	-16%	-8%	-2%	-2%	-4%
	Post-closure	-17%	-16%	-7%	-2%	-2%	-4%
Britannia Creek*	Construction	0%	0%	0%	-	-	-
	Operations	-3%	-4%	-5%	-	-	-
	Closure	-8%	-10%	-5%	-	-	-
	Post-closure	-8%	-10%	-4%	-	-	-

*Flows in Britannia Creek are inferred using data from hydrology stations in upper Britannia and Canadian Creeks; Dashes indicate that results were not calculated due to the lack of in-stream modelling.

[a]Change in flow data from KPL 2013

[b]Wetted dimension estimates based on in-stream flow data provided by Normandeau, November 2013

4. Fish Habitat Compensation Construction

Fish Habitat Compensation Construction will occur in lower Britannia Creek during the project construction phase. In lower Britannia Creek, a total flow diversion will be facilitated to direct flows from the existing creek into the historical Britannia channel, causing habitat loss in the lowest 1.4 km of Britannia Creek (Table 10.4-3). The Casino Fish Habitat Compensation Plan proposes to re-direct flows into historical lower Britannia Creek, which avulsed into its current location sometime between 1965 and 1988, to follow the straight, road right-of-way, which offered little resistance and a direct, downhill path (Appendix 10C). The majority (1048 m) of the proposed habitat loss is of poor quality, and characterized by long straight riffle segments with little to no functioning habitat in its most upstream section, followed by a large area of LWD and sediment deposition where the creek fans out and drains through multiple low-flow channels with minimal habitat structure or channel definition. However, the most downstream 357 m of habitat is of good habitat quality supporting off-channel habitat for rearing Yukon River Chinook juveniles. A habitat evaluation procedure (HEP) was carried out to quantify the loss of usable fish-bearing habitat in lower Britannia Creek, which represented approximately 25% of the total habitat area based on the lack of pool habitat (PECG and Normandeau 2013b). More detail surrounding the proposed historic Britannia Creek diversion can be found in the Fish Habitat Compensation Plan (Appendix 10C).

During construction activities, there will be a temporary alteration of stream habitat. Potential impacts may include an increase in localized sedimentation, reduced fish access, clearing of riparian vegetation, and the removal of in-stream cover such as boulders, large woody debris or in-stream vegetation.

5. Freegold Road Extension

Construction:

Construction of the Freegold Road extension will require extensive clearing and grubbing along 120 km of new road, and the installation of 39 culverts and 56 bridges at 95 crossings. The road will be an all-weather two-lane gravel road with a 70 km/h design. The existing Casino Trail and winter road which generally follows the proposed road corridor will be utilized as early site access. Access road construction will be staged, beginning with the construction of a limited access tote road in Year -4. The tote road will follow the proposed Freegold Road corridor, providing slow-moving rough terrain vehicles early site access, and facilitating construction of the permanent road.

There will be a temporary alteration of stream habitat during construction activities. Potential impacts may include an increase in localized sedimentation, reduced fish access, clearing of riparian vegetation, and the removal of in-stream cover such as boulders, large woody debris or in-stream vegetation. The information presented in Appendix D outlines a detailed risk assessment for erosion and sedimentation along the Freegold Road Extension.

As clear-span bridges will be installed on all fish-bearing creeks, only non-fish-bearing aquatic habitat will be lost along the access road due to culvert installations (Table 10.4-3, Table 10.4-4). In addition, riparian habitat loss and alteration will occur adjacent to both fish-bearing and non-fish-bearing crossings. Clear-span bridge installation on all fish-bearing watercourses will avoid any stream bed alteration, however rip rap placement may remove any undercut banks providing fish cover. As permafrost laden areas are particularly susceptible to slope failure, the use of rip rap is essential to minimize siltation below bridges where vegetation is unable to grow due to insufficient light. Further, rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows.

Despite the incorporation of rip rap reinforcement, the modification of riparian habitat may still de-stabilize stream banks and elevate levels of total suspended solids and turbidity in the stream. Increased sediment loads may

homogenize stream bed features, fill in pools, decrease habitat availability for benthic invertebrates and periphyton, and decrease the area of suitable spawning habitat for salmonid species. Other potential effects from riparian habitat loss include a slightly lowered capacity for stream temperature regulation, reduced quantities of in-stream cover, and lowered nutrient and food inputs into the stream. However, new crossing structures will provide temperature regulation and cover, offsetting the loss of riparian habitat.

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust from vehicle traffic to alter nearby watercourses. Potential impacts on habitat following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2. Siltation may homogenize stream bed features, reduce pool depths, and decrease habitat quality for periphyton and benthic invertebrate communities.

Closure:

The Freegold Road will be decommissioned at closure unless otherwise specified by the Yukon Government. Road crossing structures will be removed, stream beds will be re-established, and stream banks will be stabilized. Potential effects due to in-stream workings will be similar to those identified during construction, such as erosion and sedimentation, reduced fish access, and the clearing of in-stream cover and riparian vegetation.

6. Freegold Road Upgrade

Construction:

The existing Freegold Road originates from the village of Carmacks and extends approximately 85 km in a northwest direction towards Big Creek. The road crosses a total of 37 watercourses, 22 of which are fish-bearing. To facilitate Casino mine traffic, upgrades will include widening the road to two lanes with a design speed of 70 km/h, a 5 km bypass around Carmacks, and new bridges over Nordenskiold River, Seymour Creek, Bow Creek, and Crossing Creek. All bridges will be single-lane clear-span structures with the exception of the Nordenskiold Bridge which will be two-span with a pier located in the river channel.

There will be a temporary alteration of stream habitat during construction activities. Potential impacts may include an increase in localized sedimentation, reduced fish access, clearing of riparian vegetation, and the removal of in-stream cover such as boulders, large woody debris or in-stream vegetation.

As clear-span bridges will be installed on the majority of fish-bearing creeks, only non-fish-bearing aquatic habitat will be lost along the access road due to culvert installations with the sole exception of a 6 m^2 loss from the Nordenskiold bridge pier (Table 10.4-3, Table 10.4-4). Riparian habitat loss and alteration will occur adjacent to both fish-bearing and non-fish-bearing crossings. Clear-span bridge installation on the majority of fish-bearing watercourses will avoid any stream bed alteration, however rip rap placement may remove any undercut banks providing fish cover. As permafrost laden areas are particularly susceptible to slope failure, the use of rip rap is essential to minimize siltation below bridges where vegetation is unable to grow due to insufficient light. Further, rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows.

Despite the incorporation of rip rap reinforcement, the modification of riparian habitat may still de-stabilize stream banks and elevate levels of total suspended solids and turbidity in the stream. Increased sediment loads may homogenize stream bed features, fill in pools, decrease habitat availability for benthic invertebrates and periphyton, and decrease the area of suitable spawning habitat for salmonid species. Other potential effects from riparian habitat loss include a slightly lowered capacity for stream temperature regulation, reduced quantities of in-

stream cover, and lowered nutrient and food inputs into the stream. However, new crossing structures will provide temperature regulation and cover, offsetting the loss of riparian habitat.

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust from vehicle traffic to alter nearby watercourses. Potential impacts on habitat following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2. Siltation may homogenize stream bed features, reduce pool depths, and decrease habitat quality for periphyton and benthic invertebrate communities.

Closure:

The Freegold Road upgrade section is owned and operated by the Yukon Government and will not be decommissioned at closure. Thus, potential impacts on aquatic biota will no longer be associated with the Casino Project.

7. Tailings Management Facility (TMF)

Construction:

The predicted effects on aquatic habitat from TMF construction can be divided into three main sections, being (a) habitat loss within the TMF footprint in the upper Casino Creek watershed, (b) habitat alteration in the lower watershed due to reduced stream flows, and (c) temporary localized effects around construction sites. Potential effects from these three identified components, and the possible interactions among them, are discussed below:

Habitat loss within the TMF footprint:

Construction of the TMF will cause direct habitat loss of the upper Casino Creek watershed, including main-stem Casino Creek from its headwaters to its confluence with Brynelson Creek, Proctor Gulch, Taylor Creek, Meloy Creek, and three unnamed tributaries which drain westward into Casino Creek (Table 10.4-3). The majority of the upper watershed is considered fish-bearing with the exception of the three unnamed tributaries which are too small to permit fish passage. In addition, an identified fish barrier (1 m vertical drop within an 18% gradient segment) on Taylor Creek approximately 275 m above its confluence with Casino Creek prohibits fish from accessing habitat further upstream. While approximately 750 m of habitat will technically remain between the water management pond and the confluence of Casino and Brynelson Creeks, this section is included as lost habitat as the predicted flows are too low to support any viable aquatic communities.

The direct loss of fish-bearing habitat in upper Casino Creek will remove seasonal rearing habitat for juvenile (lengths=170 mm+) and adult Arctic grayling. As no overwintering, spawning, or young-of-the-year rearing Arctic grayling habitat or associated life stages were identified in the upper watershed, there are no predicted impacts on these more critical life stages. A HEP method was carried out to quantify the loss of usable fish-bearing habitat in the upper watershed, which represented approximately 30% of the total habitat area (PECG and Normandeau 2013b).

In addition to the direct loss of fish-bearing habitat, riparian and in-stream habitat providing the downstream transport of nutrients, food (e.g., benthic invertebrates), and structural habitat (e.g., woody debris) for fish will be removed. Large woody debris (LWD) disbursement is essential to aquatic ecosystem functioning, as it provides organic carbon, fish protective cover, and benthic invertebrate habitat. LWD also plays an important role in maintaining stream processes such as promoting channel sinuosity, facilitating the creation of complex stream features (e.g., pools, undercut banks), and aiding in the regulation of stream energy during peak flows. Notably,

upper Casino Creek is primarily dominated by small woody vegetation (e.g., shrubs), making it a very limited source of functional LWD to the lower watershed. Further, as upper Casino Creek is characterized by low quality benthic invertebrate and periphyton communities, the anticipated loss of nutrient inputs and benthic invertebrate drift to the lower watershed is considered minimal.

Habitat alteration downstream of the TMF:

The reduction of stream flows in Casino Creek following TMF construction will alter downstream fish-bearing habitat. Lower Casino Creek will experience a 41-48% flow reduction from baseline values during May peak flows, 53-68% reductions during summer "base flows", and 47-72% reductions during the winter (Table 10.4-5). The substantial noted decrease in winter flows may further reduce or eliminate the already limited overwintering habitat available for Arctic grayling and slimy sculpin in lower Casino Creek. Projected decreases in the availability of wetted summer habitat are considerably smaller than flow reductions, with mean reductions of 18% and 4% for mean wetted depths and widths, respectively. Notably, the net reduction in total wetted area in lower Casino Creek will be 1,438 m^2, which represents a relatively minor (5%) decrease relative to pre-construction values.

Further downstream, Dip Creek will experience 11-16% and 9-31% flow reductions from baseline values during the summer and winter months, respectively (Table 10.4-5). In-stream model projections indicate that there will be minor decreases in wetted area (3%), width (2%) and depth (3%) within Dip Creek.

In addition to calculating the projected change in total wetted area, in-stream flow modelling was carried out to determine the change in 'usable' habitat area based on the habitat requirements (e.g., preferred depth, velocity, and substrate) of Arctic grayling. The predicted change in usable fish habitat was assessed using a PHABSIM method in Casino and Dip Creeks downstream of the TMF influence (Refer to details in PECG and Normandeau 2013a). In lower Casino Creek, usable habitat for Arctic grayling increased under the new flow regime for all life stages with the exception of spawning habitat, which demonstrated a loss of 3,157 m^2 (Table 10.4-3). Further downstream in Dip Creek, there were small projected changes in Arctic grayling usable habitat due to the minimal influence of Casino Creek flow, including a 3.2% decrease in fry rearing habitat (-164m^2), and a 1.9% decrease in spawning habitat (-147 m^2). Although the small predicted decrease in spawning habitat in lower Casino Creek was greater than the predicted decrease in total wetted area (1,438 m^2), the larger value was conservatively employed in habitat loss calculations.

Decreased inputs from cold, high elevation headwaters may produce water temperature increases, particularly in shallow low-gradient sections. However, upper Casino and Brynelson Creeks have very similar cold-water stream temperatures, indicating that the post-construction thermal regime in lower Casino Creek will be similar to baseline conditions. Indeed, there were no significant differences (paired t-test, t=1.488, df=14, P=0.16, with significance levels set to α=0.05) in mean monthly temperatures at hydrological stations of similar elevation (W18 and H18) in Casino and Brynelson Creeks.

Other potential impacts following reduced flows include reductions of submerged in-stream cover (e.g., overhanging vegetation, large woody debris, deep pools, undercut banks), increased risk of habitat isolation during low-flow periods, and changes in stream morphology. During peak flows, the downstream transport of materials (e.g., substrate, woody debris), and natural scouring processes may be modified, with subsequent impacts on stream morphology. A moderate reduction in stream bank erosion may occur, with subsequent decreases in stream TSS and turbidity, and maintenance of complex habitat features which rely on scouring processes (e.g., pools, undercut banks). Substrate embeddedness may increase in low velocity areas due to a reduction of flushing flows, however, this increase is not considered significant as major storm events will still provide the necessary energy to re-mobilize fines.

The combined environmental effects (e.g., lowered flows, temperature increases, and altered channel morphology) may have resultant impacts on periphyton and benthic invertebrate communities downstream. However, the direction and magnitude of these potential effects on periphyton and benthic invertebrate communities are difficult to predict due to the number of factors involved (e.g., lowered flows, temperature increases, altered channel morphology) and the uncertainty surrounding their potential interactions.

General effects from construction activities:

Construction of the TMF will require initially damming Casino Creek at the Stage IA Starter Embankment, which will gradually expand in stages across the Casino Creek valley throughout the mine's operative years. In-stream activities will include the installation of cofferdams and pumping systems, extensive site clearing, stripping, and grubbing, diverting non-contact water around the construction area, and the management of sediment-laden water including construction of the water management pond located downstream of the Embankment.

During construction, there is the potential for temporary impacts on aquatic habitat including increased sedimentation, reduced fish access, and reduced in-stream cover and riparian vegetation due to clearing activities. Increased sediment loads into Casino Creek may homogenize stream bed features, fill in pools, decrease habitat availability for benthic invertebrates and periphyton, and decrease the area of suitable spawning habitat for Arctic grayling.

Operations:

During operations, a small amount of seepage (2.3 L/s) will enter Casino Creek. The seepage is predicted to near 0-1°C due to the high underground retention time before surfacing into the creek. However, the minimal contribution (0-2%) to overall flows during the ice-free season will preclude any measurable impact on stream temperatures in lower Casino Creek. Although winter seepage will contribute a slightly higher (0-16%) percentage of overall flows, seepage water temperatures will be at or near 0°C and thus will have no impact on stream temperatures in lower Casino Creek.

Closure, Decommissioning, and Post-Closure:

The Project closure and decommissioning plan is designed to have a passive walk-away approach incorporating a wetland infiltration system. The TMF spillway will be constructed during Water Management Plan (WMP) Closure Phase I (years 23-30) while the seepage collection system remains operative. In WMP Closure Phase II (years 31-114+), the embankment collection ditches and seepage collection will be decommissioned, allowing discharge to flow directly through the main Embankment into lower Casino Creek in addition to the TMF spillway which will facilitate overflow into Casino Creek.

Spillway flow will produce increases from baseline conditions in Casino and Dip Creeks downstream from the spillway outlet (Table 10.4-5). In addition, Brynelson Creek will experience a small decrease in flows (average annual decrease = 4%) due to the parallel spillway intersecting some of the natural surface drainage. Flow increases will be highest during peak flows within Casino Creek (17-27%), and will decrease with progressive downstream distance. Natural wetted habitat dimensions will be re-instated within Casino Creek, with projected mean wetted area and width being within 1% of the baseline flow regime, and wetted depth being within 3%.

Predicted flow increases in Dip Creek during freshet will be low (7%), with minimal anticipated impacts on the aquatic community. In-stream model projections indicate that there will be minor decreases in wetted area (3%), width (2%) and depth (3%) within Dip Creek. Mean wetted area, width, and depth in Dip Creek are projected to be within 1% of the baseline flow regime.

Employing the PHABSIM method, usable Arctic grayling habitat was also calculated for flow increases during closure and post-closure (PECG and Normandeau 2013a). In lower Casino Creek, usable habitat for Arctic grayling increased under the new flow regime for all life stages during closure, with the exception of spawning habitat. However, as flow increases provide more suitable flows for spawning, losses were predicted to be approximately 10x smaller (-320 m^2) than those observed in construction and operations. In post-closure, the biggest habitat loss in lower Casino Creek was observed for adult (-1083m^2) and juvenile rearing (-1038 m^2), followed by fry rearing (-360 m^2), and a concurrent increase in spawning habitat (+311m^2).

Further downstream in Dip Creek, there were small projected changes in Arctic grayling usable habitat during closure and post-closure. During closure, adult and juvenile rearing usable habitat area increased relative to baseline conditions, whereas negligible decreases of 0.2% and 1.1% were predicted for fry rearing and spawning habitat, respectively. During post-closure, 2.6-2.7% decreases were projected for adult and juvenile rearing habitat, respectively, whereas minor increases were predicted for fry rearing and spawning. During closure and post-closure, total habitat losses were overall less than those predicted for construction and operations. Thus, habitat loss values for construction and operations were conservatively used for calculating the total habitat loss value in Table 10.4-3

Augmented flows have the potential to increase erosion, downstream sediment transport, and flooding. However, anticipated peak flow increases (April-May) along lower Casino Creek are not expected to result in any significant changes to channel morphology or the aquatic habitat it supports. Lower Casino Creek has a typical width-to-depth ratio for meandering, gravel-bed channels, showing no evidence of entrenchment, and is well connected to its floodplain. Overbank flooding occurs naturally every spring, in association with the melting and detachment of anchor ice from the channel bed. As water levels rise within the channel, average velocities and shear stress exerted on the bed and banks increase proportionally. Once flows spill overbank into the adjacent floodplain, however, submerged riparian vegetation (mosses, dwarf shrubs and stunted spruce) reduces surface flow velocities across the full width of flow. Velocities at depth are unaffected or decrease slightly, in turn, which yields no significant change in erosion potential along the bed and banks. However, site-specific surveys will be required during detailed design to determine whether any minor channel modifications (e.g., local bank stabilization/restoration, riffle modification, etc.) are needed to mitigate localized erosion at existing, unstable sites.

A significant proportion of closure and post-closure flows in Casino Creek will derive from the TMF pond (Table 10.4-6). The majority of this flow will enter the creek as overflow from the closure spillway, with a smaller contribution entering as seepage through or under the TMF embankment. Seepage flows are estimated to have water temperatures at or nearing 0°C due to high underground retention times. In contrast, spillway flow temperatures will be higher, particularly during summer months as the pond surface waters warm.

Further downstream, stream temperatures in Dip Creek may also demonstrate minimal increases, although the small contribution of spillway flows relative to seepage flows will likely cancel out any potential stream temperature increases, and the drainage distance along Casino Creek further regulating any artificial temperature changes.

Table 10.4-6 Estimated contribution of flow from TMF seepage and closure spillway

Watershed	Project Phase	Mean Peak flows (May)			Mean Summer flows (June - October)			Mean Winter flows (November - April)		
		Seepage	Spillway	Total	Seepage	Spillway	Total	Seepage	Spillway	Total
Casino	Closure	13%	44%	**57%**	21%	33%	**54%**	7%	18%	**25%**
	Post Closure	13%	44%	**57%**	17%	44%	**62%**	7%	18%	**25%**
Dip	Closure	0%	15%	**15%**	4%	7%	**11%**	1%	4%	**5%**
	Post Closure	0%	15%	**15%**	4%	11%	**16%**	1%	4%	**5%**

Note:
Data from KPL 2013

10.4.1.2 Lethal Effects on Fish and Aquatic Organisms

Fish are protected under Section 32 of the Fisheries Act which prohibits the destruction of fish by any means other than fishing except as authorized by DFO. Direct fish mortality may occur as a result of fishing, blasting, the deposition of deleterious substances, or during water extraction where fish may be impinged onto pump intake screens, or entrained into pumps. Other activities such as habitat loss or degradation have the potential to cause indirect fish mortality by reducing fish health or habitat productive capacity over time. Other more sedentary aquatic organisms including incubating fish eggs and benthic invertebrates may experience lethal effects due to habitat loss or degradation. For example, erosion and sedimentation due to construction could increase the amount of fine substrate and consequently smother organisms living within stream gravel substrate (Reiser 1998, Suren and Jowett 2001).

1. Air Quality (Dust and emissions from blasting, ore transport and vehicle use)

The potential for acid and dust deposition and impacts on surface water quality are assessed in detail in 7.4.5.2. Both dust and acid deposition can lead to reduced water quality and resultant impacts on aquatic biota survival. Acid deposition forms when nitrogen oxides (NOx) and sulphur dioxides (SO_2) are emitted from burning fossil fuels equipment and vehicle use. Adverse effects from acid deposition are not anticipated as local watercourses exhibit high alkalinities, and there are no lakes within the RSA which are more sensitive to acid deposition.

2. Airstrip and Airstrip Access Road

Construction:

Similar to construction for the Freegold Road, the Airstrip and Access Road will require the clearing and grubbing of vegetation, the installation of culverts and bridges, and the construction of the Airstrip and associated facilities. Potential effects from construction include increased erosion and sedimentation, metal leaching and acid rock drainage (ML/ARD) from exposed cut rock or waste rock, fish stranding during de-watering, or fish impingement or entrainment during water extraction. The use of any heavy machinery required for construction within the stream channel can trample and destroy any fish and aquatic organisms present. Temporary de-watering, stream infilling, increased erosion and sedimentation, and ML/ARD due to construction activities may be lethal to incubating fish eggs or benthic invertebrates.

Operations/Closure:

During operations there is the potential for airstrip and road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and have lethal impacts on local aquatic biota.

Potential lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Impacts during closure are anticipated to be similar to those in operations, but at a reduced scale as vehicular activity declines. The Airstrip will not be decommissioned as it is replacing an existing smaller seasonal facility.

3. Canadian Creek Diversion

Construction – Operations (Year 10):

Lethal impacts on aquatic biota are not anticipated prior to the Canadian Creek diversion, as Project activities will have no interaction with aquatic communities.

Operations (Years 10-22):

The open pit will intersect upper Canadian Creek in year 10 of operations, producing the diversion of upper Canadian Creek around the pit. The upper section of Canadian Creek is non-fish bearing, with an identified high gradient (>20%) cascade barrier located approximately 1 km downstream of the proposed diversion. Thus, no lethal effects on fish are anticipated by the creek diversion. However, destruction of aquatic habitat will result in mortality of periphyton and benthic invertebrate communities within the Project footprint. The use of any heavy machinery required for construction within the stream channel can trample and destroy any aquatic organisms present. Temporary de-watering, and increased erosion and sedimentation due to construction activities may be lethal to periphyton and benthic invertebrate communities.

There is the potential for lethal impacts on aquatic biota in lower Canadian Creek due to the reduction of headwater flows. Flow reductions will de-water edge habitat potentially supporting periphyton, benthic invertebrates and incubating fish eggs, and may cause fish stranding, particularly if the drain down occurs during summer base flows. However, as mean wetted habitat area will decrease by approximately 0.7% relative to baseline conditions, lethal impacts on aquatic biota are predicted to be minimal. Further downstream in Britannia Creek, reductions in mean wetted habitat area will be further buffered by stream flows in upper Britannia Creek, and thus there are no anticipated lethal impacts on aquatic biota.

Closure, Decommissioning, and Post-Closure:

During closure, the Canadian Creek diversion will be decommissioned, allowing headwaters to drain directly into the open pit. Thus, periphyton and benthic invertebrate communities which have established in the diversion channel during operations will be lost.

There is the potential for lethal impacts on aquatic biota in lower Canadian Creek due to the loss of headwater flows. Flow reductions will de-water edge habitat potentially supporting periphyton, benthic invertebrates and incubating fish eggs, and may cause fish stranding, particularly if the drain down occurs during summer base flows. However, as mean wetted habitat area will decrease by approximately 2% relative to baseline conditions, lethal impacts on aquatic biota are predicted to be minimal. Further downstream in Britannia Creek, reductions in mean wetted habitat area will be further buffered by stream flows in upper Britannia Creek, and thus there are no anticipated lethal impacts on aquatic biota.

4. Drilling and Blasting

Shock waves from drilling and blasting activities greater than 100 kPa can rupture the internal organs of fish including swim bladders, and kill fish eggs or larvae (Wright and Hopky 1998). The detonation of explosives can also increase peak acoustic particle velocities, with velocities greater than 13 mm/s having the potential to destroy

incubating fish eggs. Guidelines for the use of explosives in or near Canadian Fisheries Waters (Wright and Hopky 1998) outline the required setback distance from the centre of detonation to fish-bearing waters which vary depending on the explosive charge weight and the substrate type.

As the minimum distance between the Casino pit and fish-bearing waters in upper Canadian Creek is 1.2 km, equations from Wright and Hopky (1998) were employed to determine the charge weight threshold for impacting fish downstream. Results demonstrated that charge weights of 6,300kg and 57,000 kg would be required to yield lethal impacts on incubating fish eggs and fish, respectively. As these weights far exceed anything that would be used in the Casino pit, there are no anticipated impacts due to blasting activities on fish or incubating eggs in Canadian Creek.

The use of explosives will also be required during construction of the infrastructure site pads and along access roads. As many construction sites will be in or near fish-bearing watercourses, there is the potential for explosive shockwaves to kill fish. Site-specific mitigation will be required to ensure that fish are removed the appropriate setback distance from a blasting area. For example, the detonation setbacks for a 100 kg charge set in solid rock are 50.3 m to prevent fish death from shock waves, and 150.9 m to prevent fish egg death from increased peak particle velocities.

The potential for blasting residues to leach into nearby watersheds is discussed in detail in 7.4.5.1. Briefly, all contact water from the open pit will be diverted to the TMF, whereas potential impacts from blasting residues along access roads are predicted to be minimal.

5. Fish Habitat Compensation Construction

Potential mortality of fish during compensation construction may be in result of increased erosion and sedimentation, fish stranding during de-watering, or fish impingement or entrainment during water extraction. The use of any heavy machinery required for construction within the stream channel can trample and destroy any fish and aquatic organisms present. Temporary de-watering, stream infilling, and increased erosion and sedimentation due to construction activities may be lethal to incubating fish eggs or benthic invertebrates.

6. Freegold Road Extension

Construction:

Potential fish mortality during road construction may result from increased erosion and sedimentation, metal leaching and acid rock drainage (ML/ARD) from exposed cut rock or waste rock, fish stranding during de-watering, or fish impingement or entrainment during water extraction. The use of any heavy machinery required for construction within the stream channel can trample and destroy any fish and aquatic organisms present. Temporary de-watering, stream infilling, increased erosion and sedimentation, and ML/ARD due to construction activities may be lethal to incubating fish eggs or benthic invertebrates. The information presented in Appendix D outlines a detailed risk assessment for erosion and sedimentation potential along the Freegold Road Extension

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and yield lethal impacts on local aquatic biota. Potential lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Closure:

The Freegold Road will be decommissioned at closure unless otherwise specified by the Yukon Government. Road crossing structures will be removed, stream beds will be re-established, and stream banks will be stabilized. Potential effects due to in-stream workings will be similar to those identified during construction, such as erosion and sedimentation, stranding, trampling, impingement and entrainment.

7. Freegold Road Upgrade

Construction:

Potential fish mortality during road construction may result from increased erosion and sedimentation, metal leaching and acid rock drainage (ML/ARD) from exposed cut rock or waste rock, fish stranding during de-watering, or fish impingement or entrainment during water extraction. The use of any heavy machinery required for construction within the stream channel can trample and destroy any fish and aquatic organisms present. Temporary de-watering, stream infilling, increased erosion and sedimentation, and ML/ARD due to construction activities may be lethal to incubating fish eggs or benthic invertebrates.

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and yield lethal impacts on local aquatic biota. Potential lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Closure:

The Freegold Road upgrade section is owned and operated by the Yukon Government and will not be decommissioned at closure. Thus, potential impacts on aquatic biota will no longer be associated with the Casino Project.

Mine Development (Fishing)

The large Casino Project workforce has the potential to increase fishing pressure within the mine area and along access roads. Predicted workforces include approximately 1600 workers during construction and 600 during operations. As CMC will enforce a no-fishing policy for workers during all project phases, impacts on local sport fish populations are predicted to be negligible. Further, the Freegold extension will operate as a private resource road with no public access.

8. Tailings Management Facility (TMF)

Construction:

Construction activities have the potential to temporarily elevate sediment loading in Casino Creek, which could have lethal impacts on benthic invertebrate communities, fish eggs, or, in worst case scenarios, survival of fish downstream. During construction of the Starter Embankment, the use of any heavy machinery within the stream channel can potentially trample and destroy any fish and aquatic organisms present. De-watering construction areas may result in fish stranding, mortality of benthic invertebrate and incubating eggs, or impingement and entrainment of fish into water intake pipes. Finally, habitat loss within the upper Casino Creek watershed will result in the direct mortality of any present periphyton, benthic invertebrates and incubating fish eggs.

Notably, aquatic communities in Casino Creek experienced a naturally wide range of TSS, particularly during peak flows (Table 10.4-7). Thus, the regulatory standard of 25 mg/L above baseline levels for TSS (CCME 1999) is well within the natural range experienced by communities in Casino Creek. Furthermore, the baseline analysis of fisheries in Casino Creek revealed little to no evidence for spawning activities, and thus the probability of sedimentation impacting survival of incubating eggs is minimal.

Table 10.4-7 Total Suspended Solids (TSS) in the Casino LSA

Britannia Creek Watershed					
Month	**n**	**Min**	**Mean**	**Max**	**SD**
May*	14	0.5	29.15	190	47.88
Jun	10	0.5	5.55	20	6.57
Jul	10	0.5	3.85	20	6.03
Aug*	15	0.5	6.43	34	9.30
Sep	13	0.5	1.88	4	1.14
Oct	17	0.5	0.59	1	0.20
Casino Creek Watershed					
May*	19	1	25.51	106	31.90
Jun*	9	4	50.11	160	56.80
Jul	11	0.5	4.91	11	3.83
Aug*	19	0.5	12.34	54	14.79
Sep	14	0.5	6.04	22	6.41
Oct	15	0.5	2.50	11	2.71
Dip Creek Watershed					
May*	14	0.5	43.89	123	36.19
Jun*	10	0.5	40.75	160	52.77
Jul	6	2	11.17	25	8.84
Aug	13	0.5	9.69	23	7.28
Sep	11	0.5	7.77	25	8.45
Oct	16	0.5	1.13	3	0.81

TSS is reported in mg/L
N=sample size, min=minimum value, max=maximum value, and SD=standard deviation
*Months which demonstrate a natural fluctuation in TSS exceeding 25 mg/L from mean values

There is the potential for lethal impacts on aquatic biota in lower Casino Creek due to the TMF installation. Flow reductions will de-water edge habitat potentially supporting periphyton, benthic invertebrates and incubating fish eggs, and may cause fish stranding, particularly if the dam is installed during summer base flows. However, as mean wetted habitat area will decrease by approximately 5% relative to baseline conditions, lethal impacts on aquatic biota are predicted to be minimal during the summer months (Table 10.4-5). During winter, anticipated declines in flow (66-68%) and depth (18%) may greatly elevate the risk for winter kill, particularly for fish species with limited ranges such as slimy sculpin. Further downstream in Dip Creek, there is no predicted reduction in mean wetted habitat area and thus no anticipated lethal impacts on aquatic biota.

Operations:

During operations, reduced flows may elevate the risk for winter kill and fish stranding during low-flow periods. It is suggested that a physical fish barrier should be installed directly above the Casino-Brynelson confluence to prevent any potential fish stranding downstream of the water management pond.

There are no anticipated lethal effects due to water quality during operations, as effluent seepage will be heavily contained using the seepage collection system.

Closure, Decommissioning, and Post-Closure:

Potential lethal impacts on aquatic organisms in Casino Creek due to construction activities were discussed above and are not repeated here.

Potential impacts due to effluent seepage from the TMF were assessed under the sub-lethal effects section (10.4.1.3) and not repeated here. Lethal impacts due to a change in water quality are not likely as water quality guidelines are generally developed to avoid sub-lethal effects.

10.4.1.3 Sub-lethal Effects on Fish and Aquatic Organisms

Sub-lethal effects have the potential to influence fish and aquatic organism growth, recruitment, and reproduction, with implications for the overall productive capacity of an aquatic community. Mechanisms for sub-lethal effects include changes in behavior such as habitat avoidance, and direct impacts on aquatic organism health.

1. **Air Quality (Dust and emissions from blasting, ore transport and vehicle use)**

The potential for acid and dust deposition and impacts on surface water quality are assessed in detail in 7.4.5.2. Both dust and acid deposition can lead to temporary habitat avoidance, or have negative impacts on nearby fish and aquatic organism health. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. Acid deposition forms when nitrogen oxides (NOx) and sulphur dioxides (SO_2) are emitted from burning fossil fuels equipment and vehicle use. Adverse effects from acid deposition are not anticipated as local watercourses exhibit high alkalinities, and there are no lakes within the RSA which are more sensitive to acid deposition.

2. **Airstrip and Airstrip Access Road**

Construction:

Construction activities producing excess noise, tremors, sedimentation, or ML/ARD may cause temporary habitat avoidance or have negative impacts on nearby fish and aquatic organism health. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. The removal or alteration of in-stream habitat features such as fish protective cover (e.g., undercut banks, boulders, large woody debris), deep pools for rearing and overwintering, or spawning areas may further trigger habitat avoidance behaviour.

The predicted habitat loss and alteration associated with the Airstrip and Airstrip Access Road is relatively minor in comparison to the overall quantity of available habitat in the Dip and Casino Creek drainages. Furthermore, fish-bearing habitat loss due to the airstrip diversion channel will be offset with new habitat upslope of the receiving environment from the airstrip, and providing connectivity to Dip Creek. Thus, long-term effects on the health of aquatic biota populations are anticipated to be negligible.

Operations/Closure:

During operations there is the potential for airstrip and road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and have sub-lethal effects (increased stress, habitat avoidance, impaired health) on local aquatic biota. Potential sub-lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Impacts during closure are anticipated to be similar to those in operations, but at a reduced scale as vehicular activity declines. The Airstrip will not be decommissioned as it is replacing an existing smaller seasonal facility.

3. Canadian Creek Diversion

Construction – Operations (Year 10):

Sub-lethal impacts on aquatic biota are not anticipated prior to the Canadian Creek diversion, as Project activities will have no interaction with aquatic communities.

Operations (Years 10-22):

As the closest fish-bearing section of Canadian Creek is approximately 1 km downstream of any construction activities associated with the diversion, sub-lethal impacts on fish due to excess noise, tremors, and sedimentation are predicted to be minimal. While increased sedimentation during construction may produce sub-lethal impacts on periphyton and benthic invertebrates upstream of the cascade fish barrier, it is anticipated that these effects will be short-term, localized and low in magnitude.

During operations, pumping systems will be in place to manage pit de-watering. As water collected in the pit will be used for processing, and ultimately be disposed of in the TMF, potential sub-lethal impacts on aquatic biota due to changes in water quality are addressed within the TMF discussion.

Closure, Decommissioning, and Post-Closure:

During closure, the Canadian Creek diversion will be decommissioned, re-directing headwater flows into the pit lake. Post-closure, the pit lake will be full and overflow will drain naturally through the TMF wetland area prior to entering the TMF pond.

The loss of Canadian Creek headwaters and the subsequent habitat alteration downstream may impact the overall fitness (i.e., growth, reproduction, recruitment) of local fish and aquatic organisms. For example, lowered nutrient and food inputs may decrease growth, and less available protective cover may induce stress or cause habitat avoidance. However, due to the low projected decreases in wetted habitat area (2-4%), and 'usable' fish habitat for Arctic grayling (-240 m^2 for spawning, -59 m^2 for adult rearing), impacts on the health of local aquatic biota are anticipated to be similarly minimal. Further, changes may also benefit overall species fitness if post-construction conditions are predicted to move closer to species-specific environmental optima, as demonstrated by the post-closure increases in 'usable' fry and juvenile rearing habitat.

4. Drilling and Blasting

The use of explosives will be required for open pit mining, and for the construction of infrastructure site pads and access roads. As most blasting sites will be in or near fish-bearing watercourses, there is the potential for explosive shockwaves or blast residues to increase fish stress or cause habitat avoidance. While detonation setbacks are prescribed for avoiding fish and embryo death (Wright and Hopky 1998), similar guidelines for sub-lethal effects are not available.

The potential for blasting residues to leach into nearby watersheds is discussed in detail in 7.4.5.1. Briefly, all contact water from the open pit will be diverted to the TMF, whereas potential impacts from blasting residues along access roads are predicted to be minimal.

5. Fish Habitat Compensation Construction

Construction activities producing excess noise, tremors, or sedimentation may cause temporary habitat avoidance or have negative impacts on nearby fish and aquatic organism health. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. The removal or alteration of in-stream habitat features such as fish protective cover (e.g., undercut banks, boulders, large woody debris), deep pools for rearing and overwintering, or spawning areas may further trigger habitat avoidance behaviour.

The predicted habitat loss and alteration associated with the Fish Habitat Compensation Plan is extremely minor in comparison to the overall quantity of available habitat in the Yukon River. Furthermore, new high quality habitat will be constructed adjacent to the area of habitat loss, allowing populations to re-establish quickly to baseline or above baseline conditions.

6. Freegold Road Extension

Construction:

Construction activities producing excess noise, tremors, sedimentation, or ML/ARD may cause temporary habitat avoidance or have negative impacts on nearby fish and aquatic organism health. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. The removal or alteration of in-stream habitat features such as fish protective cover (e.g., undercut banks, boulders, large woody debris), deep pools for rearing and overwintering, or spawning areas may further trigger habitat avoidance behaviour.

The predicted habitat loss and alteration associated with the Freegold Road extension is relatively minor in comparison to the overall quantity of available habitat in the Big, Selwyn, and Sunshine Creek drainages. Thus, long-term effects on the health of aquatic biota populations are anticipated to be negligible.

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and yield sub-lethal impacts on local aquatic biota. Potential sub-lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Closure:

The Freegold Road will be decommissioned at closure unless otherwise specified by the Yukon Government. Road crossing structures will be removed, stream beds will be re-established, and stream banks will be stabilized. Potential effects due to in-stream workings will be similar to those identified during construction, such as erosion and sedimentation, stranding, trampling, impingement and entrainment.

7. Freegold Road Upgrade

Construction:

Construction activities producing excess noise, tremors, sedimentation, or ML/ARD may cause temporary habitat avoidance or have negative impacts on nearby fish and aquatic organism health. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. The removal or alteration of in-stream habitat features such as fish protective cover (e.g., undercut banks, boulders, large woody debris), deep pools for rearing and overwintering, or spawning areas may further trigger habitat avoidance behaviour.

The predicted habitat loss and alteration associated with the Freegold Road upgrade is relatively minor in comparison to the overall quantity of available habitat in the Nordenskiold, Crossing, Seymour, and Big Creek drainages. Thus, long-term effects on the health of aquatic biota populations are anticipated to be negligible.

Operations:

The Freegold access road will be used to transport LNG fuel, concentrate, supplies, equipment, and for waste removal, with projected traffic volumes of 56 inbound and 68 outbound vehicles per day. Thus, there is the potential for road runoff (sedimentation, road salts) and airborne dust and emissions from vehicle traffic to pollute nearby watercourses and yield sub-lethal impacts on local aquatic biota. Potential sub-lethal impacts on aquatic biota following reduced air quality are described above under project component 1, with further detail provided in 7.4.5.2.

Closure:

The Freegold Road upgrade section is owned and operated by the Yukon Government and will not be decommissioned at closure. Thus, potential impacts on aquatic biota will no longer be associated with the Casino Project.

8. Tailings Management Facility (TMF)

Construction:

Construction activities producing noise, tremors, and elevated sediment loading have the potential to increase stress levels of nearby fish and aquatic organisms, or cause habitat avoidance behaviour. For example, increases in TSS and turbidity may cause immune suppression, reduced feeding, and lowered reproduction. Notably, aquatic communities in Casino Creek experienced a naturally wide range of TSS, particularly during peak flows (Table 10.4-7). Thus, the regulatory standard of 25 mg/L above baseline levels for TSS (CCME 1999) is well within the natural range experienced by communities in Casino Creek.

Changes in habitat quality downstream of the TMF may hold varying consequences for the fitness (i.e., growth, recruitment, reproduction) of local aquatic biota. Sub-lethal effects may arise from a myriad of potential environmental changes, and their possible interactions, including changes in water quality, stream flow, water temperature, fluvial morphology, and nutrient and food availability. However, changes may also benefit overall species fitness if post-construction conditions are predicted to move closer to species-specific environmental optima. For example, in-stream flow modeling results suggest that there will be an increase in usable rearing habitat for Arctic grayling due to the increased availability of lower velocity habitat. Further, potential temperature increases may positively influence species growth considering that baseline temperatures in Casino Creek rarely exceeded 5°C, and that many local species have thermal preferences well above that threshold (e.g., Arctic grayling: 10-12°C, slimy sculpin: 13°C, burbot: 15.6-18.3°C; Symons et al. 1976, BC MOE 2001a).

Operations:

There are no anticipated sub-lethal effects from water quality during operations, due to the implementation of the seepage collection system and the employment of alternative water quality guidelines (Section 7.4.7.2).

Closure, Decommissioning, and Post-Closure:

Potential sub-lethal impacts on aquatic organisms in Casino Creek due to closure-related construction activities are described above and include noise, tremors, and increased sedimentation. However, the most likely sub-lethal impacts on local aquatic communities during closure/post-closure will be due to the release of TMF pond flow following seepage collection de-commissioning, and the implementation of the closure spillway.

As described previously within the habitat loss and alteration assessment section, effects from increased closure/post-closure flows will be concentrated in Casino Creek, with relatively minor changes in stream flow predicted in Brynelson and Dip Creeks. Flow increases will be greatest during freshet, with potential consequences for increased erosion, TSS, and flooding in Casino Creek. The increased contribution of TMF pond water from the closure spillway may also warm Casino Creek during the summer months.

Changes in habitat quality downstream of the TMF may hold varying consequences for the fitness (i.e., growth, recruitment, reproduction) of local aquatic biota. Predictions due to varying environmental changes are difficult to make due to the complexity of natural systems, and the number of potential interactions between effects. As previously noted, changes may benefit overall species fitness if post-closure conditions are predicted to move closer to species-specific environmental optima. For example, potential stream temperature increases may positively influence species growth considering that baseline temperatures in Casino Creek rarely exceeded 5°C, and that many local species have thermal preferences well above that threshold (e.g., Arctic grayling: 10-12°C, slimy sculpin: 13°C, burbot: 15.6-18.3°C; Symons et al. 1976, BC MOE 2001a).

While higher stream velocities may reduce the availability of preferred stream flows for Arctic grayling, the majority of increases are during peak flows where velocity preferences for Arctic grayling are higher due to spawning (Hubert et al. 1985, Stewart et al. 2007). In contrast, predicted velocity increases during summer rearing months are within 11% of baseline flows and will likely yield a minimal impact on habitat usage, growth, and health of fish of local aquatic biota.

Water Quality:

There are seven parameters that exceed CCME guidelines in Casino Creek: aluminum, cadmium, copper, fluoride, molybdenum, selenium, sulphate and uranium. Of these parameters, only copper, cadmium, selenium and fluoride continue to exceed guidelines in Dip Creek. These seven parameters are considered the Contaminants of Concern (COC) and the potential effects to water quality in the Casino and Dip creek receiving environment are addressed below. All predicted water quality values are based on the water quality modeling results, which is detailed in Appendix 7F. Site W4 in Casino Creek and W5 in Dip Creek are baseline monitoring sites, while M18 is a modeled site in Casino Creek. M18 represents the water quality in Casino Creek from the point of discharge to the receiving environment to about halfway down Casino Creek. The remaining lower half of the Creek and the water discharging to Dip Creek is represented by W4. Site W5 is on Dip Creek just downstream of the confluence with Casino Creek. Predicted values in Table 10.4-8 are based on the Life-of Project median and maximum values and the proposed water quality objectives are from the Water Quality effects assessment in Section 7.

Table 10.4-8 Proposed Alternative Water Quality Objectives and Predicted Parameter Concentrations

	Site	Parameter	Predicted Values (mg/L)		CCME Guideline (mg/L)	Proposed Water Quality Objective (mg/L)	Source
			Median	Maximum			
Creek	M18	Cadmium	0.00011	0.00050	0.000036	0.00027	US EPA chronic dissolved
		Copper	0.0040	0.0174	0.0026	0.025	SSWQO-BCP based on the 95th percentile
		Fluoride	0.52	0.80	0.12	1.4	Approved BC MOE maximum
		Molybdenum	0.053	0.100	0.073	1.0	Approved BC MOE 30-day average
		Selenium	0.0028	0.0040	0.001	0.002	Approved (Interim) BC MOE 30-day average
		Sulphate	211	441	None	309	Approved BC MOE 30-day average
		Uranium	0.013	0.021	0.015	0.019	SSWQO-BCP based on the maximum
	W4	Cadmium	0.000087	0.00045	0.000036	0.00027	US EPA chronic dissolved
		Copper	0.0034	0.0157	0.0026	0.025	SSWQO-BCP based on the 95th percentile
		Fluoride	0.40	0.72	0.12	1.4	Approved BC MOE maximum
		Molybdenum	0.039	0.091	0.073	1.0	Approved BC MOE 30-day average
		Selenium	0.0024	0.0035	0.001	0.002	Approved (Interim) BC MOE 30-day average
		Sulphate	167	404	None	309	Approved BC MOE 30-day average
		Uranium	0.012	0.019	0.0150	0.019	SSWQO-BCP based on the maximum
Dip	W5	Cadmium	0.00004	0.00011	0.000030	0.00023	US EPA chronic dissolved
		Copper	0.0018	0.0043	0.0022	0.0065	SSWQO-BCP based on 90th percentile
		Selenium	0.0005	0.0013	0.001	0.002	Approved (Interim) BC MOE 30-day average
		Fluoride	0.15	0.26	0.12	1.3	Approved BC MOE maximum

Cadmium

Cadmium is an unessential element for aquatic life and is toxic at very low concentrations (US EPA 2001). Salmonids are the most sensitive fish family to cadmium toxicity, and thus provide a conservative threshold for developing cadmium guidelines (CCME 1999). Cadmium can disrupt the functioning of fish gills, kidneys and intestines, with the effects manifested as reduced growth and reproduction rates (Eisler 1985, Besirovic et al. 2010). Cadmium has been shown to bioaccumulate, however evidence for cadmium biomagnification in aquatic life is conflicting (CCME 1999). There are several potential cellular mechanisms for cadmium toxicity including DNA and mitochondrial damage (Belyaeva et al. 2006, Bertin and Averbeck 2006, Viau et al. 2008), activation of proteases (Lee et al. 2007, Hsu et al. 2009), the promotion of radicals (Pathak and Khandelwal 2006, Liu et al. 2009, Risso-de Faverney et al. 2001), and disruption of homeostasis (Yang et al. 2007). Cadmium toxicity is complex, as the various chemical forms have differing toxicities and bioconcentration factors, and are dependent on numerous other parameters including pH, hardness, redox potential, organic ligands, hydroxides, and anions (CCME 1999; US EPA 2001).

In the case of cadmium, the US EPA chronic dissolved guideline was considered to be the most appropriate guideline as it underwent a more recent and detailed development process relative to the interim CCME guideline (see Section 7.4.7). The predicted maximum cadmium concentration at W5 in Dip Creek (0.00011 mg/L) does not exceed the US EPA chronic dissolved guideline (0.00023 mg/L during any project phases); however, the predicted maximum cadmium concentration in Casino Creek (0.0005 mg/L) does exceed the US EPA guideline (0.00027 mg/L) during four to five months of the year (Table 10.4-8). Guidelines are based on baseline median hardness values at the three respective sites, being 111 mg/L at W4 and M18 in Casino Creek, and 90 mg/L at W5 in Dip Creek. As increasing water hardness has ameliorating effects on cadmium toxicity, using the median predicted hardness value for Casino Creek (318 mg/L at W4 from Years 30+) produces a higher US EPA chronic dissolved guideline of 0.00060 mg/L, which surpasses the predicted maximum annual cadmium value at M18 and W4 during all post-closure phases.

Although predicted cadmium concentrations will exceed CCME guidelines at all sites (Table 10.4-8), exceeding these guidelines is not considered indicative of a major adverse effect based on the following points:

- The interim CCME guidance is older, published in 1999, than the US EPA guidance, published in 2001. Furthermore, a key aspect of the CCME guidance is older still. The hardness adjustment equation used by CCME to adjust its nominal chronic-toxicity-based guidance of 0.000017 mg/L cadmium at 48.5 mg/L hardness as CaCO3 is based on an unpublished report by Lewis and Porter dated 1990.
- The US EPA methodology is based on a much more thorough literature evaluation and analysis (268 pages) versus the CCME guidance (5 pages).
- The US EPA guideline is derived using chronic data from 14 fish species and 7 invertebrates. In contrast, the interim CCME guideline is based on a single lowest observed effect level (LOEL) value obtained from Lewis and Porter (1990), where cadmium concentrations could not be verified during exposure. The CCME hardness-based equation was developed using acute toxicities rather than chronic toxicities, and then extrapolated based on LOEL values.
- The CCME has recognized that their cadmium guidance is out-dated and does not reflect current scientific understanding, as is noted on the CCME website, and a revised draft cadmium guidance document was sent out for public review and comment in late 2012. However, no final updated CCME guidance for cadmium water quality has been released to date.

- Baseline cadmium concentrations exceed CCME guidelines at the majority of sites in the local and regional study area of the Casino Project, including lower Dip Creek, Britannia Creek, and the Yukon River.

A review of relevant scientific literature also suggests that chronic cadmium toxicity will not be experienced by fish in Casino or Dip Creeks. While there are no studies specifically evaluating chronic cadmium toxicity in Arctic grayling or slimy sculpin, the predominant fish species in the study area, comparable species have demonstrated hardness-standardized (50 mg/L) chronic values between 0.001308 mg/L for rainbow trout *Onchorhynchus mykiss* and 0.004265 mg/L for coho salmon *Oncorhynchus kisutch* (US EPA 2001). The chronic cadmium value for Arctic grayling is likely to fall within this range, which is well above (3-39 times greater) the maximum predicted cadmium values in either creek. Further, as watercourses in the LSA generally demonstrate higher hardness values than 50 mg/L, it is likely that the threshold for chronic effects will be even higher. The use of chronic toxicity data available for rainbow trout and coho salmon are an appropriate proxy for Arctic grayling, as acute toxicity studies have demonstrated that Arctic grayling have similar cadmium thresholds to both species (96-h LC50s adjusted to 50 mg/L total hardness: rainbow trout: 0.002108 mg/L (species mean acute value), Arctic grayling: 0.004894 mg/L (juvenile), coho salmon: 0.006221 mg/L (species mean acute value); Buhl and Hamilton 1991, US EPA 2001).

Invertebrate species generally demonstrate a higher sensitivity to cadmium toxicity than fish species (CCME 1999). The interim CCME cadmium guideline is based on the LOEL of 0.17 µg/L for *Daphnia magna* (CCME 1991), with other invertebrate species also demonstrating effects at similar cadmium concentrations (0.2 µg/L). These values were used to develop the CCME guideline, although the guideline is an order of magnitude lower based on the application of a safety factor of 0.1. While cadmium concentrations are predicted to exceed the LOEL, adverse effects are not anticipated given that predicted hardness levels in Casino and Dip Creeks are higher than the normalized hardness value of 50 mg/L. For example, using the median predicted hardness of 318 mg/L in lower Casino Creek for Years 30+, the CCME cadmium guideline would be 0.000090 mg/L. Once the application of the safety factor has been removed, it is expected that the hardness-adjusted LOEL would be approximately 0.00090 mg/L, which is approximately two times greater than maximum predicted values in Casino Creek. Similarly, maximum cadmium concentrations derived using median predicted hardness in mid-Casino and Dip Creeks (352 mg/L and 142 mg/L, respectively) will be approximately 2-4 times less than hardness-adjusted LOELs of 0.00098 mg/L and 0.00045 mg/L, respectively.

Provided that predicted cadmium concentrations will not exceed the US EPA guidelines derived using predicted hardness values, and that the lowest chronic effects guidelines for similar fish species are well above the predicted ranges (Buhl and Hamilton 1991, US EPA 2001), and also above hardness-adjusted LOELs for invertebrates (CCME 1991), it is anticipated that any adverse residual effects on aquatic biota due to cadmium toxicity will be minor.

Copper

Copper is an essential micronutrient for plants and animals at low concentrations, but can be toxic at elevated concentrations (US EPA 2007). Potential chronic effects from copper exposure include disruption of gill function, osmoregulation, oxygen transport, and energy metabolism in fish (Reid and McDonald 1991, Eisler 1998); and inhibited membrane permeability, cytoplasmic function, osmoregulation, ionic regulation and respiration in invertebrates (Alberta Environmental Protection 1996). Copper speciation and resultant bioavailability is complex as numerous physicochemical characteristics of the ambient water can produce markedly different toxicities, including temperature, dissolved organic compounds, suspended particles, pH, various inorganic ions, and alkalinity (US EPA 2007). Given the narrow biological tolerance range, and the noted complexity of estimating

copper bioavailability, the US EPA has developed and implemented their Biotic Ligand Model (BLM) which facilitates the calculation of a site-specific guideline by incorporating ten site-specific input parameters.

In the case of copper, a SSWQO based on background concentrations was considered to be the most appropriate due to the naturally high copper concentrations in the baseline conditions (Section 7.4.7). In addition, the US EPA BLM was incorporated as a secondary guideline. Predicted maximum copper concentrations do not exceed SSWQOs or BLM guidelines during any project phase, with maximum values of 0.016 mg/L at W4 and 0.017 mg/L at M18 in Casino Creek, and 0.0043 mg/L at W5 in Dip Creek (Table 10.4-8). Although the 95th percentile SSWQO (0.025 mg/L) is put forth as the proposed objective, it is important to note that at post-closure, predicted copper concentrations will meet the 90th percentile SSWQO (0.015 mg/L) for all months except for November.

While predicted maximum copper concentrations will exceed the CCME copper guidelines of 0.0022-0.0026 mg/L based on baseline hardness values, the usage of the USA EPA BLM is considered a more appropriate guide for assessing potential effects on aquatic biota due to the following points:

- The CCME value is derived from an outdated US EPA chronic Ambient Water Quality Criteria (1984), which is no longer based on current scientific understanding, and was subsequently refined (2007) by the US EPA as the BLM.
- The CCME guideline has an arbitrary value of 0.2 applied to the US EPA equation, which is not founded on scientific information and reduces the guideline by an order of magnitude.
- The BLM is currently the most rigorous and thorough method of determining Copper criterion, as it incorporates an up-to-date analysis of scientific literature.
- The CCME guideline is water hardness based, whereas the updated US EPA BLM requires ten input parameters (e.g., temperature, pH, dissolved organic carbon (DOC), calcium, magnesium, sodium, potassium, sulfate, chloride, and alkalinity), and is specifically designed to allow criteria to be customized to the particular water under consideration.
- Copper toxicity varies depending on other water quality parameters, and thus the use of only hardness is simplistic and may yield under or over estimates.

Thus, the US EPA BLM model was employed here to determine acute and chronic thresholds based on the predicted water chemistry of Casino and Dip Creeks (Table 10.4-9). The BLM derived guidelines are higher than site-specific water quality objectives as a result of the high predicted ionic concentrations (e.g., calcium, magnesium, chloride, sulphate) which will alleviate the effects of increased copper by reducing the bioavailable fraction.

Table 10.4-9 Acute and chronic water quality guidelines for copper derived using the US EPA Biotic Ligand Model (US EPA 2007)

Creek	Chronic	Acute
Casino (W4)	0.030	0.047
Dip	0.021	0.033

Note:
All units are mg/L

Considering that maximum predicted copper will not exceed SSWQOs, or the water quality objectives derived from the BLM model, no significant adverse impacts are anticipated on local fish and aquatic biota.

While there are a substantial number of studies that have investigated and confirmed sub-lethal impacts on fish from low-level copper exposure (e.g., Hansen et al. 1999a, b; Baldwin et al. 2003, McIntyre et al. 2008, Meyer and Adams 2010, Baldwin et al. 2011, Kennedy et al. 2012), these findings are not currently reflected in the derivation of regulatory guidelines (Meyer and Adams 2010). Furthermore, it is uncertain whether noted impacts on fish olfactory systems yield population-level impacts (McIntyre et al. 2008). Fish and aquatic biota in Casino and Dip Creeks will experience minor increases of copper within their environments as a result of project activities, which may increase habitat avoidance behaviour, or in worst case scenarios impact aquatic biota health. However, given that current guidelines do not account for these impacts, and the uncertainty of a population-level impact, the potential for a far-reaching regional effect is considered unlikely.

Fluoride

The accumulation of toxic fluoride ions in bone, teeth, scales and exoskeletons is cumulative and permanent (BC MOE 2011). On a cellular level, fluoride inhibits enzyme activity, disrupting metabolic processes such as glycolysis and protein synthesis (Camargo 2003). Salmonid species have demonstrated disruptions in their migration patterns when exposed to low levels of fluoride (0.5 mg/L) before or during upstream spawning migrations, and thus should be considered when developing site-specific guidelines (CCME 2002).

Fluoride toxicity is dependent on water hardness and temperature, with higher temperatures increasing toxicity and higher water hardness reducing it. However, experiments demonstrating fluoride toxicity at higher water hardness levels should be considered with caution as the two are highly reactive and will quickly precipitate as long as free calcium is available. Thus, current guidelines incorporating water hardness are tentative and require further study (BC MOE 2011). In addition to water hardness and temperature, certain metals may influence the bioavailability of fluoride. Aluminum in particular is noted to have an adverse effect on fluoride toxicity in aquatic plants, and potentially also in aquatic animals (CCME 2002).

For fluoride, the maximum BC MOE guideline was used as an alternative water quality guideline in place of CCME as it incorporates water hardness, which has a proven influence on fluoride toxicity. The maximum BC MOE guideline for fluoride produces guidelines of either 1.4 mg/L or 1.3 mg/L for Casino and Dip Creeks, respectively. Maximum predicted fluoride concentrations are below BC MOE guidelines for all three sites (Table 10.4-8).

An exceedance of the interim CCME guideline (0.12 mg/L) is not considered indicative of a major adverse effect based on the following points:

- The CCME guideline is based on acute toxicity data, rather than more applicable chronic toxicity data, with an arbitrary safety factor of 0.01 applied to the LOEL for uncertainty.
- The CCME guideline is based on a 144-h LC50 for the caddisfly *Hydropsyche bronta* based on a water hardness of 40.2 mg/L and a temperature of 18°C (CCME 2002).
- As fluoride toxicity is positively related to temperature and inversely related to water hardness, the CCME guideline is overly conservative for watercourses like Dip and Casino Creeks which experience both higher water hardness and lower temperatures.
- The BC MOE guideline equation obtained from Pimental and Bulkley (1983) is meant to better approximate fluoride toxicity in cooler water temperatures around 12°C, which are still higher than stream temperatures in Casino and Dip Creeks, but provide a more reasonable estimate.

It should be noted that the technical documents for both guidelines recommend further research to better understand the interactions between water hardness and temperature with fluoride toxicity. Currently, there are limited data available from multifunctional experiments which strategically vary water hardness, temperature and fluoride concentrations. As such, guidelines tend to be overly conservative because (1) impacts of fluoride are better understood for low water hardness concentrations, and (2) guidelines have been developed with the aim of protecting anadromous adult fish which experience increased sensitivity to fluoride toxicity, and often migrate through soft coastal waters. However, as predicted maximum fluoride will not exceed the hardness-based BC MOE guidelines, and there is no evidence for salmon spawning in Casino and Dip Creeks, a major adverse effect on aquatic biota in either watershed is decidedly unlikely despite the uncertainty surrounding guideline development.

Molybdenum

Molybdenum is an essential trace metal which promotes growth in periphyton, phytoplankton and macrophytes (CCME 2001). The mechanism of molybdenum toxicity is not well understood (Ricketts 2009), although chronic effects include reduced reproduction and mortality over long periods of exposure (CCME 2001). Molybdenum is relatively non-toxic to fish (Davies et al. 2005), and bioconcentration and biomagnification through the food chain is negligible (Regoli 2012).

Currently, British Columbia is the only province where molybdenum is mined and also has approved guidelines to reflect this. The 30-day average total molybdenum BC MOE guideline is 1 mg/L, which is almost 14 times higher than the interim CCME guideline of 0.073 mg/L (Fletcher et al. 1997). Considering the Casino mine will be producing copper, gold and molybdenum concentrate, it is proposed that the BC MOE guideline of 1 mg/L is used as the alternative guideline. Median monthly molybdenum concentrations will peak at 0.100 mg/L at M18 and 0.091 mg/L at W4, remaining well below the BC MOE 30-day guideline during all project phases (Table 10.4-8). Notably, the predicted median molybdenum concentrations of 0.053 mg/L for M18 and 0.039 mg/L for W4 will also remain below the more conservative CCME guideline.

While the interim CCME molybdenum guideline will be exceeded throughout the ice-free season, major adverse effects on fish and aquatic biota are not anticipated due to the following points:

- The CCME guideline was developed using older literature (Birge 1978), and although there is a limited amount of environmental effects testing literature to-date, subsequent studies were not able to corroborate the results on which the water quality guideline was based (Davies et al. 2005).
- The guideline was derived by multiplying the lowest chronic toxicity value, the 28-d LC50 of 0.73 mg/L for rainbow trout (Birge 1978), by a safety factor of 0.1 (CCME 1991). However, the higher toxicity range reported in subsequent comparable studies (15 to >90 mg/L), and the inability to reproduce the experimental results of Birge (1978), suggests that the guideline is based on an overly conservative and potentially unrepresentative experimental artifact (Davies et al. 2005).
- Results from a newer study replicating methods in Birge (1978) were significantly higher, where molybdenum was not acutely toxic to developmental stages of rainbow trout over 32 days up to a maximum concentration of 400 mg/L, and a further 32-day experiment with a maximum molybdenum concentration of 1500 mg/L similarly did not cause sufficient mortality to allow an LC50 to be calculated (Davies et al. 2005). These molybdenum concentration experiments yielded an acute response over three orders of magnitude higher than predicted molybdenum concentrations in Casino Creek.
- Molybdenum is relatively non-toxic to fish, with acute LC50s being fairly high (70 to >2000 mg/L; Davies et al. 2005).

- Consistent with the review and experimental replication in Davies et al. (2005), there was no evidence of a cellular or physiological stress response at high concentrations (1000 mg/L) of molybdenum (Rickets 2006).
- Molybdenum bioconcentration and biomagnification through the food chain is negligible (Regoli 2012).

Selenium

Selenium has the narrowest biological tolerance range (3-5 times difference) of all essential trace elements (Wake et al. 2004), and bioaccumulates in aquatic organisms at rates of 100-30,000 above ambient conditions (Lemly 2004). Selenium is principally transferred to aquatic biota through diet, with the initial source derived from organic-rich selenium present in stream sediments (BC MOE 2001b). Selenium toxicity can produce varying effects on fish and aquatic organisms including liver and ovary abnormalities (Sorensen 1998), impaired growth (Dobbs et al. 1996), reduced reproduction (Lemly 2004), and teratogenesis during early development (Lemly and Smith 1987). In aquatic environments, the most sensitive group to selenium exposure are egg-laying vertebrates such as fish, with toxic effects typically manifested as reproductive failures and abnormalities during early development (Coyle et al. 1993, Hamilton et al. 1990, Hermanutz et al. 1996).

Selenium toxicity is arguably one of the most complex contaminants of concern due to the numerous physical and ecological properties which govern selenium bioavailability and toxicity in a given environment, and the potential for distinctly different outcomes for aquatic biota in similar waterborne selenium concentrations. Accordingly, there is ample scientific evidence indicating that traditional water-based guidelines with widespread geographical application are not appropriate for selenium, and that site-specific risk assessments incorporating critical media (e.g., fish embryonic tissues) are the most conservative means for the protection of aquatic life (Chapman et al. 2010).

Both the CCME and BC MOE water quality guidelines are based on a lowest observed effect level (LOEL) of 0.01 mg/L of Se introduced by the International Joint Commission (IJC) to protect species in the Great Lakes (IJC 1981). For the CCME guideline, a safety factor of 10 was applied to the LOEL to end up with the guidance of 0.001 mg/L Se. The BC MOE guideline of 0.002 mg/L incorporates a safety factor of 5 to recognize that Se is an essential trace element for animal nutrition and that it is bioaccumulation (chronic effects) of Se through the food chain that is the major source of risk. The US EPA guideline of 0.005 mg/L is based on the same field studies cited in IJC (1981), but differs from the CCME and BC MOE guidelines in that it employs the selenium concentration at which no effects were observed as the guideline, rather than using the LOEL multiplied by a safety factor.

The maximum predicted selenium concentrations at M18 and W4 are 0.0040 mg/L and 0.0035 mg/L, respectively, exceeding the CCME and BC MOE guidelines but remaining below the US EPA guideline (Table 10.4-8). In Dip Creek, the maximum predicted concentration is 0.0013 mg/L, exceeding the CCME guideline but remaining below the BC MOE and US EPA guidelines.

Water-based guidelines for selenium have become increasingly controversial due to the growing body of literature investigating the complex mechanism of selenium transfer into aquatic food webs (Chapman et al. 2009). Foremost among literature findings is that the main source of selenium uptake into aquatic organisms is through diet, and that toxicity is further influenced by species physiology, and local hydrological and geochemical processes which ultimately regulate the bioavailability of selenium, the probability of uptake by organisms, and the potential for toxicity. Thus, the use of a water-based criterion has been increasingly criticized as an ineffective and unscientific means for ensuring that selenium concentrations remain within narrow biological tolerance ranges. Furthermore, there is ample evidence to suggest that the water-based LOEL determined by field studies in IJC (1981) is not transferrable to other systems (US EPA 1987, 2004; Chapman et al. 2009), with results from several

laboratory studies indicating that similar or higher selenium concentrations did not produce any chronic effects on aquatic biota (e.g., Lemly 1982, Hamilton and Wiedmeyer 1990, Cleveland et al. 1993; Gissel-Nielsen and Gissel-Nielsen 1978). However, variable results over a range of selenium concentrations in both laboratory and field studies further underline the complexity of predicting adverse levels of selenium based on water concentrations in natural settings (US EPA 1987, 2004; Chapman et al. 2009). In contrast, there is mounting evidence to suggest that an alternative tissue-based criterion using the most sensitive organism and life stage in a given ecosystem is the most conservative and scientifically defensible route for ensuring protection of aquatic life from selenium exposure (Chapman et al. 2009). Both British Columbia and the US EPA have recommended that measuring the level of selenium in whole body tissue of fish is a more appropriate way to assess selenium effects, and have provided tissue-based criteria accordingly.

It is important to note that the scientific studies used to develop selenium water quality guidelines were largely in standing or slow-moving waters which demonstrate an increased risk of selenium toxicity (BC MOE 2001b). In slower moving waters (e.g., lentic environments), higher organic-rich selenium concentrations accumulate in sediments and cause increased bioaccumulation in the food chain. In fast-flowing waters (e.g., lotic environments), selenium is less likely to bioaccumulate due to the lack of organic-rich sediment and rooted plants (BC MOE 2001b). Various studies investigating selenium toxicity were compiled in a review by Adams et al. (2010) to demonstrate the clear distinction between lentic and lotic systems. Selenium bioaccumulation was generally ten times greater in lentic environments in comparison to lotic environments, with bioaccumulation occurring above 0.001 mg/L and 0.013 mg/L in lentic and lotic environments, respectively (Adams et al. 2010). Thus, in the cobble-dominant fast-flowing waters of Casino Creek, the risk of selenium bioaccumulation into the aquatic food chain is likely low. Furthermore, the LOEL reported by other studies is likely an overly conservative estimate for selenium impacts in lotic systems such as Casino Creek. Several field studies have demonstrated no discernible effects on aquatic biota residing in fast-flowing waters within the receiving environment from coal mining effluent containing high (0.0133-0.0145 mg/L) waterborne selenium concentrations (e.g., McDonald and Strosher 1998, Kennedy et al. 2000).

Due to the lack of scientific support for applying a water-based criterion to Casino and Dip Creeks, a site-specific risk assessment is proposed to determine local toxicity thresholds for selenium. The assessment will facilitate the development of site-specific guidelines based on the various moderating factors including selenium speciation, hydrology, food web structure, physiology, water temperature and chemistry. As the reproductive tissues of egg-laying vertebrates have been identified as the most sensitive endpoint for determining selenium toxicity, fish eggs will be collected and analyzed where possible to develop local guidelines. Notably, previous environmental assessments have also proposed site-specific tissue-based guidelines (e.g., High Lake Project in Nunavut), which included an adaptive management approach to ensure no adverse effects.

In summary, it is unlikely that any significant adverse effects will occur as a result of selenium toxicity due to the following points:

- A site-specific tissue-based assessment will be undertaken to provide the most conservative and scientifically defensible protection for local aquatic life.
- Predicted selenium concentrations will remain below the established US EPA guideline (0.005 mg/L) at all sites and under all project phases, and additionally below the BC MOE guideline (0.002 mg/L) in Dip Creek year-round and under all project phases.
- Casino and Dip Creeks are fast-flowing streams and the developed guidelines are likely overly conservative for these lotic (fast-flowing) systems as they are based on lentic (still water) systems which experience enhanced selenium bioaccumulation.

Sulphate

Sulphur is an essential element used in amino acid synthesis (Meays and Nordin 2013). Numerous research has demonstrated that sulphate toxicity is ameliorated with increasing water hardness, however, there is limited data demonstrating this continuing trend in very hard waters (Meays and Nordin 2013). Invertebrate species are generally more sensitive to sulphate than fish (Davies et al. 2003). Chronic sulphate toxicity effects on aquatic biota include reduced reproduction, feeding, metabolism, and growth (Soucek 2007a, b; Elphick et al. 2011).

The only available sulphate guideline is provided by the BC MOE (Meays and Nordin 2013), which is a 30-day chronic guideline that varies with water hardness up to 250 mg/L. There are no approved federal water quality guidelines for the protection of freshwater aquatic life from sulphate in Canada, the USA or elsewhere. Application of the approved 30-day average water quality guidelines using baseline median hardness of 111 mg/L for Casino Creek results in a sulphate guideline of 309 mg/L, which is lower than the predicted maximum sulphate concentrations of 441 mg/L at M18 and 404 mg/L at W4. However, as median water hardness is predicted to increase to 334 mg/L for M18 and 278 mg/L for W4, the potential for sulphate toxicity will concurrently decrease due to the ameliorating effects of water hardness. The maximum BC MOE sulphate guideline is 429 mg/L, based on water hardness levels between 181-250 mg/L, which surpasses the predicted maximum annual sulphate value at W4 during all project phases. However, predicted maximum sulphate at M18 will exceed the maximum BC MOE sulphate guideline from Years 31-52 during the month of November only.

There is currently no sulphate guideline available for water hardness concentrations greater than 250 mg/L, and the BC MOE sulphate technical appendix recommends that site-specific toxicity testing is done for hardness >250 mg/L due to the paucity of experimental studies conducted using higher water hardness concentrations. However, the majority of this limited research has demonstrated the ameliorating influence of increased water hardness on sulphate toxicity (Meays and Nordin 2013), indicating that future research will likely provide the data to develop a higher sulphate guideline for water hardness levels >250 mg/L. Based on this anticipated interaction, it is unlikely that sulphate will cause major adverse effects on aquatic biota in Casino Creek, despite periodic exceedances of the current maximum guideline at M18.

While the BC MOE technical appendix cites one study in which increasing water hardness did not reduce sulphate toxicity, the study is unclear on the mechanism which resulted in reduced reproduction rates for *C. dubia* at lower sulphate concentrations following an increase in water hardness from 160 mg/L to 320 mg/L (Elphick et al. 2011). Further, the study authors indicated that the increased sensitivity was thought to derive from osmotic stress caused by the increasing ionic strength of the total dissolved solids, and not from sulphate (BC MOE 2011). Notably, the LOEL for mortality continued to increase with water hardness up to 320 mg/L. Thus, potential effects from high water hardness appear to be more subtle than direct impacts on individual survival. There are currently no guidelines for water hardness, however unpublished research has demonstrated that lethal effects are not experienced by either rainbow trout or *C. dubia* up to concentrations of 1000 mg/L (Kennedy, *In prep*). However, more research is required in order to isolate the non-lethal thresholds of water hardness and sulphate, and to ultimately develop defensible sulphate guidelines for harder waters.

In summary, no significant adverse effects are anticipated due to sulphate toxicity due to the following points:

- Incorporating predicted water hardness, sulphate concentrations in Casino Creek remain below the BC MOE chronic 30-day guideline for water hardness of 250 mg/L for the majority of months and project phases, with the only exception being small exceedances at M18 during the month of November between Years 31 and 52. Further downstream, W4 demonstrates no exceedances during all project phases.
- No guideline currently exists for water hardness above 250 mg/L, however it is likely that it will be higher based on the ameliorating effects of water hardness (BC MOE 2011).

- Although there was evidence for a lower sulphate LOEL in *C. dubia* following increased water hardness, the authors attributed the result to water hardness effects, rather than sulphate (Elphick et al. 2011).
- Any minor residual impacts will be localized to Casino Creek, with no BC MOE exceedances predicted for W5 in Dip Creek.

Uranium

Uranium accumulation is greatest in the mineralized tissues of fish (Waite et al. 1990, Cooley and Klaverkamp 2000), although it can also build up in other organs such as the kidneys and gonads (Waite et al. 1990, Cooley and Klaverkamp 2000). In invertebrates, uranium has been shown to collect in the gills, visceral mass, stomach and digestive glands (Labrot et al. 1999, Simon and Garnier-Laplace 2004, Simon and Garnier-Laplace 2005). There is evidence for uranium bioaccumulation in aquatic ecosystems, but not for biomagnification (Swanson 1985, Environment Canada and Health Canada 2003, Simon and Garnier-Laplace 2005). In addition, trophic transfer rates of uranium are low (Simon and Garnier-Laplace 2005), with higher concentrations generally found in lower trophic organisms (Environment Canada and Health Canada 2003). Uranium toxicity may cause a range of potential chronic effects, including reduced reproduction, growth, and survival.

Natural uranium concentrations demonstrate wide variability, and may promote ecological adaptations in local aquatic life. Uranium toxicity and bioavailability varies with pH, hardness, and temperature, however the CCME guideline does not incorporate the influence of other parameters due to limited current understanding of potential interactions (CCME 2011). As there is evidence for organismal adaptation to higher natural uranium concentrations, the increase of anthropogenic uranium into an environment may be less detrimental to organisms with pre-existing high uranium tolerances (CCME 2011).

Although not at the same intensity as copper, baseline levels of uranium are also elevated in the Casino Creek watershed. Thus, a SSWQO was considered to be the most appropriate as two out of six winter samples from the 2008-2012 water quality baseline study (Appendix 7A) exceeded the CCME long term guideline of 0.015 mg/L. Predicted maximum uranium concentrations equal the SSWQO at W4 (0.019 mg/L) and exceed it at M18 (0.02 mg/L), although the noted exceedances are minor and restricted to the month of October, with all remaining months below the guideline. For both sites in Casino Creek, predicted maximum uranium will remain below the short term CCME guideline of 0.033 mg/L, and the maximum British Columbia Working Water Quality Guideline (BCWWQG) of 0.3 mg/L during all project phases.

Despite the noted exceedances, uranium is not anticipated to yield significant adverse effects due to the following main points:

- Aquatic life experiencing higher natural uranium concentrations such as in Casino Creek may have adapted higher tolerances for uranium; the CCME states that in these cases, a site-specific guideline may be necessary or advantageous (CCME 2011).
- Maximum predicted uranium concentrations will not exceed short-term CCME or maximum BCWWQ guidelines at either site.
- Maximum predicted uranium concentrations at W4 will not exceed SSWQOs at any time, and will only exceed long-term CCME guidelines during the late summer months, and by a small margin. Specifically, uranium will exceed the long-term CCME guideline during September, October and November by a maximum of 0.004 mg/L.
- While more exceedances of the long-term CCME guideline will occur further upstream at M18, the median value of 0.013 mg/L remains below the guideline. Furthermore, at Post-Closure, uranium at M18

will only exceed the site-specific water quality objective during the month of October, and by a small margin of 0.002 mg/L.

- A small exceedance in the CCME guideline is considered acceptable given that: (1) uranium concentrations appear to be naturally elevated at several sites in the LSA and RSA, including upper Dip Creek and all sites on Britannia Creek, (2) British Columbian and Yukon stream levels of uranium are highest amongst all streams in Canada (Garrett, 2007), and (3) elevated U concentrations at the Casino mine site appear to be ubiquitous and unrelated to the ore body.
- The CCME guideline is derived using the statistical (Type A) approach which sets the guideline at the 5th percentile, below which 95% of all taxa will not experience chronic uranium effects (CCME 2011). However, according to Figure 2 in the uranium CCME factsheet, an increase to 0.02 mg/L is still at least 2 times below the LOEL for 12 of 13 aquatic species used to derive the guideline. Furthermore, it is not significantly different from the guideline, falling below the upper 95% confidence interval of 0.025 mg/L (CCME 2011). Only one sensitive species, the amphipod *Hyalella azteca* is within the potential range of chronic effects with a LOEL of 0.012 mg/L, although notably it is also not protected by the CCME guideline of 0.015 mg/L. Finally, the lowest chronic threshold experienced by fish species used to derive the guideline is much higher, with a 30-day EC10 (non-viable embryos) of 0.350 mg/L for rainbow trout (Vizon 2004).
- Any minor residual impacts will be localized to Casino Creek, with no CCME exceedances predicted for W5 in Dip Creek.

10.4.2 Identification of Mitigation Measures and Potential Residual Effects

Mitigation measures were identified and compiled for each potential effect on fish and aquatic resources (Table 10.4-10 to Table 10.4-12). For the purposes of this assessment, mitigation measures included any action, project design feature, or proposed habitat compensation that will reduce or eliminate impacts on fish habitat and aquatic organism health in the LSA. A detailed Fish Habitat Compensation Plan is included as an appendix to this assessment, outlining the proposed habitat compensation plan to offset unavoidable habitat losses (Appendix 10C). Each mitigation measure was evaluated for its predicted effectiveness on reducing or eliminating impacts. Following the application of all potential mitigation measures, residual effects were identified and carried forward in the assessment to determine significance (Section 10.4.3).

General Mitigation Measures:

All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Environmental Management Plan and Water Management Plan, which aim to reduce or eliminate impacts on fish and aquatic resources by incorporating best management practices (BMPs), such as:

- Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading)
- The use of cofferdams or stream diversions to de-water construction areas
- Diverting clean water around crossings to maintain sufficient flows downstream
- Monitoring of TSS and turbidity during construction to ensure compliance with regulatory guidelines (<25 mg/L increase if background levels are less than 250 mg/L, <10% increase if background levels are greater than 250 mg/L; CCME 1999)
- Stabilizing and re-vegetating disturbed areas following construction

- Dust suppressants and enforced traffic speed limits along all access roads to reduce any potential contamination of nearby watercourses
- Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan
- Completing fish salvages prior to any in-stream activities in fish-bearing watercourses
- DFO guidelines for:
  - Timing windows for the protection of fish and fish habitat during critical life history stages
  - Freshwater Intake End-of-Pipe Fish Screen (DFO 1995), to avoid fish impingement and entrainment while pumping water during construction
  - The Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998)

In addition to mitigation and compensation measures, an environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and biological communities in the LSA. Additional mitigation or compensation measures will be incorporated on an as-needed basis.

Bridges and Culverts:

To minimize impacts, bridges will be installed on all fish-bearing creeks where reasonably possible. Single-lane clear-span bridges designed for a minimal footprint within the stream channel will be used at all crossings with the exception of the Nordenskiold River Bridge, which will be two-span with a pier located in the river channel. Clear-span bridge installation on fish-bearing watercourses will avoid any stream bed alteration, and rip rap will be installed below bridges in order to minimize the risk of slope failure where vegetation is unable to grow due to insufficient light. Further, rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows.

When possible, permanent bridges and culverts will be installed during the initial construction stages to minimize the duration of in-stream activities. However, any required temporary crossing structures will comply with measures outlined in DFO operational statements. Where technically and economically feasible and reasonably practical, bridge construction will occur in the winter, whereas all major culvert construction will be completed during the summer months. Where required, temporary ice bridges will be used to provide far shore access to construction equipment. Ice bridges will be removed prior to spring break-up to prevent unnatural ice jamming and flooding.

Several assessments were completed along the access road corridors with the aim of identifying any areas which may be sensitive to disturbances and requiring either project re-design or mitigation. A fluvial geomorphological assessment was carried out along the Freegold road extension and airstrip access road to assess the sensitivity of aquatic habitat to disturbance, and thus the potential risk for unnatural erosion, sedimentation, permafrost destabilization or potential crossing structure blow-outs (Appendix D). Final crossing structure sites, orientations and spans will be modified for sensitive sites to mitigate any potential impacts on aquatic habitat.

An Erosion and Sedimentation Risk Assessment (Appendix D) was carried out along the Freegold road extension to identify areas that may require additional mitigation strategies during construction. Crossings were classified as either low, moderate or high, based on the “Erosion Potential” and the “Potential Ecological Consequences of Erosion”. Erosion Potential is a physical measure of an area’s susceptibility to erosion and considers factors such as surficial materials, slope gradients, and presence of permafrost. Potential Ecological Consequences of off-site sediment mobilization considers the potential for sediment to actually reach a watercourse and the sensitivity of the watercourse.

The majority of crossings were low (68%) or moderate (23%) risk, as a direct result of project planning to avoid, where practical, steep north-facing slopes and maintain the road alignment within low gradient valley bottoms and exposed bedrock soils. Based on the erosion and sedimentation control practices described in "Best Management Practices for Works Affecting Water in Yukon" (Environment Yukon 2011), the following risk-commensurate erosion and sedimentation control measures are suggested for construction of the Freegold Road Extension:

- **Low Risk**: General preventative best management practices (BMPs); minimal monitoring;
- **Moderate Risk**: Active sediment controls and BMPs; periodic monitoring; and
- **High Risk**: Active sediment controls and, where applicable, active erosion controls; priority for monitoring.

Insufficient data was available at the time of analysis to conduct an erosion and sedimentation risk assessment on the Freegold Road Upgrade Section, Airstrip Road or the Casino Mine site. If the appropriate data becomes available at later projects stages, a similar risk assessment can be conducted for the remaining project elements.

Water Quality:

A water quality monitoring plan will be designed and implemented to ensure that water quality threshold objectives are met downstream of the TMF. Other mitigation to improve water quality downstream of the TMF is built into design of the TMF, including the construction of wetlands both upstream and downstream of the TMF pond, a winter seepage mitigation pond (WSMP), strategic placement of waste rock in TMF, and protection of the dam shell with rip rap.

ML/ARD potential was assessed along the Freegold road corridor to determine areas requiring additional investigation, mitigation and/or monitoring (Lorax Environmental, 2012). Sites with ML/ARD potential were further assessed using available fisheries and aquatic habitat data, with the most ecologically significant and sensitive habitats receiving the highest rating. For example, habitat supporting commercial, recreational, or aboriginal fisheries such as Chinook salmon were assigned the highest rating. Where impacts from ML/ARD were anticipated, proposed mitigation strategies included (1) avoidance of high acid generating potential (PAG) materials during construction activities, (2) diluting PAG material with acid consuming material, and (3) storing PAG material at a safe distance from watercourses. On-site testing of materials during construction will be required for higher-risk sites to ensure that materials are managed accordingly. Similar ML/ARD assessments are currently underway for the airstrip access road.

Mitigation of potential fuel and chemical spills into watercourses are outlined in the Casino Emergency Response Plan (Appendix 22C). The conservative setback distance of the airstrip to Dip Creek (>400 m), and the design of the airstrip diversion channel will further reduce potential contamination as it flows upslope around the receiving environment from the airstrip and into Dip Creek.

Habitat Loss:

Unavoidable fish-bearing habitat loss will be compensated in adherence to DFO's guiding principle of no net loss. Direct habitat loss will occur during construction of the TMF and the airstrip, whereas wetted habitat loss due to flow reductions are anticipated in lower Canadian and Casino Creeks. HEP methodology was employed to calculate habitat loss in areas that will be completely removed (Refer to details in PECG and Normandeau 2013b). In lower Canadian and Casino Creeks, a PHABSIM model was used to determine the change in usable habitat for Arctic grayling under the new flow regime.

Casino Creek stream flow increases (Closure/Post-closure):

The original proposed location of the TMF closure spillway outlet was on Brynelson Creek, upstream of Casino Creek. Hydrological and geomorphological assessments conducted identified significant habitat loss in Brynelson Creek due to projected peak flow increases between 122-452% from baseline values. To mitigate effects, the proposed spillway was modified to bypass Brynelson Creek and directly enter Casino Creek just upstream of its confluence with Brynelson Creek. Further, the overflow discharge schedule was modified to evenly spread flow increases across the summer months, rather than having a major flow increase event during freshet. The re-designed discharge schedule has reduced peak flow increases from 50% to 25%.

Projected flow increases following closure will require additional mitigation to minimize localize erosion at existing, unstable sites. Site-specific surveys will be conducted during detailed design to determine whether any minor channel modifications (e.g., local bank stabilization/restoration, riffle modification, etc.) are needed as mitigation measures.

Table 10.4-10 Identification of Mitigation Measures and Potential Residual Effects for Fish and Aquatic Resources due to Habitat Loss and Alteration

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure1	Predicted Effectiveness	Residual Effect
Air quality	C, O	Habitat degradation due to dustfall from blasting, ore transport and vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
Airstrip and Airstrip Access Road	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at airstrip access road crossings	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Airstrip and Airstrip Access Road	C	Fish-bearing in-stream and riparian habitat loss within and downstream of the airstrip	Adverse	Fish habitat compensation	Moderate	Yes
Airstrip and Airstrip Access Road	C, O, CD, PC	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances	High	Yes
Canadian Creek Diversion	O	Non-fish-bearing in-stream and riparian habitat loss within the open pit footprint in upper Canadian Creek	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Canadian Creek Diversion	O	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to loss of surface drainage to the open pit	Adverse	Fish habitat compensation for serious harm to Arctic grayling habitat	Moderate	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure1	Predicted Effectiveness	Residual Effect
Canadian Creek Diversion	O, CD	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan	High	Yes
Canadian Creek Diversion	CD	Non-fish-bearing habitat loss (e.g., nutrients, food) in upper Canadian Creek	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Canadian Creek Diversion	CD, PC	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to decommissioning of the Canadian Creek Diversion	Adverse	Fish habitat compensation for serious harm to Arctic grayling habitat	Moderate	Yes
Fish Habitat Compensation Construction	C	Fish-bearing in-stream and riparian habitat loss in lower Britannia Creek	Adverse	Fish habitat compensation for serious harm to Arctic grayling habitat	High	Yes
Fish Habitat Compensation Construction	C	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan	High	Yes
Freegold Road Extension	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Freegold Road Extension	C, O, CD	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances	High	Yes
Freegold Road Upgrade	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure1	Predicted Effectiveness	Residual Effect
		Freegold access road crossings				
Freegold Road Upgrade	C, O, CD	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances	High	Yes
LNG Transport to site	C, O	Habitat degradation due to dust and road runoff from vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
On-site equipment and vehicle use	C, O	Habitat degradation due to dust and road runoff from vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
Tailings Management Facility (TMF)	C	Fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek	Adverse	Fish habitat compensation	Moderate	Yes
Tailings Management Facility (TMF)	C	Non-fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Tailings Management Facility (TMF)	C	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Sediment and erosion control plan	High	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure1	Predicted Effectiveness	Residual Effect
Tailings Management Facility (TMF)	C, O	Change in water temperature in lower Casino Creek due to reduced flows	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Tailings Management Facility (TMF)	C, O, CD, PC	Reduced stream flows, nutrients, food, woody debris in lower Casino Creek	Adverse	Fish habitat compensation for serious harm to Arctic grayling habitat	Moderate	Yes
Tailings Management Facility (TMF)	C, O	Change in stream morphology from flow decreases	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Tailings Management Facility (TMF)	CD, PC	Change in water temperature in lower Casino Creek due to release of TMF pond	Adverse	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details	n/a	Yes
Tailings Management Facility (Closure spillway)	CD, PC	Increased stream flows	Adverse	Modification of closure spillway location, magnitude and timing	Moderate	Yes
Tailings Management Facility (TMF)	CD, PC	Change in stream morphology from flow increases	Adverse	Site-specific fluvial geomorphology studies	Moderate	Yes
Traffic (Equipment and Materials to Site)	C, O	Habitat degradation due to dust and road runoff from vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No

Notes: [1]For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures
C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

Table 10.4-11 Identification of Mitigation Measures and Potential Residual Effects for Fish and Aquatic Resources due to Lethal Effects on Fish and Aquatic Organisms

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Air quality	C, O	Lethal effects due to dust and emissions from blasting, ore transport and vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
Airstrip and Airstrip Access Road	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Adverse	Fisheries working windows to avoid destroying incubating fish eggs	Moderate	Yes
Airstrip and Airstrip Access Road	C	Lethal effects on fish and aquatic organisms such as trampling by heavy machinery, impingement or entrainment during water extraction, and stranding during de-watering	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows and Freshwater Intake End-of-Pipe Fish Screen to prevent fish impingement and entrainment into water pumps	High	No
Airstrip and Airstrip Access Road	C, O, CD, PC	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage, modify culvert and bridge design for areas with increased sensitivity to disturbances, airstrip diversion channel	High	Yes

Airstrip and Airstrip Access Road	C, O, CD, PC	Lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Canadian Creek Diversion	O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan	High	Yes
Canadian Creek Diversion	O, CD	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling in the open pit footprint, and loss of wetted habitat area downstream following reduced stream flows	Adverse	Fisheries working windows to avoid destroying incubating fish eggs	Low	Yes
Drilling and Blasting (Noise, Fly Rock, Vibration)	C	Lethal effects on fish and aquatic organisms due to blasting residue contamination	Adverse	Divert contaminated water from the open pit into the TMF; Best Management Practices for explosives selection, drilling, handling and loading; environmental effects monitoring; natural dilution	High	No
Drilling and Blasting (Noise, Fly Rock, Vibration)	C	Mortality of fish and incubating fish eggs	Adverse	Adhere to DFO guidelines for The Use of Explosives In or Near Canadian Fisheries Waters	High	No
Fish Habitat Compensation Construction	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to diversion of lower Britannia Creek	Adverse	Fisheries working windows to avoid destroying incubating fish eggs	Moderate	Yes

Fish Habitat Compensation Construction	C	Lethal effects on fish and aquatic organisms such as trampling by heavy machinery, impingement or entrainment during water extraction, and stranding during de-watering	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows and Freshwater Intake End-of-Pipe Fish Screen to prevent fish impingement and entrainment into water pumps	High	No
Fish Habitat Compensation Construction	C	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage	High	Yes
Freegold Road Extension	C	Direct mortality of periphyton and benthic invertebrates due to infilling	Adverse	Minimize disruption of fish food production by installation culverts on non-fish bearing streams only where possible	Moderate	Yes
Freegold Road Extension	C	Lethal effects on aquatic organisms such as trampling by heavy machinery and stranding during de-watering for culvert installation	Adverse	Minimize disruption of fish food production by installation culverts on non-fish bearing streams only where possible	High	No
Freegold Road Extension	C, O	Lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Freegold Road Extension	C, O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, modify culvert and bridge design for areas with increased sensitivity to disturbances	High	Yes

Freegold Road Upgrade	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Adverse	Minimize disruption of aquatic biota by installing culverts on non-fish bearing streams only where possible. Fisheries working windows to avoid destroying incubating fish eggs around Nordenskiold Bridge	Moderate	Yes
Freegold Road Upgrade	C	Lethal effects on fish and aquatic organisms such as trampling by heavy machinery, impingement or entrainment during water extraction, and stranding during de-watering	Adverse	Minimize disruption of aquatic biota by installing culverts on non-fish bearing streams only where possible. For the Nordenskiold Bridge installation: de-water construction area, fish salvage, guidelines for fisheries working windows and Freshwater Intake End-of-Pipe Fish Screen to prevent fish impingement and entrainment into water pumps	High	No
Freegold Road Upgrade	C, O	Lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Freegold Road Upgrade	C, O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances For the Nordenskiold Bridge installation: fisheries working windows, fish salvage	High	Yes
LNG Transport to site	C, O	Lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No

Mine Development	C, O, CD, PC	Lethal effects on local fish populations due to increased fishing pressure	Adverse	No fishing policy for CMC workforce, the Freegold extension will not be open to the public	High	No
On-site equipment and vehicle use	C, O	Lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
Tailings Management Facility (TMF)	C	Lethal effects on fish and aquatic organisms such as trampling by heavy machinery, impingement or entrainment during water extraction, and stranding during de-watering	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows and Freshwater Intake End-of-Pipe Fish Screen to prevent fish impingement and entrainment into water pumps	High	No
Tailings Management Facility (TMF)	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling and reduction of wetted habitat area	Adverse	Fisheries working windows to avoid destroying incubating fish eggs	Moderate	Yes
Tailings Management Facility (TMF)	C	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage	High	Yes

Tailings Management Facility (TMF)	O, CD, PC	Change in water quality	Adverse	Water Management, including a Reclamation Plan (i.e. construction of two engineering wetlands: North TMF wetland and South TMF wetland, construction of a Winter Seepage Mitigation Pond to contain seepage during December to April and release during higher flows)	Moderate	Yes
Tailings Management Facility (TMF)	C, O, CD, PC	Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows	Adverse	Monitoring of biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation	Moderate	Yes
Traffic (Equipment and Materials to Site)	C, O	Lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No

[1]For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures
C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

Table 10.4-12 Identification of Mitigation Measures and Potential Residual Effects for Fish and Aquatic Resources due to Sub-lethal Effects on Fish and Aquatic Organisms

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Air quality	C, O	Sub-lethal effects due to dust and emissions from blasting, ore transport and vehicle traffic	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality	High	No

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
				Management Plan		
Airstrip and Airstrip Access Road	C	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms during construction	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows	High	No
Airstrip and Airstrip Access Road	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage, modify culvert and bridge design for areas with increased sensitivity to disturbances, airstrip diversion channel	High	Yes
Airstrip and Airstrip Access Road	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Airstrip and Airstrip Access Road	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation	Moderate	Yes
Canadian Creek Diversion	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan	High	Yes
Canadian Creek Diversion	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional	Moderate	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
				compensation		
Drilling and Blasting (Noise, Fly Rock, Vibration)	C	Sub-lethal impacts on aquatic biota due to blasting residue contamination	Adverse	Divert contaminated water from the open pit into the TMF; Best Management Practices for explosives selection, drilling, handling and loading; environmental effects monitoring; natural dilution	High	No
Drilling and Blasting (Noise, Fly Rock, Vibration)	C	Sub-lethal impacts (e.g., stress, habitat avoidance) on fish and incubating fish eggs	Adverse	Adhere to DFO guidelines for The Use of Explosives In or Near Canadian Fisheries Waters	High	Yes
Fish Habitat Compensation Construction	C	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms during construction	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows	High	No
Fish Habitat Compensation Construction	C	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage	High	Yes
Fish Habitat Compensation Construction	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation	Moderate	Yes
Freegold Road Extension	C	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms during construction	Adverse	Minimize disruption of aquatic biota by installing culverts on non-fish bearing streams only, Guidelines for fisheries working windows	High	No

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Freegold Road Extension	C, O	Sub-lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Freegold Road Extension	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, modify culvert and bridge design for areas with increased sensitivity to disturbances	High	Yes
Freegold Road Extension	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Monitoring of fish habitat to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation	Moderate	Yes
Freegold Road Upgrade	C	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms during construction	Adverse	Minimize disruption of aquatic biota by installing culverts on non-fish bearing streams only where possible. For the Nordenskiold Bridge installation: de-water construction areas, fish salvage, guidelines for fisheries working windows	High	No
Freegold Road Upgrade	C, O	Sub-lethal effects on fish and aquatic organisms due to ML/ARD	Adverse	ML/ARD risk assessment and management plan	High	No
Freegold Road Upgrade	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances For the Nordenskiold Bridge installation: fisheries working windows, fish salvage	High	Yes
Freegold Road	C, O, CD	Sub-lethal effects on	Adverse	Monitoring of fish habitat to identify	Moderate	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Upgrade		fish and aquatic organisms due to change in habitat productive capacity		any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation		
LNG Transport to site	C, O	Sub-lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
On-site equipment and vehicle use	C, O	Sub-lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No
Tailings Management Facility (TMF)	C	Sub-lethal effects such as habitat avoidance, elevated stress or impaired health of fish and aquatic organisms during construction	Adverse	De-water construction areas, fish salvage, guidelines for fisheries working windows	High	No
Tailings Management Facility (TMF)	C	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Sediment and erosion control plan, fisheries working windows, fish salvage	High	Yes
Tailings Management Facility (TMF)	O, CD, PC	Change in water quality	Adverse	Water Management, including a Reclamation Plan (e.g., Construction of two engineered wetlands: North TMF wetland and South TMF wetland, construction of a Winter Seepage Mitigation	Moderate	Yes

Project Component	Project Phase	Potential Effect	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
				Pond to contain seepage during December to April and release during higher flows)		
Tailings Management Facility (TMF)	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation	Moderate	Yes
Traffic (Equipment and Materials to Site)	C, O	Sub-lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	Adverse	Traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan	High	No

[1]For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures

C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

10.4.3 Significance of Residual Effects

Significance of residual effects was evaluated based on several criteria including: magnitude, geographical extent, duration, frequency, reversibility, context, and probability of occurrence, as defined for fish and aquatic resources (Table 10.4-14). Ratings were assigned to each individual residual effect and compiled in Table 10.4-14 (Habitat Loss and Alteration), Table 10.4-15 (Lethal effects) and Table 10.4-16 (Sub-lethal effects).

Following the assessment, all adverse residual effects were considered non-significant due to the low or medium magnitude and limited geographical extent of the impacts. A summary of the fish and aquatic resources residual effects which were evaluated are provided below:

- Temporary losses of fish-bearing in-stream and adjacent riparian habitat as compensated areas are constructed and become fully established
- Flow reductions in lower Canadian Creek
- Flow reductions and subsequent increases in lower Casino Creek
- Non-fish-bearing habitat loss including riparian vegetation and in-stream production of periphyton and benthic invertebrates, with subsequent decreases in the downstream transport of nutrients, food, and structural habitat (e.g., woody debris)
- Changes in stream temperature and morphology in lower Casino Creek
- Changes in water quality in lower Casino Creek and in Dip Creek
- Mortality of periphyton and benthic invertebrates due to stream infilling and reductions in downstream wetted areas
- Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows
- Minor sedimentation at the immediate vicinity of road crossings due to permanent stream bank alteration, and at various locations during mine infrastructure construction. Potential adverse residual effects from increases in stream TSS and turbidity include:
    - Alteration of downstream habitat including the potential for stream bed homogenization, reduced pool depths, loss of benthic invertebrate and periphyton habitat, and the loss of suitable spawning habitat for salmonids
    - Lethal or sub-lethal impacts on periphyton and benthic invertebrate communities
    - Sub-lethal impacts on fish such as habitat avoidance or stress
- Adverse effects on aquatic biota fitness (e.g., growth, reproduction, recruitment) due to habitat avoidance and reduced aquatic biota health throughout the LSA
- Sub-lethal impacts on fish from blasting activities

Table 10.4-13 Determining Significance of Residual Effects for Fish and Aquatic Resources

Criteria	Rating	VC Specific Definitions
Magnitude	Low	Predicted effects on fish and aquatic organisms are within the natural baseline variability
	Medium	Predicted effects on fish and aquatic organisms are not within the natural baseline variability but do not exceed any applicable regulatory thresholds
	High	Predicted effects on fish and aquatic organisms are not within the natural baseline variability and exceed any applicable regulatory thresholds
Geographical Extent	Localized	Effect limited to the LSA
	Widespread	Effect extends to the RSA
Duration	Short Term	Effect lasts <2 years
	Long Term	Effect lasts more than 2 years but less than 30 years (equivalent to estimated Post-Closure phase of the Project)
	Permanent	Effect continues beyond Post-Closure phase into the foreseeable future
Frequency	Infrequent	Effect occurs rarely (i.e. monthly to yearly)
	Frequent	Effect occurs intermittently or continuously (i.e. weekly or daily)
Reversibility	Reversible	Effect is reversed after the activity ceases
	Irreversible	Effect will not be reversed after the activity ceases, or the effect is permanent
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur. (Unknown)
	High	High likelihood that the predicted residual effect will occur.

Habitat loss and alteration in the LSA was considered non-significant based on the following specific points:

- Aquatic habitat in the LSA is generally of low quality and productivity, and does not contain regionally unique species or habitat
- The majority of aquatic habitat in the LSA does not support fish overwintering, and thus provides only seasonal habitat
- Habitat loss and alteration in the LSA will not affect regional biodiversity, and there will be no measurable impact on regional productivity
- Once habitat compensation in Britannia Creek and along the road corridor is constructed and developed it will offset any temporary losses in local productive capacity of habitat
- While significant local habitat loss and alteration will occur in Casino and Canadian Creeks, impacts on the productive capacity of habitat immediately downstream in Dip and Britannia Creeks will be negligible for the following reasons:
    - Upper Casino Creek demonstrates the lowest habitat quality within the LSA and is characterized by poor water quality, limited primary and secondary production, and low quality riparian habitat. Together, these qualities demonstrate that upper Casino Creek provides an insignificant source of nutrients, benthic invertebrate drift, and functional woody debris to the lower watershed.

- From a regional fisheries perspective, the loss of upper Casino Creek will yield a negligible impact as very low numbers of fish migrate to the upper watershed, only Arctic grayling are present, and no critical life history stages such as overwintering, spawning or young-of-the-year rearing are supported.
- While adverse residual effects on aquatic communities in lower Casino Creek may occur, such as a significant decrease in winter flows, flow modelling results clearly demonstrate that these impacts will not extend to Dip Creek as maximum changes in habitat availability will be within 3% of baseline conditions (Table 10.4-3 and Table 10.4-5).
- Canadian Creek has experienced recent and historical extensive placer mining disturbance, and is not fish-bearing in the upper watershed where the diversion and habitat loss will occur
- Projected changes in wetted habitat in Canadian Creek downstream of project activities are minor during summer months (2-4% reductions in wetted widths and depths), and the impact on potential overwintering habitat is predicted to be similarly minimal
- Minor impacts observed in Canadian Creek will be further buffered downstream by surface and groundwater inputs in Britannia Creek, with impacts continually decreasing as flows approach the Yukon River.

- While there is the potential for a stream temperature increase in lower Casino Creek due to reduced flows, and following the construction of the TMF pond spillway, all resident fish species have thermal preferences well above baseline stream temperatures and thus no adverse effects are anticipated. Instead, increased stream temperatures will likely yield a positive impact on seasonal growth rates as incipient lethal temperatures will not be approached.
- Stream morphology changes in lower Casino Creek during construction/operations will include a moderate reduction in bank erosion, and a minor increase in substrate embeddedness in low velocity areas due to the reduction of flushing flows. However, the accumulation of fine substrate will be negligible as major storm events will still provide the necessary energy to re-mobilize fines.
- Stream morphology changes in lower Casino Creek during closure/post-closure will be regulated by natural floodplain processes which aid in minimizing channel erosion and sediment transport during freshet.
- Road crossing structures will provide new cover and shade to fish and aquatic biota.
- Impacts on habitat from minor increases in erosion and sedimentation are considered to be negligible as aquatic habitat in the LSA experiences a naturally wide range of TSS, particularly during peak flows, which are well within the regulatory standard which all project construction activities will adhere to.

Lethal and sub-lethal impacts in the LSA were considered non-significant based on the following specific points:

- Any sub-lethal impacts on fish species will be low in magnitude, localized, and yield no impact on regional fisheries productive capacity. In addition, fish communities will be monitored at near-field sites in Casino, Dip, Canadian and Britannia Creeks to identify and potentially mitigate/compensate any future impacts on the fitness of local fish species
- Alternative water quality guidelines which take into account site-specific water chemistry will be applied
- While there will be a significant loss of periphyton and benthic invertebrate production due to project activities, impacts will be localized and have no far-reaching effects on regional productivity or diversity.

- Aquatic communities in the LSA experience a naturally wide range of TSS, which is well within the regulatory standard which all project construction activities will adhere to.

Table 10.4-14 Significance of Residual Effects for Fish and Aquatic Resources due to Habitat Loss and Alteration

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Airstrip and Airstrip Access Road	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at airstrip access road crossings	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Airstrip and Airstrip Access Road	C	Fish-bearing in-stream and riparian habitat loss within the airstrip footprint	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Airstrip and Airstrip Access Road	C, O, CD, PC	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
Canadian Creek Diversion	O	Non-fish-bearing in-stream and riparian habitat loss within the open pit footprint in upper Canadian Creek	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Canadian Creek Diversion	O	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to loss of surface drainage to the open pit	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	High	Not Significant
Canadian	O, CD	Increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Creek Diversion		causing habitat loss and alteration									
Canadian Creek Diversion	CD	Non-fish-bearing habitat loss (e.g., nutrients, food) in upper Canadian Creek	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Canadian Creek Diversion	CD, PC	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to decommissioning of the Canadian Creek Diversion	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	High	Not Significant
Fish Habitat Compensation Construction	C	Fish-bearing in-stream and riparian habitat loss in lower Britannia Creek	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Fish Habitat Compensation Construction	C	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
Freegold Road Extension	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Freegold Road Extension	C, O, CD	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
Freegold Road Upgrade	C	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Freegold Road Upgrade	C, O, CD	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
Tailings Management Facility (TMF)	C	Fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C	Non-fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Tailings Management Facility (TMF)	C, O	Change in water temperature in lower Casino Creek due to reduced flows	Adverse	Low	Localized	Long term	Frequent	Reversible	High resilience	Medium	Not Significant
Tailings Management Facility (TMF)	C, O, CD, PC	Reduced stream flows, nutrients, food, woody debris in lower Casino Creek	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C, O	Change in stream morphology from flow decreases	Adverse	Low	Localized	Long term	Frequent	Irreversible	High resilience	Medium	Not Significant
Tailings Management Facility (TMF)	CD, PC	Change in water temperature in lower Casino Creek due to release of TMF pond	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Medium	Not Significant
Tailings Management Facility (Closure spillway)	CD, PC	Increased stream flows	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	CD, PC	Change in stream morphology from flow increases	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

[1]For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures

C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

Table 10.4-15 Significance of Residual Effects for Fish and Aquatic Resources due to Lethal Effects on Fish and Aquatic Organisms

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Airstrip and Airstrip Access Road	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Airstrip and Airstrip Access Road	C, O, CD, PC	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Canadian Creek Diversion	O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Canadian Creek Diversion	O, CD	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling in the open pit footprint, and loss of wetted habitat area downstream following reduced	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
		stream flows									
Fish Habitat Compensation Construction	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to diversion of lower Britannia Creek	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Fish Habitat Compensation Construction	C	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Freegold Road Extension	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Freegold Road Extension	C, O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Freegold Road Upgrade	C	Direct mortality of periphyton, benthic invertebrates, and	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
		fish eggs due to infilling									
Freegold Road Upgrade	C, O, CD	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Tailings Management Facility (TMF)	C	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling and reduction of wetted habitat area	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Tailings Management Facility (TMF)	O, CD, PC	Change in water quality	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C, O, CD, PC	Lethal effects on fish and aquatic organisms due to stranding or	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
		winter kill following reduced flows									

For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures
C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

Table 10.4-16 Significance of Residual Effects for Fish and Aquatic Resources due to Sub-Lethal Effects on Fish and Aquatic Organisms

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Airstrip and Airstrip Access Road	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Airstrip and Airstrip Access Road	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
		productive capacity									
Canadian Creek Diversion	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Canadian Creek Diversion	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
Drilling and Blasting (Noise, Fly Rock, Vibration)	C	Sub-lethal impacts (e.g., stress, habitat avoidance) on fish and incubating fish eggs	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Fish Habitat Compensation Construction	C	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Fish Habitat Compensation Construction	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
Freegold Road Extension	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Freegold Road Extension	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
Freegold Road Upgrade	C, O, CD	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Freegold Road Upgrade	C, O, CD	Sub-lethal effects on fish and aquatic	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant

Project Component	Project Phase	Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
			Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
		organisms due to change in habitat productive capacity									
Tailings Management Facility (TMF)	O, CD, PC	Change in water quality	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Tailings Management Facility (TMF)	C	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
Tailings Management Facility (TMF)	C, O, CD, PC	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	Moderate	Not Significant

[1]For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures

C: Construction, O: Operations, CD: Closure and Decommissioning, PC: Post-Closure

10.4.4 Discussion of Significance

No significant habitat loss and alteration (Table 10.4-17), lethal effects (Table 10.4-18), or sub-lethal effects (Table 10.4-19) on fish and aquatic organisms are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including proposed compensation works, which are outlined in Section 10.4.2.

The level of confidence applied for each residual effect is defined in Section 5 and varies from low (<50%) to high (>80%). Where sufficient baseline data was available and interactive mechanisms were relatively well understood, confidence levels were predicted to be medium or high. Conversely, a few potential residual effects were rated as low confidence due to insufficient baseline data or scientific literature available, and/or the potential for complex mechanisms. For example, the understanding of potential sub-lethal effects on local aquatic biota following reduced stream flows in lower Casino and Canadian Creeks is low due to the number of factors involved (e.g., lowered flows, temperature increases, altered channel morphology) and the uncertainty surrounding their potential interactions. In addition, the confidence for understanding the potential for winter kill in lower Casino Creek is low as the decline of overwintering habitat will be dependent on multiple factors including temperature, groundwater flow, and fish presence in a given year. Lastly, the water quality assessment is generally moderate, with a few exceptions where guideline development is still preliminary and based on limited datasets (e.g., fluoride, sulphate, selenium). Proposed site-specific risk assessments for these parameters would provide the most conservative and scientifically defensible protection for local aquatic life, thus increasing the non-significant confidence rating from low to moderate or high.

Table 10.4-17 Summary of Residual Effects for Fish and Aquatic Resources due to Habitat Loss and Alteration

Project Component	Potential Residual Effects	Direction	Significance	Level of Confidence
1, 4, 7	Fish-bearing in-stream habitat loss	Adverse	Not Significant	High
1, 2, 5, 6, 7	Non-fish-bearing in-stream habitat loss	Adverse	Not Significant	Moderate
1, 4, 5, 6, 7	Fish-bearing riparian habitat loss	Adverse	Not Significant	Moderate
1, 2, 5, 6, 7	Non-fish-bearing riparian habitat loss	Adverse	Not Significant	High
1, 2, 4, 5, 6, 7	Increased erosion and sedimentation causing habitat loss and alteration	Adverse	Not Significant	High
2, 7	Reduced downstream transport of stream flows, nutrients, food, woody debris	Adverse	Not Significant	Moderate
7	Change in stream morphology	Adverse	Not Significant	Moderate
7	Change in water temperature	Adverse	Not Significant	Moderate
7	Increase in stream flows	Adverse	Not Significant	Moderate

1. Airstrip and Airstrip Access Road, 2. Canadian Creek Diversion, 3. Drilling and Blasting, 4. Fish Habitat Compensation Construction, 5. Freegold Road Extension, 6. Freegold Road Upgrade, 7. Tailings Management Facility

Table 10.4-18 Summary of Residual Lethal Effects for Fish and Aquatic Resources

Project Component	Potential Residual Effects	Direction	Significance	Level of Confidence
1, 2, 4, 5, 6, 7	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Adverse	Not Significant	High
1, 2, 4, 5, 6, 7	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Not Significant	High
2, 7	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to loss of wetted habitat area downstream following reduced stream flows	Adverse	Not Significant	High
7	Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows	Adverse	Not Significant	Low
7	Change in water quality	Adverse	Not Significant	Moderate

1. Airstrip and Airstrip Access Road, 2. Canadian Creek Diversion, 3. Drilling and Blasting, 4. Fish Habitat Compensation Construction, 5. Freegold Road Extension, 6. Freegold Road Upgrade, 7. Tailings Management Facility

Table 10.4-19 Summary of Residual Sub-Lethal Effects for Fish and Aquatic Resources

Project Component	Potential Residual Effects	Direction	Significance	Level of Confidence
1, 2, 4, 5, 6, 7	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation	Adverse	Not Significant	Moderate
1, 2, 4, 5, 6, 7	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Adverse	Not Significant	Low
3	Sub-lethal impacts (e.g., stress, habitat avoidance) on fish and incubating fish eggs	Adverse	Not Significant	Moderate
7	Change in water quality	Adverse	Not Significant	Low to Moderate

1. Airstrip and Airstrip Access Road, 2. Canadian Creek Diversion, 3. Drilling and Blasting, 4. Fish Habitat Compensation Construction, 5. Freegold Road Extension, 6. Freegold Road Upgrade, 7. Tailings Management Facility

10.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

10.5.1 Introduction

Residual effects on fish and aquatic resources as a result of the Casino Project were described in Section 10.4. In this section, identified residual effects were further assessed for their potential to cumulatively interact with other past, present, and future projects which overlap spatially and temporally with the Casino Project.

10.5.2 Identification of other Activities Potentially Affecting the VC

A list of all potential past, present and likely future projects and activities that could reasonably be expected to have a spatial or temporal interaction with the residual effects of the Casino Project is reported in Appendix 5B. Section 5.0 provides further details into the compilation of this list. These projects and activities include quartz mines, mineral and placer claims, heritage sites, and registered outfitting and trapline concessions. These projects and activities were assessed on whether or not they met three conditions, as outlined in Section 5.0, to warrant further assessment of cumulative effects. They are reiterated here:

- Adequate qualitative and/or quantitative information which is publicly available to allow for spatial and temporal characterization, and
- Spatial overlap with the residual effects of the Casino Project, and
- Temporal overlap with the residual effects of the Casino Project.

Of these projects and activities, potential overlap of fish and aquatic resources residual effects with the Casino Project includes (Table 10.5-1):

- Past mining in the Casino Creek watershed;
- Present mining at the Minto Copper Mine;
- Current development and future mining at the Carmacks Copper Mine;
- Past, present, and future mineral exploration around the Casino Mine site and within watersheds along the Freegold access corridor; and
- Past, present and future placer mining around the Casino Mine site and within watersheds along the Freegold access corridor.

While there are numerous other projects and activities outlined in Appendix 5B, insufficient data often precluded any assessment of a potential interaction with the Casino Project. Only projects for which data was available are reported herein.

Table 10.5-1 Residual Effect Information for Other Projects or Activities – Fish and Aquatic Resources

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Mining				
Historic Casino Property Mining	Past	Cadmium, silver, lead, zinc loading into Casino Creek from historical adit	Casino Creek from confluence of Meloy Creek to confluence of Dip Creek	Life of mine
Minto Copper Mine	Present	Reduced water quality Increased erosion and sedimentation	Yukon River, Big Creek, Wolverine Creek, Dark Creek, Unnamed Creek B and Minto Creek	2022
Carmacks Copper Mine	Future	Increased erosion and sedimentation	Yukon River, Williams Creek, Nancy Lee Creek, Merrice Creek, Crossing Creek, Murray Creek, Nordenskiold River	Project in review; Predicted 8-year mine life
Mineral Exploration				
Upper Canadian Creek and Canadian Creek	Past, Present and Future	Reduced water quality Increased erosion and sedimentation Disturbances from drilling and trail clearing	Canadian Creek	Unknown
Sonora Gulch			Hayes Creek Watershed	
Prospector Mountain			Hayes Creek and Big Creek Watersheds	
Nucleus			Big Creek Watershed	
WS Total			Big Creek and Crossing Creek Watersheds	
Placer Mining				
See Appendix 5b for specific placer claim information	Past, Present and Future	Increased erosion and sedimentation Channel re-alignments Reduced water quality Stream temperature increases Changes in hydrology	Canadian and Britannia Creeks Rude Creek Seymour Creek Hayes Creek Watershed Big Creek Watershed	Indeterminate

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

Mining

The Casino Property has had a long and varied exploration history. Between 1965 and 1980, silver-rich veins were explored and developed intermittently by underground and surface workings. A remnant of the past

exploration activities include an adit with a pipe that discharges water to Casino Creek via surface runoff to Meloy Creek. This water is elevated in silver, lead, cadmium and zinc and has likely been discharging to Casino Creek for the past 33 to 48 years.

The Minto Copper mine is located 240 km northwest of Whitehorse and can be accessed by barge or ice road along the Yukon River via Minto Landing. An all-weather access road provides access from the west side of the Yukon River to the mine site, with one major bridge crossing over lower Big Creek. Commercial production of the Minto mine commenced in 2007, with operations expected to run until 2022. Mining activities reside within Minto, Wolverine, and Dark Creeks, which all drain directly into the Yukon River with the exception of Dark Creek which is a tributary to Big Creek. Potential residual effects are expected to be generally confined to the Minto Creek drainage, although there may be impacts in the lower Big Creek drainage due to the access road crossing, and possible development in upper Dark Creek. Effects may include habitat loss or alteration in Dark Creek, with resultant negative impacts on aquatic ecosystem health. The existing bridge on Big Creek may increase erosion and sedimentation due to slope failure, or road runoff and dust from vehicle traffic.

The proposed Carmacks Copper mine is located 38 km northwest of the town of Carmacks, and accessed from a 12 km road originating via the Freegold Road (km 33). Exploration on the property has been ongoing since 1970, with the most recent program initiated in 2006. The Carmacks mine is currently under YESAB review, and once permitted will have an anticipated mine life of eight years. Mining activities will occur in the Williams Creek sub-basin which flows northward into the Yukon River, however, site access will require usage of the shared Freegold Road. Usage of the Freegold Road may increase erosion and sedimentation due to slope failure, or road runoff and dust from vehicle traffic into watercourses along the shared portion of the Freegold Road, which includes the Nordenskiold River, Murray Creek, and Crossing Creek.

Mineral Exploration

There has been extensive mineral exploration along the Dawson Range dating back to the Klondike Gold Rush in the late 1800's. Several recent exploration projects are situated around the Casino Mine site and along the proposed Freegold Road corridor. Directly west of the Casino Mine property, recent mineral exploration in the Canadian Creek area began in 1993 and is still ongoing within the 6180 ha property. Field programs on the Canadian Creek property share several access roads with the Casino Project.

There are several active mineral exploration programs along the Freegold Road corridor, including Sonora Gulch, Prospector Mountain, Nucleus, and WS Total. Below is a brief summary of the location of each property relative to the proposed Freegold Road corridor:

Sonora Gulch claims are situated at the junction of Hayes and Selkirk Creeks, and overlap several Hayes Creek tributaries including Butterfield Creek and Klines Gulch. The Freegold Road extension is proposed to run directly through the Sonora Gulch property along the western and southern banks of Hayes Creek.

Further east, the Prospector Mountain property is located in the Hayes Creek headwaters, and extends southward into the Big Creek drainage. The proposed Freegold road passes the property to the northeast in reaches further downstream.

The Nucleus property is located in the Big Creek watershed just upstream of its confluence with Seymour Creek. The Freegold Road is proposed to run directly through the Nucleus property along the south bank of Big Creek.

The WS total property is proximate to the proposed Carmacks Copper Mine, just south of the Yukon River. The property claims traverse several watersheds, including Big Creek tributaries just upstream of its outlet into the Yukon River, and Crossing Creek which drains northeast into the Yukon River. The Freegold Road upgrade

section runs through the southern edge of the WS property on the north bank of Crossing Creek, but enters the Big Creek watershed well upstream of the Yukon River.

Placer Mining

Placer mining activities are prevalent within the Casino local study area and occur in all major watersheds. Known past and present operation locations include:

- Britannia and Canadian Creeks;
- Rude Creek (Jaworski and Vanwermeskerken 2000), a tributary to upper Dip Creek;
- Hayes Creek upstream of its confluence with the Selwyn River;
- Several Big Creek tributaries just upstream of its confluence with Seymour Creek, and near the end of the Freegold Road upgrade section; and
- Seymour Creek, just upstream of its confluence with Big Creek.

Potential residual effects from placer mining include changes in hydrology or channel morphology due to channel re-alignments and water withdrawals, losses of complex in-stream habitat features such as protective cover, reduced health of riparian habitat, stream temperature increases, increased erosion and sedimentation, and reduced water quality. Combined, the potential for habitat loss and alteration may negatively impact the health of local fish and aquatic communities. Further, areas where placer mining activities are particularly dense may be at risk of experiencing cumulative impacts in downstream mainstems.

10.5.3 Interactions between Residual Project Effects and Other Activities

The fish and aquatic resources residual effects of the Casino Project were compared to residual effects of the mining, mining exploration and placer mining projects and activities identified within the cumulative effects assessment boundaries (Table 10.5-2). Spatially and temporally, there is potential for these residual effects to interact with fish and aquatic resources residual effects from the Casino Project.

There are several potential cumulative effects due to the interaction of the Casino Project with other projects and activities (Table 10.5-3). Directly around the Casino Mine site, there is the potential for cumulative effects as a result of historic mining in upper Casino Creek, past and present mineral exploration of upper Canadian Creek, and past and potential future placer mining in Canadian and Britannia Creeks. Impacts from placer mining on Rude Creek were not considered here, as Rude Creek is over 10 kilometres upstream of the confluence of Casino Creek and Dip Creek, making it highly unlikely that any residual effects from current and likely future placer mining activity on Rude Creek would have any additive or synergistic effects with fish and aquatic resources residual effects from the Casino Project.

Historic mining on the Casino property has resulted in the frequent discharge from a historical adit into the upper watershed, subsequently lowering water quality in downstream Casino Creek (Refer to Appendix 7A – Water and Sediment Quality Baseline Report for details). As the majority of residual impacts from the Casino Project will occur in Casino Creek, there is high potential for linkage between the two projects to cause negative cumulative effects on local aquatic biota health and survival. On the northern side of the Casino property, present and future mineral exploration activities may increase erosion and sedimentation into Canadian Creek headwaters, disturb riparian habitat, and lower water quality. There is also the potential for placer mining in Canadian and Britannia Creeks to produce cumulative effects on local aquatic communities. While impacts from previous placer mining activities have been captured within the Fish and Aquatic Resources Baseline conditions (Appendix 10A), there is

still the potential for future placer mining to further increase erosion and sedimentation, alter channel morphology and hydrology, and ultimately impact local aquatic biota health and survival.

Along the Freegold Road corridor, there are numerous mining, mineral exploration, and placer mining projects and activities with the potential to interact with the Casino Project. Road construction will result in habitat loss, increased erosion and sedimentation, and lethal and sub-lethal effects on local aquatic biota due to construction activities and dense vehicle traffic.

Residual effects from the Minto Copper Mine are not anticipated to interact with the Casino Project, as the proposed Freegold road corridor is located over 20 km upstream from the confluence of Dark and Big Creeks. As the proposed Carmacks copper mine will share 33 km of the Freegold Road upgrade section with the Casino Project, there is the potential for a cumulative effect between the two projects. Impacts to local aquatic communities will include effects from upgrade construction and vehicle traffic, including siltation and road run-off into nearby watercourses.

The most likely residual effect from ongoing mineral exploration programs is increased erosion and sedimentation into local watercourses. The potential for a cumulative effect with the Casino Project will be greatest where the road alignment passes directly through an exploration property, such as at Sonora Gulch and Nucleus. Although the Freegold Road extension will be a private resource road with restricted access to other activities and projects along the corridor, there is still the potential for interactions with the Casino Project along this segment. Other potential residual effects may occur as a result of trail clearing and drill pad building. For example, riparian vegetation disturbance may reduce bank stability, temperature regulation, and food and nutrient inputs into local watercourses. Further, exploration activities may also lower water quality, with resultant negative impacts on local aquatic biota health.

The proposed Freegold Road corridor will run through several past, present and future placer mining operations including areas within the Hayes, Big and Seymour Creek watersheds. Anticipated cumulative effects along these sections include lowered habitat productive capacity, and the potential for reduced aquatic organism health and survival.

Table 10.5-2 Cumulative Effects Assessment Interactions Matrix – Fish and Aquatic Resources

Casino Project Residual Effect	Potential Spatial and Temporal Overlap										
	Mining			Mineral Exploration			Placer Mining				
	Cadmium, silver, lead, zinc loading into Casino Creek from historical adit	Reduced water quality due to Minto Copper mining	Increased erosion and sedimentation	Reduced water quality	Increased erosion and sedimentation	Disturbances from drilling and trail clearing	Increased erosion and sedimentation	Channel re-alignments	Reduced water quality	Stream temperature increases	Changes in hydrology
Habitat Loss	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Increased erosion and sedimentation	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Change in Casino Creek water quality	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Habitat alteration downstream of TMF	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Habitat alteration downstream of Canadian Creek diversion	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES
Lethal effects on aquatic biota due to infilling, wetted habitat area loss, or stranding	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Sub-lethal impacts due to blasting	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES

1 YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

Table 10.5-3 Potential Cumulative Effects – Fish and Aquatic Resources

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Habitat Loss	Mining, Mineral Exploration, Placer Mining	Reduction in the productive capacity of aquatic
Increased erosion and sedimentation	Mining, Mineral Exploration, Placer Mining	Reduction in the productive capacity of aquatic habitat Negative effects on aquatic biota health Aquatic community population declines
Change in Casino Creek water quality	Mining	Reduced water quality in Casino Creek due to adit discharge and TMF discharge Negative effects on aquatic biota health in Casino Creek Aquatic community population declines in Casino Creek
Habitat alteration downstream of TMF	Mining	Reduction in the productive capacity of aquatic habitat in Casino Creek Negative effects on aquatic biota health in Casino Creek Aquatic community population declines in Casino Creek
Habitat alteration downstream of Canadian Creek diversion	Mineral Exploration, Placer Mining	Reduction in the productive capacity of aquatic habitat in Canadian Creek Negative effects on aquatic biota health in Canadian Creek Aquatic community population declines in Canadian Creek
Lethal effects on aquatic biota due to infilling, wetted habitat area loss, or stranding	Mining, Mineral Exploration, Placer Mining	Aquatic community (e.g., fish, periphyton, benthic invertebrates) population declines
Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Mining, Mineral Exploration, Placer Mining	Habitat avoidance, increased stress, lowered population fitness (e.g., growth, reproduction, recruitment)
Sub-lethal impacts due to blasting	Mining, Mineral Exploration, Placer Mining	Habitat avoidance, increased stress of local aquatic biota

10.5.4 Proposed Mitigation Measures and Potential Residual Cumulative Effects

Proposed Mitigation Measures of the Casino Project are outlined in Section 10.4.2. Briefly, mitigation will include several developed mitigation plans including the Erosion and Sediment Control Plan, Water Management Plan, Environmental Management Plan, and the Air Quality Management Plan. Further, a Fish Habitat Compensation Plan has been produced to ensure no net loss of habitat within the LSA (Appendix 10C), and Environmental Effects Monitoring will be implemented to monitor water quality and the health of aquatic communities in watercourses adjacent to the mine site. Further, the Freegold Road design incorporates the installation of bridges at all fish-bearing crossings, significantly reducing the impact to aquatic communities along the road corridor.

Additional mitigation to be considered by CMC includes permanently sealing the adit pipe in the upper Casino Creek watershed. A suitable time to implement this measure may be during the construction of the heap leach facility as the proposed footprint of the heap leach facility is adjacent to the historic adit.

In Yukon, current and future projects and activities are required to adhere to their own developed mitigation plans, including sediment and erosion mitigation around construction activities and access roads. In conjunction with mitigation plans implemented by the Casino Project, areas of spatial and temporal overlap between projects will be monitored and mitigated where necessary. The permitting and monitoring of placer mines has additional mitigation built into its regulatory infrastructure. For example, each watercourse has pre-determined TSS thresholds which vary depending on the local habitat rating (i.e. Fish Habitat Suitability rating), and operators must continually monitor TSS discharge to ensure compliance. Habitat is ranked by its environmental significance and sensitivity, with the highest quality habitat garnering the best water quality standards. High suitability habitats are those supporting Chinook salmon production, or habitat identified as supporting ecologically or culturally important fisheries or aquatic resources (i.e., Areas of Special Consideration, such as in lower Britannia Creek). In addition to high TSS standards, channel diversions, in-stream works, and the creation of new fords are not authorized, and riparian buffers of 30 m must be maintained along high suitability habitat.

Table 10.5-4 Additional Mitigation Measures and Residual Cumulative Effects – Fish and Aquatic Resources

Potential Cumulative Effect	Mitigation Measures for Project-Specific Effects[1]	Additional Mitigation[2] (if possible)	Effectiveness of Additional Mitigation Measure (Low, Moderate, High, Unknown)	Residual Cumulative Effect (Yes/No)
Reduction in the productive capacity of aquatic habitat	Bridges at fish-bearing crossings Erosion and Sediment Control Plan Fish Habitat Compensation Plan	Placer mining regulations	Moderate	Yes
Negative effects on aquatic biota health; Lowered population fitness (e.g., growth, reproduction, recruitment)	Erosion and Sediment Control Plan Environmental Effects Monitoring	Placer mining regulations; Control contaminate discharge from the historic adit in upper Casino Creek	Moderate	Yes
Aquatic community population declines	Bridges at fish-bearing crossings Erosion and Sediment Control Plan Fish Habitat Compensation Plan	Placer mining regulations	Moderate	Yes
Habitat avoidance	Bridges at fish-bearing crossings Erosion and Sediment Control Plan DFO Guidelines for: The Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998) Environmental Effects Monitoring	Placer mining regulations	Moderate	Yes

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.

2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

10.5.5 Significance of Residual Cumulative Effects

Residual impacts from the Casino Project are concentrated in the Casino and Canadian Creek drainages, with impacts along the proposed access roads anticipated to be minimal. Conversely, the majority of active or near-future projects within the RSA are situated along the proposed road corridor and are well removed from the Casino Mine site. Thus, all identified cumulative effects are anticipated to be non-significant based on the minimal potential of project effect interactions (Table 10.5-5). The result of project effect linkages will be low in magnitude and geographical extent, and are not expected to have far-reaching effects on regional productivity or diversity. In particular, the use of bridges on all fish-bearing watercourses along the road corridor, the restriction of the Freegold extension as a private resource road, and the implementation of the Casino Fish Habitat Compensation Plan (Appendix 10C) will serve to minimize, and then compensate for any potential project impacts on fish and aquatic resources in the RSA.

Table 10.5-5 Significance of Residual Cumulative Effects – Fish and Aquatic Resources

Residual Cumulative Effect	Predicted Degree of Effect After Additional Mitigation Measures								Significance of Residual Cumulative Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Reduction in the productive capacity of aquatic habitat	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
Negative effects on aquatic biota health; Lowered population fitness (e.g., growth, reproduction, recruitment)	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	Moderate	Not Significant
Aquatic community population declines	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	Moderate	Not Significant
Habitat avoidance	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	Moderate	Not Significant

10.5.6 Discussion of Significance of Residual Cumulative Effects

No significant cumulative effects (Table 10.5-6) on fish and aquatic organisms are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, low magnitude, and high level of confidence of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including proposed compensation works, which are outlined in Sections 10.4.2 and 10.5.4.

Table 10.5-6 Summary of Residual Cumulative Effects – Fish and Aquatic Resources

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Reduction in the productive capacity of aquatic habitat	Adverse	Not Significant	High
Negative effects on aquatic biota health; Lowered population fitness (e.g., growth, reproduction, recruitment)	Adverse	Not Significant	High
Aquatic community population declines	Adverse	Not Significant	High
Habitat avoidance	Adverse	Not Significant	High

10.6 SUMMARY AND CONCLUSIONS

No significant habitat loss and alteration (Table 10.4-17), lethal effects (Table 10.4-18), sub-lethal effects (Table 10.4-19), or cumulative effects (Table 10.5-6) on fish and aquatic organisms are predicted to occur due to the Casino Project. All residual effects were considered non-significant due to the low geographical extent, and low to medium magnitude of the anticipated impacts. The assessment of significance is contingent on the complete implementation of mitigation measures, including proposed compensation works, which are outlined in Sections 10.4.2 and 10.5.4.

While habitat loss and alteration in Casino Creek will be notable, the reduction in available habitat will be offset with new higher quality habitat in lower Britannia Creek (Appendix 10C). For example, flow reductions during winter may decrease or eliminate the low amount of overwintering habitat currently available in lower Casino Creek, however, the proposed compensation pond will more than offset this loss. Overall, the net habitat gain will ensure that there is no impact on the productive capacity of habitat on a regional scale.

Impacts from mine effluent discharge are not anticipated to be significant based on the application of alternative water quality guidelines which take into account site-specific water chemistry including high water hardness, and elevated baseline metal concentrations. The designation of non-significance is directly formulated on results from the water quality model (Appendix 7F).

Sub-lethal effects on fish and local aquatic biota are difficult to predict owing to the number of factors involved (e.g., lowered flows, temperature increases, altered channel morphology) and the uncertainty surrounding their potential interactions. Thus, monitoring of water quality and aquatic communities at near-field sites in Casino, Dip, Canadian and Britannia Creeks is required to identify and potentially mitigate/compensate any future impacts on the fitness of local fish species. Despite the uncertainty involved, potential project impacts are not predicted to yield far-reaching effects on regional productivity or diversity.

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11 – RARE PLANTS AND VEGETATION HEALTH

11.1 INTRODUCTION

The Casino Project will interact with vegetation. Vegetation includes vascular plants and lichens. This section provides an assessment of potential Project and cumulative effects on rare plants and vegetation health. It also includes proposed mitigation to reduce Project effects on vegetation. The assessment focusses on issues related to rare plants and vegetation health within the Project's Potential Disturbance Area (PDA) and larger Local Study Area (LSA). When Project effects cannot be completely mitigated, potential cumulative effects are described.

A rare plant is defined as "*one that has a small population within the area under consideration. It may be restricted to a small geographical area, where it may be locally common, or it may occur in low numbers over a wide area*" (Douglas et al. 1981). The Project will interact with rare plants by clearing vegetation, including some rare plant habitat. Potential effects of the Project on rare plants are primarily loss of habitat within the Project footprint. The footprint will disturb vegetation and fugitive dust generated from Project activities will settle on surrounding vegetation, which may affect plant health.

The scope of this assessment is based on various guidelines provided by YESAB, previous projects completed for an Executive Committee Level review, and environmental assessments completed for projects of a similar size in other jurisdictions. Additionally, the assessment scope and methods were informed by input from regulatory agencies and concerns raised during stakeholder engagement meetings.

11.1.1 Regional Setting

The Project area lies within the Dawson Range of the Klondike Plateau Ecoregion, in the Boreal Cordillera Ecozone (Smith et al. 2004). Elevations range from approximately 376 meters above sea level (masl) at the Yukon River to over 1,600 masl in the western portion of the Project area. The majority of the Project is within the boreal bioclimate zone, with areas of subalpine and alpine occurring mainly in the western portion of the study area. Major landforms in the region include the Yukon River and the Dawson Range. The region is characterized by relatively long cold winters and short warm summers, and little precipitation.

The Dawson Range is largely unglaciated, with few high-elevation areas comprised of glaciated features. The colluvial surface deposits have been deeply incised, forming steep-sided V-shaped valleys with small streams flowing northward and eastward to the Yukon River, or south to the Donjek River. Tors (outcroppings of resistant rock) and felsenmeer are common features on many high-elevation ridges. Lakes are absent and ponds are sparse. Wetlands are mainly limited to slope toes and valley floors and are generally small in size, with the exception of Big Creek, Hayes Creek and the Dip Creek area near its confluence with Casino Creek.

Vegetation in the boreal bioclimate zone consists mainly of open forest stands of white spruce (*Picea glauca*) and/or black spruce (*Picea mariana*). Mixed forests of aspen (*Populus tremuloides*) and/or birch (*Betula neoalaskana*) also occur and are common on well-drained slopes. Stunted aspen stands with associated grass and forb dominate steep dry slopes, and are common features in the area. Subalpine areas are dominated by open coniferous stands with a dense shrub layer. Low and dwarf shrubs dominate as elevation increases. Tors are common features, with graminoids and forbs present on ledges and in crevices. Alpine areas support mainly dwarf shrubs, forbs, mosses and lichens.

Fire is a common natural disturbance in the Klondike Plateau Ecoregion, and many forest stands show signs of previous burns. Fire sign was also noted on a number of steep dry slopes supporting open grass and forb vegetation and patches of aspen.

Land uses of the area include mineral exploration, big game outfitting, recreational and subsistence hunting, trapping, and recreation, primarily canoeing on the Yukon River. The region has a recent history of industrial developments such as mineral exploration, and quartz and placer mining. There are a number of active and historic quartz mine exploration properties; however, Capstone Mining Corp.'s Minto mine is the only property that has produced a mineable resource. The Project is the largest known deposit in the Dawson Range.

11.1.2 Rationale for VC Selection

Rare plants and vegetation health were selected as a Valued Component (VC) because they may be particularly sensitive to disturbance. Rare plants included in this assessment are plant species identified as rare, and on the Yukon's Conservation Data Centre's (YCDC) 'watch list' or 'track list'. Vegetation includes vascular plants and lichens. Part of the Project area falls within Beringia, an area has not been recently glaciated and that may have some unique plants and plant ecosystem associations. Potential Project effects that could cause a change in rare plant abundance are primarily related to direct loss of individual plants due to the Project footprint. The Project footprint will disturb vegetated areas and fugitive dust generated from project activities will settle on surrounding vegetation, possibly affecting plant health.

11.2 ASSESSMENT BOUNDARIES

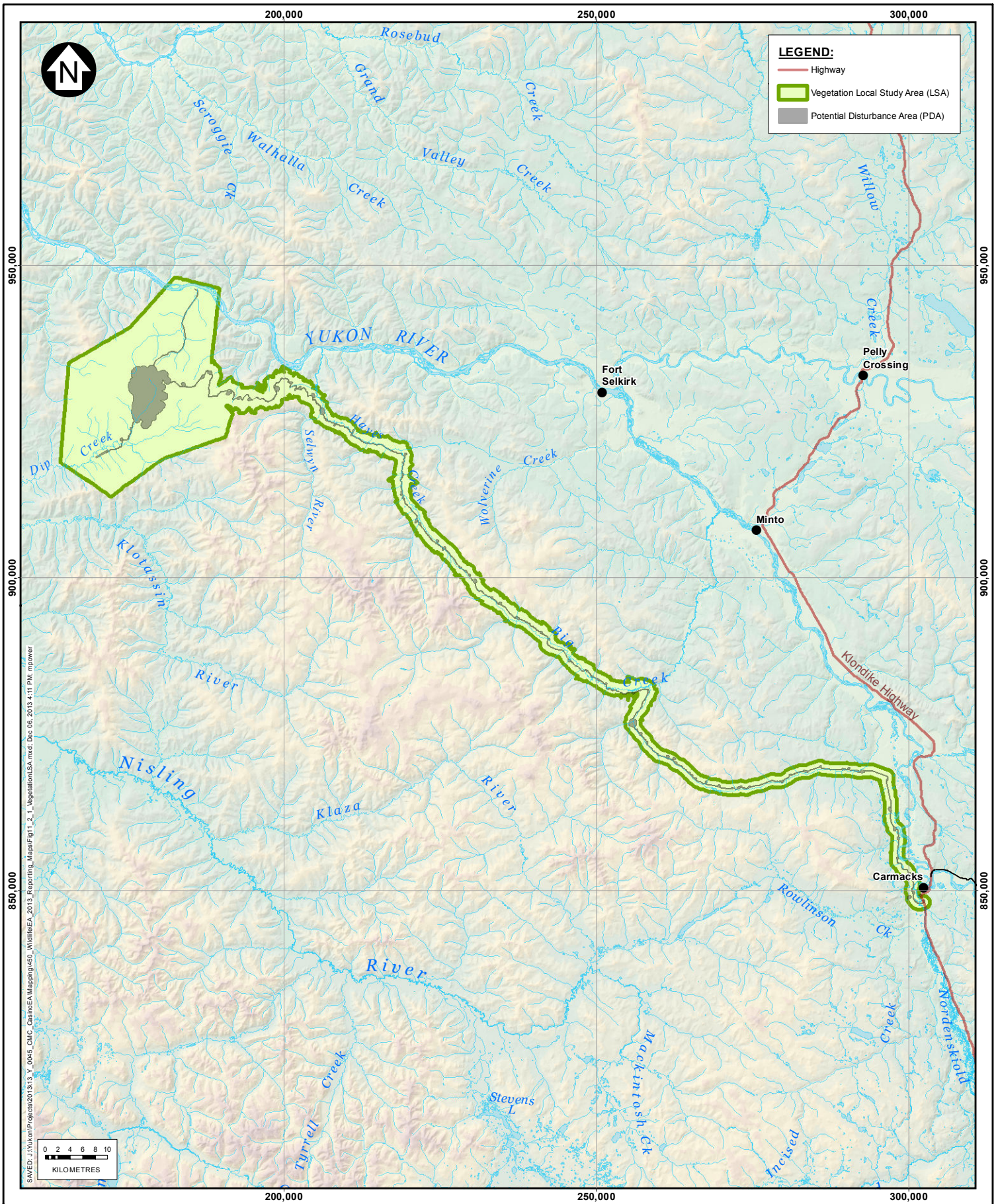
11.2.1 Spatial Boundaries

Potential Disturbance Area (PDA) - The PDA is an estimate of the amount of disturbance the Project components and associated activities are likely to affect based on information available at the time of submission of this Proposal. For the purpose of quantifying the likely area of potential disturbance, we make several assumptions:

- Mine site activities will occur within 500 m from the outermost edge of the proposed arrangement.
- Airstrip, airstrip access road, Freegold Road extension, Freegold Road upgrade, and the Yukon River pipeline components and activities will take place within 50 m of either sides of the proposed alignment.
- Activities associated with the potential borrow areas will take place within 100m of either sides of the proposed area. Any segments of the PDA associated with borrow areas must be accessible by the proposed roads or existing roads; if not, the PDA area was extended to connect the road and borrow areas.

For the purposes of the rare plants and vegetation health effects assessment, the PDA is a conservative estimate used to represent the maximum potential loss of rare plants features from the Project footprint. The PDA encompasses an area of 80.6 km², but the actual footprint is estimated to be 23.5 km².

Local Study Area (LSA) - The LSA is the zone where there is a reasonable potential for immediate interaction between Project components and rare plants and vegetation health. The LSA for rare plants and vegetation health includes the Potential Disturbance Area (PDA) within a 1 km buffer. The total area of the LSA is 536 km².



PREPARED BY:

EDI

DESIGNED	MP
DRAWN	MP/LG
CHK'D	MS
APP'D	MS
REV	-
DATE	06/12/2013

SOURCES:
Potential Disturbance area: Knight Piesold, Sept. 2013.
Wildlife assessment areas developed by EDI, 2013.

1. BASE MAP: Geomatics Yukon - YG, NRCan
2. PROJECTION: NAD 1983 CSRS Yukon Albers
3. COORDINATE GRID: Metres

* Study area varies depending on measureable parameter.

CASINO COPPER AND GOLD

CASINO PROJECT

Study areas used for rare plants and vegetation health

FIGURE # 11.2-1

REF REPORT 1

P/A VA101-325/15

11.2.2 Temporal Boundaries

The general temporal boundaries for the effects assessment are defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project are provided in Section 4.0 of the Proposal. Two specific temporal boundaries are used for the assessment of potential Project effects on vegetation:

Baseline represents the conditions present prior to Project-specific developments.

Maximum disturbance represents the worst-case scenario of Project footprint disturbance related to mining and transportation activities during construction and operations. Construction and mining activities and traffic volumes will fluctuate through the life of the mine, but the maximum disturbance scenario is used as a conservative approach to assessing the worst-case scenario effects on vegetation.

Project effects during closure and decommissioning and post closure are discussed qualitatively. The positive effects of reclamation on vegetation will occur but they will not be realized for a number of years following closure.

11.3 CRITERIA FOR ASSESSING SIGNIFICANCE

There are no known species at risk within the Project area so there are no plant species known to be at imminent risk of extinction. There are no known thresholds or levels of disturbance that are published or otherwise for characterizing the significance of effects on vegetation health. Therefore, a general characterization of what may be considered a significant effect on vegetation is based on measureable effects and proportional loss. Magnitude (in this case the proportional loss of rare plant habitat) and the geographic extent (e.g., minor if limited to Project footprint, extensive if the effects on vegetation extend beyond the LSA) are key factors in determining significance. Permanent effects are expected to occur within the Project footprint/PDA on a high proportion of the vegetation present within the PDA. The other criteria such as duration, frequency, reversibility and context, if they are relevant, are used to further characterize the effect. Table 11.3-1 summarizes the criteria used to determine the significance of residual effects on rare plants and vegetation health.

Table 11.3-1 Determining Significance of Residual Effects for Rare Plants and Vegetation Health

Criteria	Rating	VC Specific Definitions
Direction	Adverse	A negative effect on baseline vegetation conditions
	Beneficial	An improvement relative to baseline vegetation conditions
Magnitude	Low	≤5% change from natural variability in vegetation conditions
	Medium	>5% to ≤10% change from natural variability in vegetation conditions
	High	>10% change from expected natural variability
Geographical Extent	Localized	Effect limited to within the Local Study Area
	Widespread	Effect extends outside of the Local Study Area
Duration	Short Term	Effect occurs for less than one year.
	Long Term	Effect occurs longer than the construction phase of the Project.
	Permanent	Effect lasts longer than the life of the Project
Frequency	Infrequent	Effect occurs only a few times during the Project.
	Frequent	Effect occurs regularly throughout the Project.
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the interaction.
	Irreversible	Pre-Project conditions will not return following the cessation of the interaction.
Context	Low resilience	Low resilience to imposed stresses, or vegetation will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or vegetation will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur.
	High	High likelihood that the predicted residual effect will occur.

11.4 BASELINE CONDITIONS

The Project is located within the eastern edge of Beringia, a geographical area where rare vascular plants with territorial, national, or global conservation status are known to occur, but there is limited information on the distribution and abundance. A baseline inventory of the distribution of rare plants within the proposed Project footprint was completed in August 2010 and July 2012 by AECOM and Environmental Dynamics Inc. (EDI) respectively. The methods and survey details are provided in the Casino Vegetation Baseline Report.

Populations of nine species listed as having conservation concern, were located during the two surveys: *Artemisia laciniata*, *Botrychium alaskense*, *Cypripedium guttatum, Koenigia islandica,* and *Phacelia mollis*, in 2010, and Silene *williamsii, Minuartia yukonensis, Erigeron purpuratus* and *Helictotrichon hookeri* with additional populations of *Phacelia mollis* were located in 2012. Of these nine species, *Botrychium alaskense, Artemisia laciniata,* and *Silene williamsii* are on the YCDC Track list and the remainders are on the Watch list. *Erigeron purpuratus* has since been removed from the Watch list; however, at the time of the survey it was included on the Watch list. *Scirpus hudsonianus* was also found during the 2010 survey, but has since been removed altogether from the YCDC Watch list and is no longer considered rare in Yukon. Locations and other data for rare plant surveys conducted in 2010 and 2012 are described in further detail in the Casino Vegetation Baseline Report. Figure 3.1 in the baseline report shows the areas with high, medium and low potential for rare plants and rare plant locations within the LSA.

Within the LSA, human activity currently exists that may affect rare plants and/or vegetation health. These activities include mineral exploration at the proposed Casino Mine, use of the existing section of the Freegold Road by various users. Placer mining and other exploration activities are also likely to occur in the LSA.

11.5 PROJECT-SPECIFIC EFFECTS

11.5.1 Project Interactions and Potential Effects on Rare Plants and Vegetation Health

The Project includes: development of a large deposit of gold, copper, and molybdenum accessed by open pit mining; construction of processing facilities adjacent to the deposit and associated camp infrastructure; construction of a Tailings Management Facility (TMF); construction of an airstrip and access road; construction of a pipeline connecting the mine site to a water well adjacent to the Yukon River and use of a pre-existing road accessing the pipeline; construction of a section of road that extends the current Freegold road to the mine site; and upgrading of the current Freegold road to meet the required design standards.

Project components and activities that have the potential to interact with rare plants and vegetation health, including the mechanism of interaction and potential effects, are presented in Table 11.5-1. The phases of the Project considered in the assessment are pre-development, baseline, construction, operation, reclamation and closure, and temporary closure. Project components and activities that are identified as potentially interacting with rare plants and vegetation health are assessed for each Project Component; however, when one activity or component is similar in timing, location, and scale, then the component or activity with the largest potential effect in assumed to encompass the other Project components or activities.

Project components and activities will interact with and potentially affect rare plants and vegetation health primary through:

- Loss of rare plants and rare plant habitat by land clearing within the Project footprint;
- Introduction of invasive plant species; and
- Dust deposition and emissions from construction and operation.

The most substantive and permanent effect of the Project to plants, is the land clearing required for construction of the mine site and Freegold Road extension and upgrade. Direct loss of habitat from land clearing is estimated at 23.5 km² (proposed Project footprint) but may be up to 80.6 km² (potential disturbance area). Reclamation will return land to a more natural state, but will not return the area to baseline conditions.

Mine site — The mine site will interact with rare plants through the loss of rare plants and rare plant habitat within the footprint. During construction and operation, dust deposition and combustion emissions may affect vegetation health. The mine site is the location where the majority of Project activities will take place.

Airstrip and access road — The airstrip and access road will interact with rare plants and vegetation health through land clearing during the construction phase. Effects on rare plants and vegetation health are similar to the effects from the Mine site during the construction phase. Project effects during the operation phase are expected to be minimal.

Yukon River access road and freshwater pipeline — The existing Yukon River access road will be used to access and maintain the well system adjacent to the Yukon River. The 36 inch diameter Yukon River water supply pipeline with four booster stations will be 17.4 km long and follow the existing access road where practicable. Land clearing will be required during construction to install the pipeline. Effects on rare plants and vegetation

health are similar to the effects from the Mine site during the construction phase. Effects during the operation phase are expected to be minimal.

Freegold Road Upgrade and Extension — The Freegold Road upgrade and extension will affect rare plants and rare plant habitat by clearing and removing habitat during the construction phase of the project. During the construction phase, effects on rare plants and vegetation health are similar to the effects from the Mine site. During the operation phase, deposition of dust on plants will occur. Dust deposition from the road is characterized in the air quality impact assessment.

Table 11.5-1 Potential Interactions between the Project and Rare Plants and Vegetation Health

Project Components and Activities	Project Phase	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C	Yes	Clearing Project footprint
Aggregate sources / Borrow Sites	C	Yes	Clearing Project footprint; generation of dust
Airstrip and Airstrip Access Road	C,O,CD	Yes	Clearing Project footprint
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C,O	Yes	Clearing Project footprint
Concentrate Transport and Loading	O	Yes	Generation of dust and emissions
Concrete Batch Plant Operation	C,O	No	No additional clearing outside of footprint that is addressed in the Potential Disturbance Area
Contracted Employment	C,O,CD	No	Administrative, no ecological interaction
Cyclone Sand Plant	C,O	Yes	Clearing Project footprint; generation of dust
Dismantling of Facilities	CD	No	No additional clearing outside of footprint that is addressed in the PDA
Diversion of Canadian Creek	C,O	Yes	Clearing Project footprint
Drilling and Blasting	C,O	No	No additional clearing outside of footprint that is addressed in the PDA
Fish Habitat Compensation Construction	C,O	Yes	Clearing Project footprint
Freegold Road Extension	C,O,CD	Yes	Clearing Project footprint; generation of dust
Freegold Road Upgrade	C,O,CD	Yes	Clearing Project footprint; generation of dust
Fuel Storage and Distribution System	C,O	Yes	Clearing Project footprint
Gold Extraction Plant / Oxide Ore Processing	C,O	Yes	Clearing Project footprint
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C	Yes	Clearing Project footprint; generation of dust

Project Components and Activities	Project Phase	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Hazardous Materials Storage, Transport, and Disposal	C,O	No	No additional clearing outside of footprint that is addressed in the PDA
Heap Leach Facility	C,O	No	No additional clearing outside of footprint that is addressed in the PDA
Heap Leach Pad	C,O	Yes	Clearing Project footprint
Laydown Areas	C,O	Yes	Clearing Project footprint
LNG Transport to site	C,O	Yes	Generation of dust and emissions
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C,O	No	Generation of dust and emissions
Potential Disturbance Area	C,O,CD	Yes	Clearing Project footprint
Mine Development	C,O,CD	No	Administrative, no ecological interaction
Mine Staffing	C,O,CD	No	Administrative, no ecological interaction
On-site equipment and vehicle use	C,O	Yes	Generation of dust and emissions; potential for introduction of invasive species
Open Pit Mining	C,O	Yes	Generation of dust and emissions
Ore Conveyors	C,O	No	No additional clearing outside of footprint that is addressed in the PDA
Ore Crushing	C,O	Yes	Generation of dust
Ore Hauling	C,O	Yes	Generation of dust and emissions
Ore Stockpiles	C,O	Yes	Clearing of Project footprint; generation of dust and emissions
Processing Facilities for Sulphide Ore	O	No	No additional clearing outside of footprint that is addressed in the PDA
Reagent Storage and Distribution	C,O	No	No additional clearing outside of footprint that is addressed in the PDA
Site Reclamation / Re-Vegetation	O, CD	Yes	Beneficial effect of vegetation recovery; potential for introduction of invasive species
Site Security and Fencing	C,O,CD	No	No interaction with vegetation
Surface Water Management (Contact Water)	C,O,CD	No	No interaction with vegetation
Surface Water Management (Non-Contact Water)	C,O,CD	No	No interaction with vegetation
Tailings Management Facility	C,O,CD	Yes	Clearing Project footprint
Topsoil Stockpiles	C,O	Yes	Clearing Project footprint; generation of dust
Traffic (Equipment and Materials to Site)	C,O,CD	Yes	Potential for introduction of invasive species
Waste management: garbage and sewage waste facilities	C,O	Yes	Clearing Project footprint

Project Components and Activities	Project Phase	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Wasterock and Overburden Disposal	C,O	Yes	Clearing Project footprint; generation of dust
Water Supply	C,O,CD, PC	Yes	Clearing Project footprint

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Loss of Rare Plant Habitat

Rare plants may be destroyed, and rare plant habitat will be removed, from the proposed Project footprint during construction. All project activities will occur within the PDA, so direct loss of vegetation will occur solely within the PDA. During the construction phase, direct habitat loss will occur primarily as a result of surface disturbance including compaction, burial and removal. During the operation phase, direct habitat loss will occur as ore extraction expands. During the closure phase, the Project footprint should not expand, but incidental vegetation loss may occur during reclamation activities.

Indirect changes to rare plants and vegetation health are possible, but this loss would be limited to a few cases and will not occur at a large scale. Indirect changes to rare plants and vegetation health that could occur as a result of the Project include the introduction of invasive plant species, changes to surface drainage, erosion, changes to permafrost, and snow accumulation patterns.

The Vegetation Baseline Report (Appendix 11A) includes an analysis of rare plant habitat and delineated three classes of habitat suitability for rare plants: high, moderate and low likelihood of rare plants. Within the PDA, 0.6 km² is rated as 'high likelihood of rare plants', 13.0 km² is rated as 'moderate likelihood of rare plants and 56.2 km² is rated as 'low likelihood of rare plants'. Although the proposed footprint is 23.5 km², additional area within the PDA may be cleared.

The introduction of invasive, non-native plant species may reduce habitat available for rare plants. Invasive plants can be introduced to the site via contaminated equipment or by re-vegetating areas with non-native seed mixes.

Proposed reclamation activities will provide physical and chemical stability and will be designed to promote natural re-vegetation. Experimental plots conducted during operations, examining progressive rehabilitation using local, native species, may identify suitable progressive re-vegetation techniques that can be incorporated into future closure plans. The effects to vegetation, and rare plants, will be long-term as natural re-vegetation is expected to occur slowly.

Dust Deposition

Dust (Total Suspended Particles — TSP) deposition will occur as a result of construction, operation and closure activities. Dust will be transported downwind and deposited according to local atmospheric conditions and particle size. The probable dust deposition scenarios are characterized and described in further detail in the air quality section of this effects assessment (Section 8). The effects of dust on vegetation will depend on the type of dust, the deposition load and the type of exposure.

Dust can physically inhibit plant function and/or plants can uptake metals in dust either directly through tissue or via roots in the soil. The direct effects of dust on vegetation included decreased chlorophyll and photosynthesis

(Spatt and Miller 1981) and blocking or covering the stomata, resulting in physical inhibition to function. This can result in reduced growth and a decrease in the overall health of the plant.

Table 11.5-2 Potential Effects on Rare Plants and Vegetation Health

Mechanism of interaction	Key indicator(s)	Project Phase	Potential effect	Direction
Clearing Project footprint	Rare plant abundance	C,O	Destruction of rare plants, loss of rare plant habitat and loss of rare ecological land types	Adverse
Loss of rare plant habitat due to invasive, non-native species	Presence of invasive species	C,O, CD, PC	Loss of rare plant habitat due to the expansion of non-native, invasive species	Adverse
Dust and emissions from roads and construction/operation	Vegetation health in areas near dust and emission sources	C,O	Reduction in plant growth, plant death	Adverse
Beneficial effect of vegetation recovery	Vegetation health	C, O, CD, PC	Vegetation reclamation	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

11.5.2 Identification of Mitigation Measures and Potential Residual Effects

Within the PDA, construction and land clearing associated with the Project will cause a direct loss of terrestrial habitat of up to 80.6 km². Of this, 0.6 km² is rated as 'high likelihood of rare plants', 13.0 km² is rated as 'moderate likelihood of rare plants and 56.2 km² is rated as 'low likelihood of rare plants'. Although the proposed footprint is 23.5 km², additional area within the PDA may be cleared.

Establishment of invasive species within the LSA is unlikely, but has the potential to occur. Invasive plants could reduce habitat for rare plants and other native vegetation species.

The loss of vegetation, including rare plants, may occur from dust deposition and other pollutants within the LSA.

CMC will mitigate potential effects to rare plants and vegetation health by:

- Planning and conducting Project activities that the Project footprint will be minimized to the extent possible.
- Using established roads within the PDA during operation thereby limiting new disturbance to the PDA.
- Reducing the potential for the introduction of invasive plant species by:
  - Using equipment clean of soils from other sites;
  - For reclamation, using only local soil and rock material, or ensure that it is clean fill;
  - Re-vegetating terrestrial habitat naturally, unless it is determined during progressive rehabilitation studies that re-seeding with native species is preferable and can be accomplished without introducing invasive, non-native plant species; and

- Establishing a program for invasive plant detection on-site with a follow-up control and removal program, if required, in accordance with the recommendations of the Yukon Invasive Species Council for invasive plant control (YISC 2011).

- Implementing dust control measures, as per the air quality management guidelines.

Table 11.5-3 Identification of Mitigation Measures and Potential Residual Effects for Rare Plants and Vegetation Health

Potential effect	Project Phase	Direction	Proposed mitigation measure	Predicted effectiveness	Residual effect
Loss of rare plants and rare plant habitat	C,O	Adverse	Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.	Moderate	Yes
Loss of rare plant habitat due to introduction or expansion of invasive species	C,O,CD,PC	Adverse	Use clean equipment. Allow vegetation to re-establish naturally or by using native seed mixes. Establish a program for invasive plant detection.	Moderate	No
Dust deposition on vegetation, particularly rare plants	C,O	Adverse	Dust control measures will be implemented as per the Air Quality Management Plan.	Moderate	Yes
Vegetation reclamation	CD,PC	Beneficial	N/A	Moderate	No

Notes
1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

11.5.3 Significance of Residual Effects

The significance of residual effects on rare plants and vegetation health is summarized in Table 11.5-4. Within the Project footprint, the removal of rare plants and/or rare plant habitat will occur during construction. The effects from clearing will remain until the closure and reclamation of the Project. Project effects on rare plants and rare plant habitat are considered to be localized in extent, long term in duration and have a high probability of occurrence. However, this effect is considered reversible following closure of the Project. The residual effect on rare plants has been determined to be of low significance primarily because it is localized and is mostly reversible.

The deposition of dust and emissions on vegetation is considered to be an adverse effect, with low magnitude, is long term in duration and will occur frequently throughout the life of the Project. Because this effect is localized and is reversible once the project is complete, the residual effect is considered to be of low significance. The residual effect of the Project on rare plants and vegetation health is considered not significant (Table 11.5-5) effects will be localized to the Project footprint. Confidence in this prediction is moderate.

Table 11.5-4 Significance of Residual Effects - Rare Plants and Vegetation Health

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Loss of rare plants and rare plant habitat	Adverse	Low	Localized	Long term	Infrequent	Reversible	Low resilience	High	Not significant
Deposition of dust and emissions on vegetation	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	High	Not significant

Table 11.5-5 Summary of Residual Effects after Mitigation Measures - Rare Plants and Vegetation Health

Potential Residual Effects	Direction	Significance	Level of Confidence
Loss of rare plants and rare plant habitat	Adverse	Not significant	Moderate
Deposition of dust and emissions on vegetation	Adverse	Not significant	Moderate

11.6 CUMULATIVE EFFECTS ASSESSMENT (CEA)

Based on available information summarized in the vegetation baseline report, rare plant habitat may be extensively distributed within the broader landscape. There is no indication that these features are limited to the extent of any past, present or future project's LSA.

The assessment of cumulative effects on rare plants and vegetation health is qualitative because analyses is limited by the availability of detailed vegetation mapping in the region, making it difficult to quantify combined project effects in the region. The Casino Project's mapping area was limited to a relatively small area surrounding the PDA to address detailed mapping to potentially mitigate site-specific locations of rare ecosystems or rare plant locations. That level of mapping is not available region-wide, so it is difficult to determine if other projects are having an equivalent effect that may, when combined with the Casino Project, have an overall significant cumulative effect on rare plant abundance and vegetation health in the region.

11.6.1 Other Activities Potentially Affecting Rare Plants and Vegetation Health

For past, present or likely future projects/activities to be included in the cumulative effects assessment, three conditions were required to warrant further assessment:

1. Adequate qualitative and/or quantitative information on a project or activity is publicly available to allow for spatial and temporal characterization;
2. The project spatially overlaps with the residual effects of the Casino Project; and
3. The project temporally overlaps with the residual effects of the Casino Project.

Mineral exploration and placer mining projects have occurred in, and are likely to continue to occur in, the Project region. There are no known areas that are excluded from mineral exploration, and there are a number of placer claims that will likely exist and be active either continuously or intermittently into the foreseeable future. Although the claim blocks can be very extensive and numerous (e.g., as illustrated in the White Gold Cumulative Effects Report; EDI 2013), actual works are likely to be limited to a few focal areas for either a short period of time, or seasonally for many years, as is the case for several quartz claims in the area. Projects and/or activities that meet the conditions described above are summarized in Table 11.6-1. Projects/activities in the same category (e.g., placer mining, quartz claims) are assumed to cause similar types of residual effects and are therefore assessed collectively.

Table 11.6-1 Residual Effect Information for Other Projects or Activities - Rare Plants and Vegetation Health

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Minto Mine	Present operating mine	Rare plant habitat loss, dust effects on adjacent vegetation health.	Current footprint: 12.92 km², including mine site and access road.	Minto mine is expected to operate through the construction and initial operating years of the Casino Project.
Carmacks Copper (proposed mining project)	Likely future project	Rare plant habitat loss, dust effects on adjacent vegetation health if project goes through to construction and operation.	Current footprint: 1.36 km², and if developed assumed equivalent to disturbance observed at Casino mine site. Current activities are likely very sporadic and site-specific.	No indication of development or operation period.
Mt. Nansen (reclamation project)	Past mine development, Present care and maintenance, future reclamation activities	Rare plant habitat loss, dust effects on adjacent vegetation. Some recovery when reclamation is complete.	Current footprint: 1.85 km². Activities likely to be limited to extent of existing disturbance footprint.	Likely to occur over a two to three year period within the next decade.
WS Total (exploration project)	Present	Likely minimal effect on rare plant habitat.	Current footprint: 0.08 km². Likely includes some individual seasonal drill locations	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Nucleus (exploration project)	Present	Likely minimal effect on rare plant habitat.	Current footprint: 0.08 km². Likely includes some individual seasonal drill locations.	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Prospector Mountain (exploration project)	Present	Likely minimal effect on rare plant habitat.	Assumed equivalent to disturbance observed at Casino mine site during exploration phase. Likely includes some individual seasonal drill locations.	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Sonora Gulch (exploration project)	Present	Likely minimal effect on rare plant habitat.	Current footprint: 0.27 km². Activities likely to be limited to extent of existing disturbance footprint.	Exploration likely to continue intermittently through life of the Casino Project. No indication of development or operation period.
Numerous quartz exploration permits	Past, present and future	Likely minimal effect on rare plant habitat.	Localized effects, but distributed across the landscape.	Exploration likely to continue intermittently and seasonally through life of the Casino Project.
Numerous placer mining permits	Past, present and future	Some localized effects on rare plant habitats from loss due to placer mining.	Localized effects in areas accessible to heavy equipment.	Placer mining likely to continue intermittently and seasonally through life of the Casino. Project.
Canadian Creek, Upper Canadian Creek (Placer mine)	Present	Some localized effects on rare plant habitats from loss due to placer mining.	Current footprint: 0.52 km². Footprint likely increases with successive placer mining operations, but older areas will naturally re-vegetate.	Mining likely to continue intermittently and seasonally through life of the Casino Project. No indication of operation period.

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for rare plant habitat and vegetation health, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

11.6.2 Residual Effects of Other Projects and Activities and Potential Cumulative Effects

The interaction matrix shown in Table 11.6-2 was used to determine whether any spatial or temporal overlap exists between the residual effects of the Project and the noted projects. The word “YES” is used to indicate where a residual effect of the Project has the potential to overlap spatially and temporally with the predicted residual effects.

Table 11.6-2 Cumulative Effects Assessment Interactions Matrix – - Rare Plants and Vegetation Health

	Potential Spatial and Temporal Overlap				
	Minto Copper Mine	**Carmacks Copper Mine**	**Mt. Nansen (reclamation project)**	**Numerous placer mining permits**	**Canadian Creek, Upper Canadian Creek (Placer mine)**
Casino Project Residual Effect	Rare plant habitat loss, dust effects on adjacent vegetation health.	Rare plant habitat loss, dust effects on adjacent vegetation health if project goes through to construction and operation.	Rare plant habitat loss, dust effects on adjacent vegetation. Some recovery when reclamation is complete.	Some localized effects on rare plant habitats from loss due to placer mining.	Some localized effects on rare plant habitats from loss due to placer mining
Loss of rare plants and rare plant habitat	YES	YES	YES	YES	YES
Deposition of dust and emissions on vegetation	YES	YES	YES	YES	YES

The spatial overlap may lead to the potential cumulative effects described in Table 11.6-3. These effects are the same as the residual effects from the Project except that they would be seen beyond the Project area.

Active or historic quartz mines such as the Minto Mine and Mt Nansen Mine can have residual effects on vegetation features within their project footprint, but the presence of rare plant habitat within those project footprints is unknown. It is unlikely that the small footprints required for quartz exploration projects would have substantial effects on vegetation because those footprints are likely limited to camp and drill locations, trenching in accessible terrain and access trails. Only the assumed residual effects of other projects and activities that meet all three conditions and overlap spatially and temporally with the Casino Project were carried forward into the CEA as potential cumulative effects and summarized in Table 11.6-3.

Table 11.6-3 Potential Cumulative Effects - Rare Plants and Vegetation Health

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Loss of rare plants and rare plant habitat	Combined active/historic quartz mines and placer mining operations	Cumulative loss of vegetation features in the Dawson Range within an additional 17.08 km² of footprint disturbance
Deposition of dust and emissions on vegetation	Combined active/historic quartz mines and placer mining operations	Cumulative decrease in plant health due to emissions

11.6.3 Proposed Mitigation Measures and Residual Cumulative Effects

There are no additional mitigation actions proposed beyond what CMC has already committed to at the Project-specific level; the mitigation measures that are proposed are included in Table 11.6-4.

Table 11.6-4 Mitigation Measures and Residual Cumulative Effects - Rare Plants and Vegetation Health

Potential Residual Cumulative Effect	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Loss of rare plants and rare plant habitat	Adverse	Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.	Moderate	Yes
Deposition of dust and emissions on vegetation	Adverse	Dust control measures will be implemented as per the Air Quality Management Plan.	Moderate	Yes

Note

1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

11.6.4 Significance of Residual Cumulative Effects

Residual cumulative effects are those that remain after mitigation measures have been applied. In accordance with Section 5, the residual cumulative effects on terrain features were assessed based on eight rating criteria to determine the likelihood for a significant negative effect (Table 11.6-5).

Table 11.6-5 Significance of Residual Cumulative Effects - Rare Plants and Vegetation Health

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Loss of rare plants and rare plant habitat	Adverse	Low	Localized	Long term	Infrequent	Reversible	Low resilience	High	Not significant
Deposition of dust and emissions on vegetation	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	High	Not significant

11.6.5 Discussion of Significance of Residual Cumulative Effects

Based on the cumulative effects assessment, the Casino Project is not likely to have any significant adverse effects on terrain features after the implementation of mitigation measures. This is summarized in Table 11.6-6. The level of confidence in these predictions is high.

Table 11.6-6 Summary of Residual Cumulative Effects on Rare Plants and Vegetation Health

Residual Cumulative Effect	**Direction** (Adverse/Beneficial)	**Significance** (Significant/Not Significant)	**Level of Confidence** (Low, Moderate, High)
Loss of rare plants and rare plant habitat	Adverse	Not Significant	Moderate
Deposition of dust and emissions on vegetation	Adverse	Not Significant	Moderate

11.7 SUMMARY AND CONCLUSIONS

The largest portion of the footprint associated with the Casino Project, the Freegold Road extension, is likely the largest disturbance footprint that the region will experience in the foreseeable future. Even with that footprint, there is limited disturbance to rare plant habitat, and no unique habitats will be removed as a result of combined project effects. It is unlikely that there are significant cumulative effects on vegetation features in the Dawson Range as a result of industry in the Dawson Range. Further, it is unlikely that this landscape will experience landscape-level disturbances (e.g., commercial forestry) that would substantially increase the risk to rare plant habitats.

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12 – WILDLIFE

12.1 INTRODUCTION

This section provides an assessment of potential Project effects and cumulative effects on wildlife. Proposed mitigation and an effects monitoring framework of wildlife values are presented. The assessment focuses on Project effects related to wildlife populations and habitat that have a reasonable likelihood of occurring. When Project effects cannot be completely mitigated, potential residual effects are described and the potential for cumulative effects are considered.

Wildlife are defined here as terrestrial mammals and birds. The Project will interact with wildlife through potential effects to individuals, populations and their habitats. Wildlife are important because of their value to local people who rely on wildlife as a subsistence and economic resource, and for their intrinsic value as a symbol of wilderness and a healthy ecosystem. Potential effects of the Project on wildlife are primarily loss of available habitat due to the Project footprint, reduced habitat effectiveness from sensory disturbance and mortality due to collisions with vehicles, problem animal kills and increased hunter access. The assessment of the Project's potential effects is focussed on a number of wildlife Key Indicators (KIs) including the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, bird species at risk, and waterfowl.

The scope of the assessment is based on various guidelines provided by YESAB, previous projects completed for a YESAB Executive Committee review, and environmental assessments completed for projects with similar disturbance characteristics in other jurisdictions. The assessment scope and methods were informed by input from regulatory agencies and concerns raised during stakeholder engagement meetings.

12.1.1 Regional Setting

The Project is located in the Boreal Cordillera Ecozone within the Yukon Plateau-Central Ecoregion and the Klondike Plateau Ecoregion. Major topographic features in the region include the Yukon River and the Dawson Range. The region is characterized by relatively long cold winters and short warm summers, and little precipitation. The region contains a normal diversity of Yukon's wildlife species. The area was characterized as containing a low density of large mammals during the original wildlife baseline inventory of the region in the late 1980s. The reason for the low density of wildlife in the area is unknown. Today, density estimates of caribou and moose have roughly doubled since the original baseline inventories in the region. Songbird diversity in the region is typical of species that occupy the central and northern Yukon, and the density of birds is relatively normal within habitat types. There are low densities of waterfowl because of limited available habitat.

Land uses of the area include mineral exploration, big game outfitting, recreational and subsistence hunting, trapping, and recreation — primarily canoeing on the Yukon River. The region has a recent history of industrial developments such as mineral exploration, and quartz and placer mining. There are a number of active and historic quartz mine exploration properties; however, Capstone Mining Corp.'s Minto mine is the only property that has produced a mineable resource. Casino is the largest known deposit in the Dawson Range.

Access into the Dawson Range is currently limited to the Mt. Nansen Road, Freegold Road, Minto Road, Yukon River access road, winter trails, Yukon River, and aircraft access. There are active or abandoned airstrips at the Minto mine site, Casino mine site, Rude Creek placer operation, and Northern Freegold Resources' Tad-Toro and Revenue camps, and at the confluence of Ballarat Creek and the Yukon River. Winter trails include the Dawson Overland Trail, Casino Trail, and a number of other trails used intermittently by land users to access mine properties, cabins and traplines.

12.1.2 Regulatory Setting

Various federal, territorial and regional legislation, guidelines, and plans are integral to the management of wildlife and habitats in the Yukon. Some of the legislation is directly applicable to scoping the assessment of Project effects. In general, the applicable legislation and guidelines promote a balance between development and the conservation and sound management of wildlife and wildlife habitat. Relevant legislation and documents are described below.

***Yukon Environment and Socio-economic Assessment Act* (S.C. 2003, c. 7)** — YESAA does not specifically identify wildlife as a valued environmental component, but states the act's purpose is to "…*protect and maintain environment quality…*" (YESAA, section 5.2[c]), and "…*ensure that projects are undertaken in accordance with principles that foster beneficial socio-economic change without undermining the ecological… systems on which communities, their residents, and societies in general, depend*" (YESAA, section 5.2[e]).

***Yukon Wildlife Act* (R.S.Y. 2002, c.229)** — Relevant to the wildlife effects assessment the Yukon Wildlife Act states:

- "*A person shall not destroy, take or possess any egg or nest of a bird that belongs to a species that is wild by nature*" (Wildlife Act 17[1]).
- "*No person shall damage or interfere with a beaver dam, or the den, lair or nest of any wildlife*" (Wildlife Act 91[1]).
- "*A person shall not harass any wildlife*" (Wildlife Act 91[1]).
- "*A person shall be deemed to harass wildlife if the person operates a vehicle or boat in a manner that might reasonably be expected to harass any wildlife; or attempts to interfere with the movement of any wildlife across any road or watercourse*" (Wildlife Act 92[2] c and d).
- "*Subject to subsection (4), a person shall be deemed to have encouraged dangerous wildlife to become a public nuisance if the person feeds it or leaves food or garbage in a place where dangerous wildlife may have access to it and he or she does not take reasonable precautions to prevent dangerous wildlife from having access to it or being attracted to the area by it*" (Wildlife Act 93[3]).

***Species at Risk Act* (S.C. 2002, c. 29)** — Relevant to the wildlife effects assessment, the federal *Species at Risk Act* (SARA) legislation aims to:

- Prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct.
- Provide for the recovery of endangered or threatened species.
- Encourage the management of other species to prevent them from becoming at risk (SARA Public Registry 2012).

Under Schedule 1 of the Act, species of conservation concern fall under four risk categories: extirpated, endangered, threatened, or of special concern. Once a species is listed on Schedule 1 as endangered, threatened or extirpated, it is unlawful to "*… kill, harm, harass, capture, or take an individual,…* [or] d*amage or destroy the residence of one or more individuals*" of the species (SARA; Subsection 32 (1,3)) and the development of species-specific recovery or management plans are required.

Under the Act, all environmental assessments must identify any species at risk or critical habitat that is likely to be affected, and "*…must identify the adverse effects of the project on the listed wildlife species and its critical habitat*

and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans" (SARA; Subsection 79 (2)). Additionally, if the project is likely to affect a listed wildlife species, the proponent must promptly notify the relevant minister.

***Migratory Bird Convention Act* (S.C. 1994, c. 22)** — The *Migratory Birds Convention Act* (MBCA), created in 1917 and updated in 1994, protects and conserves migratory birds, eggs, and nests through the implementation of the Migratory Birds Regulations and the Migratory Birds Sanctuary Regulations. According to the MBCA, removal of migratory birds, their eggs, or nests from a site is only permissible if the migratory birds are causing or may cause damage to property and equipment (subject to permitting). Deposit of harmful substances to birds in areas or waters frequently visited by migratory birds is prohibited. No migratory bird sanctuaries fall within the Casino project area.

***Selkirk First Nation Final Agreement* (1998); *Little Salmon/Carmacks First Nation Final Agreement* (1998)** — There does not appear to be any references to wildlife and Project effects assessment in the Selkirk First Nation Final Agreement.

Community-Based Fish and Wildlife Work Plan for the Little Salmon/Carmacks First Nation Traditional Territory 2012–2017 — Related to the Klaza caribou herd, the plan proposes to conduct a population census survey, conduct composition surveys (if census is not possible), collect further baseline data and monitor the herd, update habitat use information, and monitor harvest levels. All these actions have been completed as part of the CMC's Project Proposal and presented in Appendix 12A, Error! Reference source not found..

Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada — Relevant to the wildlife effects assessment, Canada's management plan for the northern mountain population (NMP) of woodland caribou includes several guiding principles considered in scoping. The goal of the plan is to prevent the NMP from becoming threatened or endangered by engaging responsible agencies to carefully manage the NMP caribou and their habitat. The plan is focused on achieving the following goals that are re-evaluated on a 5-year basis:

- NMP herds are maintained or recovered, and populations operate within the natural range of variability;
- The ecological integrity of key habitats and ecosystems required by the NMP are maintained; and
- First Nations, local communities, government agencies and other interested parties are meaningfully involved in the stewardship of the NMP and its habitats.

The objectives and recommended recovery measures are based on a set of principles developed by the Northern Mountain Caribou Steering Committee and Technical Working Group. Recommended management objectives for the NMP are:

- Objective 1: Determine herd status and trends over time.
- Objective 2: Manage harvest for sustainable use.
- Objective 5: Identify and assess the quality, quantity and distribution of important habitats for the population.
- Objective 6: Manage and conserve important habitats to support caribou herds.

Of particular relevance to this effects assessment is management Objective 7:

- Objective 7: Promote conservation of the NMP through environmental and cumulative effects assessments.

Yukon Fish and Wildlife Woodland Caribou Management Decision Guidelines —July 1996 — These interim guidelines (no update or final guidelines are known to exist) were developed by a caribou management team from the Yukon government. The guidelines were intended to provide a framework for consistent departmental input and responses to management plans and programs. Among many guidelines related to harvest, of particular relevance to the Casino Project is guideline no. 16 (habitat), stating:

- Management experience in North America has shown that virtually any type of development activity that increases access for hunters results in a herd decline. Hunter access must be very carefully controlled, particularly where roads bisect caribou winter range.

12.1.3 Rationale for Wildlife as a VC

Valued Components (VCs) are used as the approach for assessing Project effects (described in Section 5). Wildlife was selected as a VC because of potential Project interactions and effects on individuals, populations, and their habitats. Wildlife includes terrestrial mammals, songbirds, raptors, and waterfowl, and is important because of wildlife's value to local people who rely on wildlife as a subsistence and economic resource and for their intrinsic value as a symbol of wilderness and a healthy ecosystem. Yukon residents are concerned about the health of Yukon's fish and wildlife, and indicators such as the status of Yukon caribou herds are used in Yukon State of the Environment reporting (DataPath Systems 2009). Species at risk are included as Key Indicators (KIs) in the VC because they must be assessed where potential Project effects can occur (*SARA*, subsection 79). Potential effects of the Project on wildlife include loss of available habitat from the Project footprint; sensory disturbance from mine related activities; and mortality due to increased hunter access, collisions with vehicles, and having to destroy animals as a result of human-wildlife conflict.

12.1.3.1 Key Indicators

All terrestrial wildlife and birds were considered candidates for a focused effects assessment. However, the determination of effects on all species likely to interact with the Project is unrealistic, and unlikely to provide information upon which to assess effects on wildlife as a whole. Therefore, several criteria were used which identified Key Indicators (KIs) to focus the wildlife effects assessment. The key criteria for selection of KIs included the following considerations:

- ***Species and/or populations with a clear interaction with the Project footprint*** — for example, seasonal ranges of the Klaza caribou herd clearly overlaps with the Freegold Road Extension and there is likely to be interaction with a substantial portion of the herd;
- ***Species that are known to be sensitive to disturbance*** — for example, grizzly bear have generally been regarded as being particularly sensitive to disturbance, and human interaction with grizzly bear are often detrimental to individual bears;
- ***Habitat specialists*** — for example, cliff-nesting raptors have established long-term residences at particularly defined habitat sites (i.e., cliffs) either within or near Project infrastructure;
- **Species that are culturally important** — for example, moose are important to local communities as a food source;
- ***Species at Risk*** — as noted above in Section 12.1.2, the Project's effects assessment must identify the adverse effects on species listed in *SARA* that are likely to occur in the Project area. Although several

species have been listed with a status of Threatened or Special Concern by COSEWIC, many of the species have not been included on *SARA* Schedule 1. Regardless, for this assessment, the COSEWIC designation is regarded here as a *SARA* designation and listed species likely to occur in the Project area are considered as KIs in this assessment; and

- ***Species identified in engagement meetings or otherwise documented as a concern*** — for example, the Klaza caribou herd is included as a KI for wildlife because the Project footprint intersects the herd's range, and the herd is part of the Northern Mountain Population of Canada's woodland caribou population and potential interactions were identified in earlier Casino Trail reports (e.g., Casino Trail Project Advisor Committee 1985; and the Yukon Government Department of Environment has had concerns about the Project's effects on the caribou since studies began on the herd in response to the Casino trial development in the late 1980s).

Based on the criteria outlined above, the Project's effects assessment is focused on several KIs, including the Klaza caribou herd, moose, grizzly bear, collared pika, cliff-nesting raptors, passerine and bird species at risk and waterfowl. These species represent the likely range of potential Project effects on wildlife (Table 12.1-1). Species that were not included as KIs were those who, while they may be found in the broader Project area, are unlikely to interact with the Project in substantial numbers (e.g., Dall's sheep, wood bison), are found only in very low densities and effects may be addressed by a species that is a KI (e.g., wolverine will be largely covered by the assessment on grizzly bears), were not species at risk, were not identified as of concern to stakeholders or regulators, or are generally numerous and not susceptible to anthropogenic disturbances (Table 12.1-2). Wildlife groups that are not reasonably represented by KIs (e.g., medium-sized carnivores, small mammals, amphibians) and where there may be particular issues of concern are discussed generally. Additionally, site-specific habitat features such as mineral licks are discussed as appropriate.

Table 12.1-1 Rationale for Selection of Wildlife Key Indicators

Key Indicator	Species/Population	Conservation Status	Reason for Selection
Klaza caribou herd	Northern mountain population of woodland caribou (Rangifer tarandus caribou)	SARA Schedule 1 Special Concern (2002)	Identified as a value by local land users; winter habitat concern for Environment Yukon; SARA; subsection 79 (2)
Moose	Alces alces	Not assessed, but assumed to be secure	Primary harvest species in the region and Yukon; high cultural value, strong regional interest.
Grizzly bear	Western population of grizzly bear (Ursus arctos)	COSEWIC Special Concern (2012)	History of adverse interactions with humans, SARA; subsection 79 (2). Northern interior grizzly bears have the lowest recruitment rate of all terrestrial mammals; biological limits to both reproduction and recruitment prevent a rapid increase in population size if substantial mortality occurred (YGWCM 1997)
Collared pika	Ochotona collaris	COSEWIC Special Concern (2011b)	Uses alpine within the PDA, SARA; Subsection 79 (2)
Cliff nesting raptors	Peregrine falcon, golden eagle, gyrfalcon	SARA Schedule 1 Special Concern (peregrine falcon)	Potential site-specific effects on long-established residence sites (cliff nests); SARA; subsection 79 (2) (for peregrine falcon), gyrfalcon and peregrine falcon are specially protected wildlife in the Yukon Wildlife Act
Bird species at risk	Horned grebe, barn swallow, bank swallow, olive-sided flycatcher, rusty blackbird, short-eared owl	COSEWIC Threatened (barn swallow, bank swallow, olive-sided flycatcher); Special Concern (rusty blackbird, short-eared owl)	There is limited wetland habitat in the LSA (relevant to horned grebe and rusty blackbird), otherwise SARA; subsection 79 (2)
Passerine birds	All passerine bird species as a group	Various	Several upland habitats are not represented by assessing bird SAR alone.

Key Indicator	Species/Population	Conservation Status	Reason for Selection
Waterfowl	Ducks, geese, swans, waterbirds	Various	Development of a wetland as part of closure phase where waterfowl may establish residence; Environment Canada concern about uncertainty about how waterfowl will use wetland; trumpeter swan are specially protected wildlife in the Yukon Wildlife Act.

Table 12.1-2 Species Known or Likely to Occur in the Project Area, but not Included as Key Indicators

Key Indicator	Species/ Population	Conservation Status	Potential Interaction with Project	Reason for Exclusion from Assessment
Dall's sheep	Ovis dalli	Not assessed, but assumed to be secure	Unlikely. Occurs in Project area, but PDA does not intersect sheep range.	No spatial or temporal overlap with the Project (Appendix 12A**,** Error! Reference source not found.). While they may occur near site, there is expected to be little interaction with the Project, and are not considered further for effects assessment.
Wood bison	Bison bison athabascae	Listed as Threatened on Schedule 1 of SARA (2000)	Unlikely. The PDA does not intersect the current wood bison range.	No spatial or temporal overlap with the Project (Appendix 12A**,** Error! Reference source not found.). While they may occur near site, there is expected to be little interaction with the Project, and are not considered further for effects assessment.
Wolverine	Gulo gulo	Assessed as Special Concern by COSEWIC (2003)	Occurs in the Project area. Distribution is unknown.	Low density and wide home range movements. Effects may be inferable from effects assessment on grizzly bears (e.g., security habitat). Application of general mitigation measures for wildlife year-round (e.g., waste management) will mitigate most potential Project effects on wolverine (e.g., avoid attraction to mine site). Distribution is likely prey-based rather than habitat-based.
Mule deer	Odocoileus hemionus	Not assessed, but assumed to be secure	Unlikely. May occur in the Project area.	Uncommon in the area, at the northern extent of range. Populations are not at risk
Black bear	Ursus americanus	Assessed as Not at Risk by COSEWIC (1999)	Occurs in the Project area. Distribution is assumed to include most habitat types.	Although there are habitat use differences, the assessment on grizzly bear includes overlapping issues and habitat. Mitigation included for grizzly bear should also mitigate Project effects on black bear.
Snowshoe hare	Lepus americanus	Not assessed, but assumed to be secure	Occurs in the Project area. Distribution is unknown.	Not a species at risk. Not raised as a valued component in stakeholder engagement meetings.
Canada lynx	Lynx canadensis	Assessed as Not at Risk by COSEWIC (2001)	Occurs in the Project area. Distribution is unknown	Not a Species at Risk. Project interaction is expected to be minimal. Species abundance is related more to prey (snowshoe hare) availability than to specific habitat requirements. There are little data with which to characterize baseline characteristics of a lynx "population" upon which to predict, or later to detect, population-changes due to Project effects.
Grey wolf	Canis lupus	Assessed as Not at Risk by COSEWIC (1999)	Occurs in the Project area. Assumed to be distributed across entire RSA.	Not a species at risk. Potential for increased mortality risk is addressed for mitigation related to reducing mortality risk for all wildlife.
Coyote	Canis latrans	Not assessed, but assumed to be secure	Assumed to occur in the Project area. Distribution is unknown	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Red fox	Vulpes vulpes	Not assessed, but assumed to be	Likely. Assumed to occur in the Project area. Distribution is	Species is adapted to many human disturbance factors. An effects assessment on this species would provide little to no

Key Indicator	Species/ Population	Conservation Status	Potential Interaction with Project	Reason for Exclusion from Assessment
		secure	unknown	knowledge about Project effects on the VC wildlife.
Porcupine	Erethizone dorsatum	Not assessed, but assumed to be secure	Occurs in Project area. Distribution is unknown	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss. There is limited existing information on human disturbance effects to porcupine.
Small mustelids	American marten (Martes americanus); weasels (Mustella spp.); American mink (Neovison vison).	Not assessed, but assumed to be secure	Likely. Occurs in the Project area. Distribution is unknown	Not species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Aquatic mammals	Beaver (Castor canadensis); muskrat (Ondatra zibethicus); river otter (Lontra canadensis)	Not assessed, but assumed to be secure	Likely occurs in aquatic habitats in Project area.	Limited habitat within the PDA. Effects will be managed through mitigations for silt and erosion control and fish and aquatic resources.
Small mammals	Ground squirrel (Spermophilus parryii); red squirrel (Tamiasciurus hudsonicus); mice and voles	Not assessed, but assumed to be secure	Occurs in the Project area. Distribution is unknown	Not species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Hoary marmot	Marmota caligata	Not assessed, but assumed to be secure	Distribution in the Project area is unknown.	Not a species at risk. Habitat effects on this species are addressed in quantification of general habitat loss.
Amphibians	Wood frog (Lithobates sylvatica)	Not listed	Limited distribution.	Limited habitat within the PDA, Effects will be managed through mitigations for silt and erosion control and fish and aquatic resources.
Terrestrial insects	Various	Various	Likely distributed throughout Project area. Distribution and abundance unknown.	No baseline data available. Management of aquatic resources will reduce adverse effects on breeding habitat.

12.1.3.2 Measurable Parameters

Measurable parameters are clearly defined aspects of a Key Indicator that can be quantified and compared against a baseline value or condition. Each measurable parameter has an associated performance level or standard that can establish an effect magnitude or indicate compliance with formal standards. The measureable parameters used to address Project effects on wildlife are described below.

Project effects on habitat availability — is a quantitative (sometimes partially quantitative) analysis that considers the area (e.g., km² or hectares) and percent change in habitat quality from baseline availability versus availability after the Project is constructed and operating.

Project effects on movement patterns — is a qualitative discussion that is generally based on existing knowledge about terrestrial mammal movement patterns, habitat mapping, and likely responses to Project infrastructure.

Project effects on direct mortality risk — is a qualitative discussion about likely mortality risk in the absence of detailed baseline information on current mortality or predictive mortality tools. It will be discussed in the context of likely interaction and risk from Project infrastructure and activities.

Project effects on animal health — is a qualitative discussion, for waterfowl only, based on baseline knowledge and studies in other sites in Yukon (e.g., Mt. Nansen, Faro).

Although measurable parameters are discussed in more detail for each KI in sections below, a summary of the quantified measure is provided in Table 12.1-3. Select measureable parameters are quantified and discussed in detail for some KIs and in less or no detail for others depending on level of concern expressed in engagement meetings, information available in the literature, or availability of baseline data.

Table 12.1-3 Key Indicators and Measurable Parameters: Wildlife

Key Indicator	Potential Project-Related Effects	Measurable Parameter	Description
Klaza caribou herd	Habitat: direct loss within the PDA, reduced effectiveness within a Zone of Influence (indirect)	Area of late-winter habitat unit change from baseline conditions	Quantitative assessment
	Movement: changes to movement patterns, filtering of baseline movement through Project infrastructure.	Qualitative discussion.	Qualitative assessment.
	Mortality Risk: Increased from direct (infrastructure and activities) and indirect (increased harvester access) Project effects	Qualitative discussion based on experience from other projects in Yukon and relevant projects from elsewhere	Qualitative assessment
Moose	Habitat: direct loss within the PDA, reduced effectiveness within a Zone of Influence (indirect)	Area of late winter habitat unit change from baseline conditions	Quantitative assessment
	Movement: changes to movement patterns, filtering of baseline movement through Project infrastructure.	Qualitative discussion	Qualitative assessment.
	Mortality Risk: Increased from direct (infrastructure and activities) and indirect (increased harvester access) Project effects	Qualitative discussion based on experience from other projects in Yukon and relevant projects from elsewhere	Qualitative assessment
Grizzly bear	Habitat: direct loss within the PDA, reduced effectiveness within a Zone of Influence	Change in habitat effectiveness, security areas, open road density and denning habitat (area) from baseline conditions	Quantitative assessment
	Movement: Changes to movement patterns, filtering of baseline movement through Project infrastructure	Change in linkage zones (area) from baseline conditions	Quantitative assessment
	Mortality: Increased mortality risk due to Project personnel/bear encounters	Qualitative discussion based on experience from other projects in Yukon and relevant projects from elsewhere	Qualitative assessment
Collared pika	Habitat: direct loss within the PDA, reduced effectiveness near the PDA	Change in annual habitat (area) from baseline conditions.	Quantitative assessment.
Cliff-nesting raptors	Habitat: direct loss of existing nest sites to PDA, reduced effectiveness near PDA	Change in number of available nest sites from baseline conditions	Quantitative assessment
Passerines and bird species at risk	Habitat: direct loss of existing habitat to PDA, reduced effectiveness near PDA	Habitat (area) change from baseline conditions	Quantitative assessment
Waterfowl	Health: Potential use of tailings pond wetland for foraging.	Qualitative discussion based on experience from other projects in Yukon and relevant projects from elsewhere	Qualitative assessment

12.1.4 Assessment Boundaries

12.1.4.1 Potential Disturbance Area (PDA)

The Potential Disturbance Area (PDA) is an estimate of the amount of disturbance the Casino Project components and activities are likely to cause based on information available at the time of submission of the Proposal. For the purpose of quantifying the likely area of potential disturbance, we make several assumptions:

- Mine site components and activities will take place within 500 m from the outermost edge of the proposed footprint.
- Airstrip, airstrip access road, Freegold Road Extension, upgrade, and the Yukon River pipeline components and activities will take place within 50 m of either sides of the proposed alignment.
- Activities associated with the potential borrow areas will take place within 100 m of the proposed area. Any segments of the PDA associated with borrow areas must be accessible by the proposed roads or existing roads; if not, the PDA area was extended to connect the road and borrow areas.

For the purposes of the wildlife effects assessment, the PDA is a conservative estimate used to represent the maximum potential loss of habitat from the Project footprint. The PDA encompasses an 80.57 km² area.

12.1.4.2 Local Study Area (LSA)

The LSA is the zone where there is a reasonable potential for immediate interaction between Project components and the wildlife KI. The LSA generally is defined by the extent of Terrestrial Ecosystem Mapping (1 km buffer of the Freegold Road Extension and an area encompassing the drainages of the mine site). The LSA is primarily used for quantifying the direct loss of available habitat (Figure 12.1-1).

12.1.4.3 Regional Study Area (RSA)

The RSA varies by the Key Indicator (KI) species used in determining Project effects on wildlife (Figure 12.1-1). In general, the RSAs for wildlife that have large home ranges are either the annual or seasonal range of the species (e.g., Klaza caribou herd) or the Game Management Subzones that intersect or interact with the Project (e.g., applicable to moose and grizzly bear). The RSAs for wildlife with small seasonal home ranges or seasonal territories (e.g., birds) is a 5 km buffer from Project infrastructure. Specifically, the following RSAs are used for the wildlife KIs:

Caribou — The Klaza caribou herd range — but seasonal ranges are considered and described in further detail in the caribou section;

Moose and grizzly bear — Game management subzones 509–511, 522–524, 526 (which encompass the Bear Management Units used for the assessment of grizzly bear). These represent the scale at which moose and grizzly bear are managed and thus make a reasonable scale at which to assess potential project effects;

Collared pika — Extent of the Terrestrial Ecosystem Mapping (i.e., the terrain LSA) that accounts for localized distribution of Pika, a Key Indicator discussed below; and

Cliff-nesting raptors — The RSA for cliff-nesting raptors is an area encompassing a 5 km buffer around the PDA.

Passerines and bird species at risk — The RSA for passerines and birds species at risk is limited to the area where detailed habitat mapping is available — the extent of the Terrestrial Ecosystem Mapping (i.e., the terrain LSA) encompassing ~1 km radius around the Freegold Road Extension and an area encompassing drainages around the mine site.

Waterfowl —The assessment of Project effects on waterfowl is limited to their potential interaction with open water in the TMF. The area of open water fluctuates through the life of the Project.

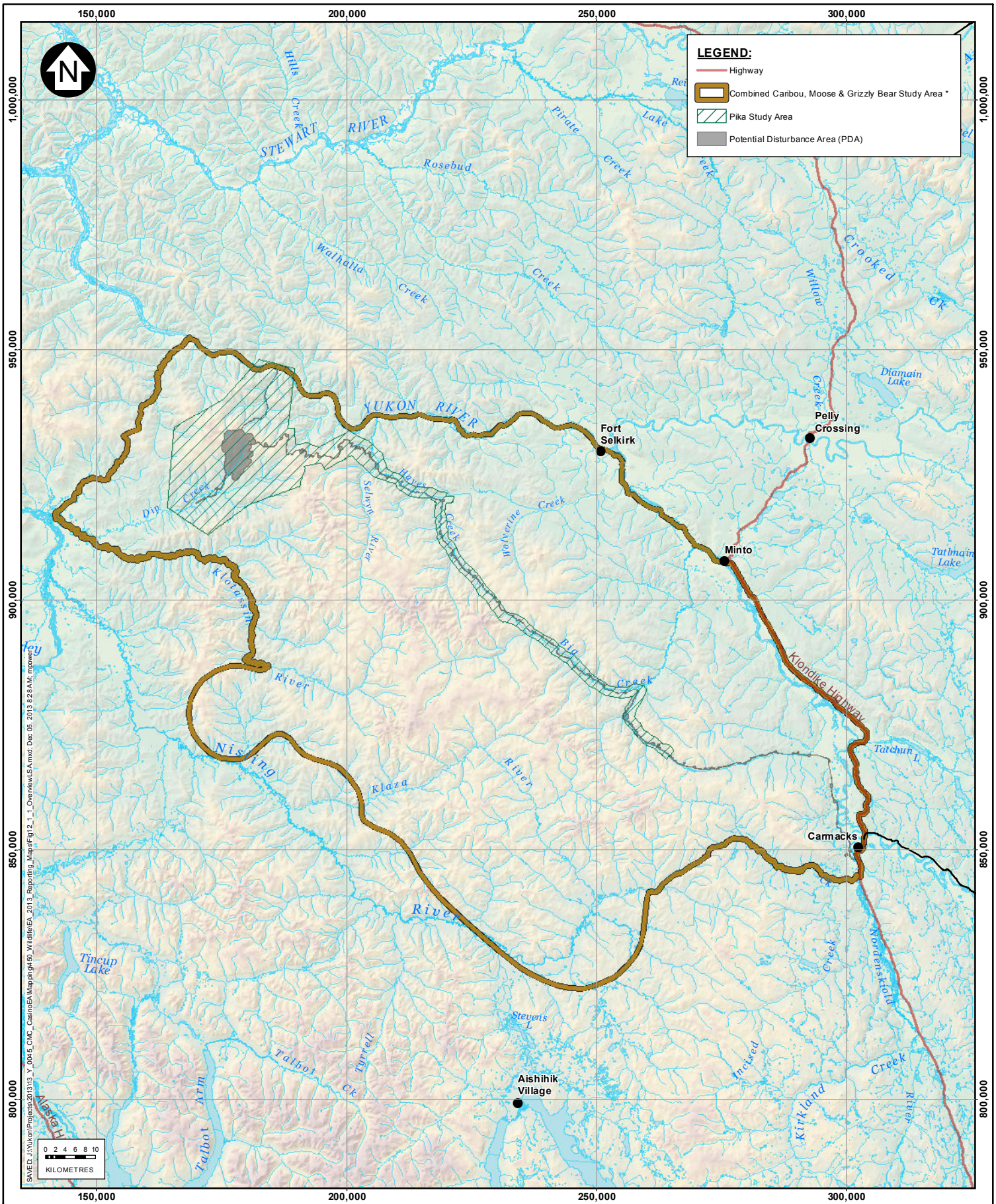
12.1.4.4 Temporal Boundaries

The general temporal boundaries for the effects assessment are defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project are provided in Section 4 of the Proposal. Two specific temporal boundaries are used for the assessment of potential Project effects on the wildlife KIs:

Baseline represents the conditions present prior to Project-specific developments.

Maximum disturbance represents the worst-case scenario of Project footprint disturbance and sensory disturbances related to mining and transportation activities during construction and operations. Construction and mining activities and traffic volumes will fluctuate through the life of the mine, but the maximum disturbance scenario is used as a conservative approach to assessing the worst-case scenario effects on wildlife KIs.

Project effects during closure and decommissioning and post closure are discussed qualitatively. The positive effects of reclamation on wildlife habitat will occur but they will not be realized for a number of years following closure.



PREPARED BY:

EDI

DESIGNED	MP
DRAWN	MP/LG
CHK'D	MS
APP'D	MS
REV	-
DATE	05/12/2013

SOURCES:
Potential Disturbance area: Knight Piesold, Sept. 2013.
Wildlife assessment areas developed by EDI, 2013.

1. BASE MAP: Geomatics Yukon - YG, NRCan
2. PROJECTION: NAD 1983 CSRS Yukon Albers
3. COORDINATE GRID: Metres

* Study area varies depending on measureable parameter.

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CASINO PROJECT

Study areas used for wildlife assessments

FIGURE # 12.1-1

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P/A VA101-325/15

12.1.5 Criteria for Assessing Significance

Significance of the Project's effect(s) on wildlife is determined in consideration of one or more of the following sources of information (Canter 1999):

- Guidelines or standards outlined in laws, regulations, policies, etc.;
- Pre-defined thresholds;
- Setting (e.g., is the Project in a protected habitat or sensitive zone, or land-use zone);
- The intensity of the effect (e.g., anticipated percentage change and whether the change is within normal variability); and
- Public concerns.

The nature of the residual effect is characterized against the following criteria:

- Direction: long term trend of the effect;
- Magnitude: the amount or intensity of change of the effect;
- Geographic extent: the spatial extent over which the effect occurs;
- Duration: the period of time over which effects are measurable;
- Frequency: the number of times an effect may occur;
- Reversibility: whether baseline conditions will return following cessation of an interaction;
- Environmental and socio-economic context: the ability of wildlife to accommodate change; and
- Probability of occurrence, or the likelihood that an effect will occur.

The criteria are assessed in the context of the mitigation measures and strategies that will be applied to eliminate or minimize the effect on the wildlife KI and measurable parameter being evaluated. General definitions and rating scales for the criteria are provided in Table 12.1-4. Specific definitions and ratings will vary by wildlife KI as indicated in the KI subsections of Section 12.3 (Project Effects Assessment). Where legislation, thresholds, standards, or objectives exist to define criteria rating and are relevant to the assessment, they are used. Similarly, quantitative values, if available, are used over qualitative criteria. Where empirical knowledge, traditional knowledge, or scientific evidence is lacking, professional judgement and experiences from similar projects will be used in determining if a criterion is given more or less weight in assigning impact significance. Any weighting and justification of the weighting are described. After considering the criteria, a confidence rating is determined and applied that considers the accuracy and application of analytical tools, an understanding of the effectiveness of mitigation measures, and an understanding of known responses of wildlife KIs to potential Project effects.

Significance thresholds specific to wildlife KIs are discussed in the subsections below, and a summary table of those thresholds are provided in Table 12.1-5. The thresholds are discussed in more detail in the wildlife key indicator subsections of Section 12.3.

Table 12.1-4 Definition of Environmental Effects Criteria for Wildlife

Criteria	Rating Definitions
Magnitude	Quantitative assessment — When possible, expressed as units depending on the measurable parameter, and usually as either area (e.g., km² or hectares) or as percent difference from baseline to maximum disturbance. Relative rating (low, medium, high) identified in the KI-specific sections where applicable.
	Qualitative assessment — definitions vary depending on the effect(s), but generally use the following conventions Low: No measurable effect and is an unlikely risk to the wildlife KI within the RSA Medium: A measurable effect but is unlikely to pose a risk to the persistence and natural variability of the wildlife KI within the RSA High: A measurable effect that is likely to put at risk the persistence of the wildlife KI within the RSA
Geographic extent	Localized: Effect limited to within the LSA
	Widespread: Effect extends outside of the RSA
Duration	Short Term: Effect occurs over less than one year.
	Long Term: Effect occurs beyond the life span of a wildlife KI.
	Permanent: Effect is detectable through post-closure.
Frequency	Infrequent: Effect occurs only a few times during the annual cycle of a wildlife KI.
	Frequent: Effect occurs repeatedly throughout the annual cycle of a wildlife KI
Reversibility	Reversible: Baseline conditions will return following the cessation of the Project activity and successful reclamation.
	Irreversible: Baseline conditions will not return following the cessation of the interaction.
Context	Low resilience: Low resilience of the KI to imposed stresses, or will not easily adapt to the effect(s).
	High resilience: High resilience of the KI to imposed stresses, or are known to adapt to the effect(s).
Probability of occurrence	Low: Low likelihood that the predicted residual effect will occur.
	Moderate: Moderate likelihood that the predicted residual effect will occur
	High: High likelihood that the predicted residual effect will occur.
Prediction confidence	Low: Conclusion is based on absent or weak data and there little to no published information on examples from other projects.
	Moderate: Conclusion is based on experience from other projects of a similar scale and similar KIs, but baseline data may not be necessarily sufficient for the Casino Project.
	High: Conclusion is based on sufficient baseline data, effects are well understood and quantified/quantifiable either for the Casino Project or other similar projects with similar wildlife KIs.

Table 12.1-5 Summary of Thresholds for Wildlife Key Indicators

Key Indicator	Potential Project-related effect	Threshold	Justification/Rationale
Klaza caribou herd	Habitat loss/reduced effectiveness	If total disturbance in range is 0–10% (low), 10–15% (moderate), or >15% (high)	Environment Canada 2008
	Movement	Qualitative assessment considering infrastructure as a barrier or "filter" to movement.	No known thresholds exist for assessing effects on caribou movement.
	Mortality risk	Predicted project-related mortality results in overall mortality (combined with cumulative natural and harvest-caused) exceeds 2% (moderate) or 3% (high) of population estimate.	Environment Yukon 1996a
Moose	Habitat loss/reduced effectiveness	If total moderate or high habitat quality loss in RSA is 0–10% (low), 10–15% (moderate), or >15% (high)	Andrén 1994; Swift and Hannon 2010
	Movement	Road density is 0–0.2 km/km² (low); >0.2–0.4 (moderate), >0.4 – (high)	Beyer et al. (2013) noted a functional response to moose crossings when road densities exceeded 0.4 km/km² in winter
	Mortality risk	Predicted Project-related mortality (combined with cumulative natural and harvest-caused) exceeds ≥2 and ≤4% (moderate) or >4% (high) of population in a GMS per year.	Environment Yukon 1996b
Grizzly bear	Habitat loss/reduced effectiveness	Magnitude high if: <70% of each BMU is effective; or <65% of each BMU secure; or open road density >0.16 km/km²; or denning habitat change >15%	Parks Canada 1997; Axys 2001; Purves, pers. comm as cited in Axys 2001; Mattson 1993; Craighead et al. 1995
	Movement	Magnitude high if linkage zone availability within a BMU changes >15% from baseline.	No known thresholds available
	Mortality: Increased mortality risk due to Project personnel/bear encounters	Magnitude high if mortality is greater than allowable number of human-caused mortalities (6%).	J.Hechtel, pers. comm as cited in Axys 2001; YFWCM 1997
Collared pika	Habitat loss/reduced effectiveness	If total suitable habitat loss in LSA is 0–10% (low), 10–15% (moderate), or >15% (high)	Andrén 1994; Swift and Hannon 2010
Cliff nesting raptors	Individual nest site loss	Addressed on a site-by-site basis, not threshold identified.	Limited nesting sites available, but those in study area represent a small proportion of those available in the region.
Bird species at risk/passerine bird	Habitat loss/reduced effectiveness	If total suitable habitat loss in LSA is 0–10% (low), 10–15% (moderate), or >15% (high)	Andrén 1994; Swift and Hannon 2010
Waterfowl	Health: Reduced health due to ingestion of contaminated water	Qualitative assessment considering potential waterfowl use of TMF and exposure to other mine areas.	Thresholds related to water quality are addressed in the water quality volume and the closure plan.

12.2 BASELINE CONDITIONS FOR WILDLIFE

Wildlife baseline (Appendix 12A) and bird baseline (Appendix 12B) reports provide details on all previous and Project-specific knowledge about wildlife distribution and abundance and the Project area. Those reports include a history of interest in the area from the perspective of wildlife managers, a review of available data, and a summary of the wildlife inventory work that was completed as a component of the current Project commissioned by CMC. A summary of those baseline reports is provided here to provide a general overview of wildlife diversity and habitats in the Project area. Baseline information specific to the wildlife KIs and measurable parameters is provided in various sub-sections of Section 12.3.

Caribou and moose dominate the landscape in this region and also play an integral role in the region's culture by providing sustenance and resource opportunities. Caribou herds within the region include the Klaza, Aishihik, and Forty Mile herds; however, the Project interacts primarily with the Klaza herd. Woodland caribou from the Klaza

herd are present within the Project's Regional Study Area (RSA) year-round, with parts of the herd's annual range overlapping with the proposed Freegold Road Upgrade and extension. The Klaza herd has experienced a population increase since the early 1990s. The herd, once numbering approximately 440 animals is now estimated at around 1,179 animals.

Moose are the largest ungulate within the RSA and are considered the primary harvest species for resident hunters. Moose are unevenly distributed throughout the RSA, likely selecting available burned and treed riparian areas. Moose densities in the area are considered low for the Yukon. Other ungulates present within the RSA include Dall's sheep, bison (Aishihik herd), and mule deer. Dall's sheep are known to use traditional seasonal ranges in three main areas in the RSA. Wood bison are only sporadically present in the very southern section of the RSA, and mule deer are occasionally observed on south-facing slopes near the Yukon River (in the western portion of the RSA).

The dominant carnivores in the RSA include grizzly and black bears, wolves, and wolverine, all of which occur at relatively low densities; however, little is known about these species in the region. Lynx, marten, coyote, and red fox are also present. Collared pika are known to inhabit alpine areas close to the proposed mine site.

The Project area contains a wide variety of habitats ranging from alpine peaks to forested valley bottoms and as result there is a diverse assemblage of bird species present. Field studies for birds were conducted in 2010, 2011 and 2013, consisting of point count surveys for songbirds and other upland bird species, encounter transects, aerial surveys for cliff-nesting raptors, a stand-watch survey for short-eared owl, and collection of incidental sightings. In total, 116 bird species have the potential to occur within the study area, 82 of which were confirmed present. The diversity of birds in the area is generally reflective of the avian community in this portion of the central Yukon. The only primary bird habitat type not present within the study area is lakes or other large water bodies and as such, species associated with those habitats are generally not present.

Raptors within the LSA include cliff-nesting raptors such as peregrine falcon, golden eagle and gyrfalcon, and forest-dwelling species like northern goshawk, sharp-shinned hawk, red-tailed hawk, northern hawk-owl and boreal owl, among others. Tors (rock outcrops), cliffs, and rocky outcrops on steep slopes are essential to cliff-nesting raptors within the LSA, while forest-dwelling raptors inhabit a variety of forested habitats.

Waterfowl (i.e., ducks, swans and geese) and other waterbirds (e.g., loons, grebes, gulls) are relatively uncommon in the LSA due to the limited availability of suitable habitats. In addition to the lack of lakes, open water wetland and pond habitats are infrequent and generally small in size. However, species such as mallard, American green-winged teal and bufflehead can be found in parts of the LSA, particularly in the Dip Creek drainage. Shorebirds within the LSA include two broad groups: (1) those that breed in wetlands and along stream margins, and (2) those that breed in upland tundra habitats. The most common shorebirds in the LSA are spotted sandpiper which occurs regularly along the large streams and rivers, and solitary sandpiper, which is typically found at small ponds and wetlands.

A diverse assemblage of upland bird species are found throughout the LSA including grouse, ptarmigan, kingfisher, woodpeckers, and passerines (songbirds). Passerine species include the following general groups: flycatchers, shrikes and vireos, jays and crows, swallows, chickadees, kinglets, thrushes, waxwings, warblers, sparrows, blackbirds and finches. Virtually all habitats within the LSA provide breeding habitat for songbirds and other upland bird species, but bird density and species diversity vary greatly. In general, higher elevation habitats show lower bird densities and lower species diversity than valley bottom habitats. Forested habitats have some of the highest bird density and diversity, but the richest habitats are usually associated with riparian features (e.g., riparian forest and riparian shrub habitats).

Within the LSA there are a number of bird species at risk or species of conservation concern which have been documented to be present or are likely to occur based on regional survey data or known distributions within the Yukon. Eight species — horned grebe, peregrine falcon, common nighthawk, short-eared owl, olive-sided flycatcher, bank swallow, barn swallow, and rusty blackbird — are listed as species at risk by the Committee on the Status of Endangered Wildlife in Canada, and four of these — peregrine falcon, common nighthawk, short-eared owl, and olive-sided flycatcher — are also listed under Schedule 1 of the federal *Species at Risk Act*. The Project species list also includes 14 species that are on the Yukon Conservation Data Centre's track list and 53 species that have been identified as priority species for conservation under the recent bird conservation strategy for Bird Conservation Region 4.

12.3 PROJECT EFFECTS ASSESSMENT

In this section, the potential Project effects on wildlife as a group are discussed, and then a KI-specific assessment is conducted, followed by an overall summary of effects on wildlife.

12.3.1 Project Interactions and Potential Effects on Wildlife

The Project includes: development of a large deposit of gold, copper, and molybdenum accessed by open pit mining; construction of processing facilities adjacent to the deposit and associated camp infrastructure; construction of a Tailings Management Facility (TMF); construction of an airstrip and access road; construction of a pipeline connecting the mine site to a water well adjacent to the Yukon River and use of a pre-existing road accessing the pipeline; construction of a section of road that extends the current Freegold road to the mine site; and upgrading of the current Freegold road to meet the required design standards.

Project components and activities that have the potential to interact with wildlife including the mechanism of interaction and potential effects are presented in Table 12.3-1. The phases of the Project considered in the assessment are pre-development, baseline, construction, operation, reclamation and closure. Project components and activities that potentially interact with wildlife are assessed for each wildlife species; however, when one activity or component is similar in timing, location, and scale, then the component or activity with the largest potential effect in assumed to encompass the other Project components or activities.

Project components and activities will interact with and potentially affect wildlife primarily by:

- Removing available habitat by land clearing and reducing adjacent habitat effectiveness because of sensory disturbances;
- Creating filters (semi-permeable barrier) or barriers to wildlife movement because of sensory disturbance or physical barriers created by mine infrastructure;
- Increased mortality risk due to collisions with vehicles or increased harvest, and
- Negatively affecting the health of individual animals that may be attracted to the tailings management facility during operations or at closure.

The most substantive and permanent effect of the Project to wildlife is the land clearing required for construction of the mine site and Freegold Road Extension, and those parts of the Project are the focus of the assessment. Reclamation will return land to a more natural state, but will not return the area to baseline conditions.

Mine site — The mine site will interact with wildlife through the loss of available habitat from the footprint and mining activities; mortality risk from collisions with vehicles and problem animal kills; and exposure of waterfowl to constituents of potential concern (COPCs) in the Tailings Management Facility (TMF) water. The mine site is the

location where most of the Project activities take place. The primary components of the mine site are the open pit, TMF, processing facilities, heap leach facility, accommodation facilities and temporary stockpiles.

Airstrip and airstrip access road — The Casino airstrip and airstrip access road will interact with wildlife through land clearing, vehicle traffic, and aircraft traffic on the airstrip.

Yukon River access road and freshwater pipeline — The existing Yukon River access road will be used to access and maintain the well system adjacent to the Yukon River. The 36 inch diameter Yukon River water supply pipeline with four booster stations will be 17.4 km long and follows the existing access road where practicable. Land clearing will be required during construction to install the pipeline. Traffic volumes are expected to be low and associated with scheduled pipeline well inspection and maintenance, and seasonal road maintenance. The Yukon River water supply pipeline will be built in the later part of the construction phase and used continually during the operation phase.

Freegold Road Upgrade and Extension — The Freegold Road Extension will interact with wildlife through land clearing and vehicle traffic on the road.

Loss of available habitat is the most substantive potential effect to wildlife because of construction and operation of the mine, access roads, and airstrip. Some habitat will be directly lost to the footprint of the infrastructure, but adjacent unchanged and habitat will become less effective for some wildlife because of the sensory disturbances associated with Project activities. Direct loss of habitat from land clearing is estimated at 23.5 km². Intermittent and recurring Project activities create a sensory Zone of Influence (ZOI) around the mine, road, and Project facilities. The size and magnitude of effect of the ZOI is species-specific. Vehicle traffic also has the potential to create a barrier or filter (semi-permeable barrier) to wildlife movement.

Table 12.3-1 Potential Interactions between the Project and Wildlife

Project components and activities	Project Phase	Potential interaction (Y/N)	Mechanism of interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O	No	No interaction with wildlife because activities contained within the project footprint within a building where wildlife are not present.
Aggregate sources / Borrow Sites	C, O	Yes	Clearing of Project footprint
Airstrip and Airstrip Access Road	O, C	Yes	Noise, traffic, clearing of Project footprint
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C	Yes	Clearing of Project footprint
Concentrate Transport and Loading	C, O	Yes	Noise, traffic, clearing of Project footprint
Concrete Batch Plant Operation	O	Yes	Noise
Contracted Employment		No	Administrative, no ecological interaction
Cyclone Sand Plant	O	Yes	Noise
Dismantling of Facilities	CD	Yes	Noise, traffic
Diversion of Canadian Creek	C, O, CD	Yes	Clearing of Project footprint
Drilling and Blasting (Noise, Fly Rock, Vibration)	C,O	Yes	Noise

Project components and activities	Project Phase	Potential interaction (Y/N)	Mechanism of interaction (or Rationale for No Interaction)
Fish Habitat Compensation Construction	C, O	Yes	Noise, traffic, clearing of Project footprint
Freegold Road Extension	C, O, CD	Yes	Noise, traffic, clearing of Project footprint
Freegold Road Upgrade	C, O	Yes	Noise, traffic, clearing of Project footprint
Fuel Storage and Distribution System	C	Yes	Clearing of Project footprint
Gold Extraction Plant / Oxide Ore Processing	C	Yes	Clearing of Project footprint
Ground preparation activities (e.g., cut, fill, grub, etc.)	C	Yes	Clearing of Project footprint
Hazardous materials storage, transport, and disposal		No	No ecological disturbance outside of the existing footprint.
Heap leach facility	C	Yes	Clearing of Project footprint
Heap leach pad	C	Yes	Clearing of Project footprint
Laydown areas	C	Yes	Clearing of Project footprint
LNG transport to site	O	Yes	Noise, traffic
Main and supplemental power plant (gas turbine and diesel)	C, O	Yes	Noise, traffic, clearing of Project footprint
Potential Disturbance Area	C	Yes	Clearing of Project footprint
Mine development		No	Administrative, no ecological interaction
Mine staffing		No	Administrative, no ecological interaction
On-site equipment and vehicle use	C, O, CD	Yes	Noise
Open pit mining	O	Yes	Noise
Ore conveyors	O	Yes	Noise
Ore crushing	O	Yes	Noise
Ore hauling	O	Yes	Noise and potential collisions with wildlife
Ore stockpiles	O	Yes	Clearing of Project footprint
Processing facilities for sulphide ore	O	Yes	Noise
Reagent storage and distribution	C	Yes	Clearing of Project footprint
Site reclamation / Re-vegetation	CD	Yes	Habitat recovery
Site security and fencing	O, CD	Yes	Project features as barrier to wildlife movement
Surface water management (contact water)	C	Yes	Clearing of Project footprint
Surface water management (non-contact water)	C	Yes	Clearing of Project footprint
Tailings management facility	O, CD, PC	Yes	Habitat with water exceeding CCME standards
Topsoil stockpiles	C	Yes	Clearing of Project footprint

Project components and activities	Project Phase	Potential interaction (Y/N)	Mechanism of interaction (or Rationale for No Interaction)
Traffic (equipment and materials to site)	O, CD	Yes	Noise, Potential road traffic collisions with wildlife
Waste management: garbage and sewage waste facilities	O	Yes	Wildlife attraction to garbage
Waste rock and overburden disposal	C, O	Yes	Noise, Clearing of Project footprint
Water supply	C, O	Yes	Clearing of Project footprint

Table 12.3-2 Potential Effects on Wildlife

Mechanism of interaction	Key Indicators	Potential Effect	Direction
Clearing of Project footprint	All terrestrial wildlife, cliff-nesting raptors, bird species at risk, passerine birds	Terrestrial habitat loss	Adverse
Noise, traffic	All terrestrial wildlife, cliff-nesting raptors, bird species at risk, passerine birds	Reduced habitat effectiveness	Adverse
Project features as barrier or filter to wildlife movement	Caribou, moose, grizzly bear	Loss of habitat connectivity, increased energetic costs	Adverse
Potential road traffic collisions with wildlife	Caribou, moose, grizzly bear	Increased mortality risk – road collisions	Adverse
Wildlife attraction to Project facilities	Grizzly bear	Increased mortality risk – problem wildlife kills	Adverse
Habitat with water exceeding CCME standards.	Waterfowl	Reduced health of waterfowl using the TMF (metals uptake	Adverse
Clearing of Project footprint, noise, traffic	All terrestrial mammals	Disruption at site-specific features (e.g., mineral licks)	Adverse

12.3.2 Mitigation Measures for Wildlife

This section highlights some of the general mitigation actions that CMC is instituting based on likely interactions between wildlife and Project infrastructure and activities. This is a general summary of the details provided in the *Casino Project: Wildlife Mitigation and Monitoring Plan* (Appendix 12C) and a number of other Management Plans including a Road Use Plan, Waste Management Plan, Air Quality Management Plan, Air Quality and Fugitive Dust Deposition Monitoring Program, and a Reclamation Monitoring Program.

The Wildlife Mitigation and Monitoring Plan (WMMP) describe mitigation and monitoring actions that are intended to reduce Project-related effects on wildlife. The plan is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader Project area, as well as reduce potential Project-related injury or mortality, while accounting for operational requirements and human health and safety requirements. The WMMP provides guidance to protect and limit disturbances to vegetation, birds, and terrestrial wildlife from Project activities.

Mitigation of the Project effects on wildlife and avoidance of key habitat features were considered in the Project design and actions specific to KIs are described below in effects assessment. The purpose of the WMMP is to

minimize effects to wildlife, monitor the results of mitigation, and adaptively manage for any unanticipated effects given the final Project footprint and description as provided to YESAB. CMC anticipates that further mitigation and monitoring details will be developed in continued discussion, post-approval, with the management agencies, Renewable Resource Councils (RRCs), working groups established to monitor Project effects, and other interested parties.

The WMMP will be updated periodically as required on the basis of management reviews, incident investigations, regulatory changes, or other Project-related changes. The plan will be updated as new methods or technologies become available. Mitigation and monitoring strategies developed for Species at Risk will be updated as necessary to maintain consistency with any applicable status reports, recovery strategies, action plans, and management plans that may become available during the duration of the Project. The wildlife mitigation and monitoring measures are likely to change during the life of the Project as a result of new resource discoveries, a better understanding of local wildlife behaviours, improved scientific techniques, stakeholder values, and to adapt to natural variability in wildlife distribution and abundance.

To address environmental and Project changes through time, an adaptive management approach is adopted for mitigation and monitoring plans. CMC anticipates that the plan will evolve and be adjusted to incorporate practical and workable solutions to minimize Project effects on wildlife and support regional wildlife research and management initiatives. An adaptive approach means that increasing monitoring or changes to the monitoring program can occur if unanticipated negative effects are detected, to further understand effects, or to change mitigation practices. Concomitantly, if no effects are detected over a reasonable time period, some mitigation and monitoring tasks may be removed from the program. To facilitate adaptive management and react to changing environmental and Project conditions, a process will be established to ensure regular review of the WMMP that includes regular and transparent reporting.

CMC recognizes that there will be disturbances and effects on wildlife and habitat as a result of the construction, operation, and closure of the Project. To reduce or eliminate potential Project effects on wildlife and habitat, CMC commits to a number of mitigation actions, some of which are general and apply to all Project phases, some that are specific to particular Project phases, some that are temporal and apply only certain times of years or in certain years when wildlife are present, and some that are in identified sensitive areas. CMC expects that some of the mitigation actions will be modified through the life of the Project as more information becomes available about the effectiveness of the mitigation and wildlife and habitat/vegetation response to Project-related disturbances. To inform CMC, Project regulators, and stakeholders about mitigation effectiveness and Project effects, the mitigation framework is supported by a Project effects monitoring framework described further in the WMMP (**Error! Reference source not found.**).

The WMMP lists mitigation actions that are general, Project-wide mitigation actions that are applicable to Project design, all Project phases, and all times of year; Mitigation actions that are most relevant to reducing the effects of construction activities, operations and closure and post-closure. Species-specific mitigation is mentioned separately where warranted.

12.3.2.1 Mitigation by CMC

CMC has the ability to implement mitigation through alteration of Project design and operation (mitigation by design). Other potential impacts are outside the control of CMC and can only be addressed by governments that have the legislation allowing them to manage wildlife. This Proposal presents separately the Project mitigation options that could be implemented by CMC, and multi-stakeholder mitigation and management options that will involve governments who have the ability and responsibility to manage wildlife. Samples of key mitigations are summarized below.

To mitigate potential Project effects on wildlife during construction, operation, and closure, CMC will:

- Minimize the Project footprint;
- Not damage or interfere with active dens of any species;
- Implement a no-hunting policy for Project employees while working on site, mitigating mortality risk;
- Implement a zero tolerance policy for wildlife harassment by Project-related employees and contractors, mitigating mortality risk and habitat loss;
- Suppress dust on the access road and at mine site during dry conditions to reduce the extent of dispersal into adjacent environments, mitigating habitat loss;
- Give wildlife the right-of-way when on all roads, when safe to do so, mitigating mortality risk and habitat loss; and
- Freshwater pipeline will be constructed to allow animal movement across (over or under).

To mitigate potential effects of the Freegold Road Extension on wildlife during construction, operation, and decommissioning and closure, CMC will:

- Designing road embankment heights and materials to allow for wildlife movement;
- Manage snow embankments along the road to allow wildlife easier crossing of the road and reduce the likelihood of wildlife getting trapped between embankments, mitigating potential barrier effects and mortality risk;
- Control access of non-Project personnel to the road by installing and manning a gate at the entrance of the Freegold Road Extension, mitigating mortality risk;
- Radio communication among drivers to warn others when wildlife are observed along the road, mitigating mortality risk; and
- Implement measures to prevent and manage spills to reduce the potential for wildlife exposure to contaminants, mitigating reduced health.

Details and a specific list of CMC's mitigation commitments are provided in the Casino Project: Wildlife Mitigation and Monitoring Plan (Appendix 12C).

12.3.2.2 Multi-stakeholder mitigation and management planning

Other land users, hunters in particular, have the potential to cause significant changes to the abundance and distribution of wildlife in the Project area. CMC does not have the ability to manage the public's ability to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RSA. Furthermore, proponents of other projects in the area may have conditions in their operating permits that are inconsistent with CMC's proposed mitigations. To mitigate potential Project effects that are outside of CMC's control and ensure the long-term health of regional wildlife, a landscape level planning process that could include the development of an updated Wildlife Management Plan could be initiated by management authorities. The management plan would likely be developed through a multi-stakeholder working group that includes those parties that have the responsibility for wildlife and land management. Working group members could include the Yukon Government, Little Salmon/Carmacks First Nation, Selkirk First Nation, Selkirk RRC, Carmacks RRC and CMC. While CMC cannot develop or implement the plan independently, it can participate as a stakeholder member of the working group.

12.3.3 Caribou Effects Assessment

12.3.3.1 Baseline Summary

Caribou in the Project area are from the Klaza caribou herd (KCH) and are part of the Northern Mountain Population (NMP) of woodland caribou (*Rangifer tarandus caribou*) that is listed as Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA; COSEWIC 2011a). NMP caribou generally occur at densities well below habitat carrying capacity and are held there by predation and human harvest. The KCH is currently (2012) estimated at 1,179 caribou (Hegel 2013). The herd has likely increased in numbers since the original estimate, but differences in survey methods make direct comparison difficult. The herd was first studied and identified as a discrete group of caribou during a 1987–1990 inventory (Farnell et al. 1991). The inventory was a response to local people's concerns about the Government of Yukon's plan to build a road to the Casino mine site and provide access to other mineral resources in the area. Since the first herd inventory, the population has continued to be studied and monitored. Since 1985, there have been 15 years of monitoring collared caribou and 17 years of aerial surveys; this is one of the better studied woodland caribou herds in Yukon.

The KCH range is centred on the Dawson Range of mountains. The KCH, like all northern mountain caribou, uses alpine and subalpine habitats during most of the year. Female caribou disperse to calve in higher elevation habitat as a predatory avoidance strategy. The caribou remain at higher elevations for the summer and fall, and into the winter. As winter progresses, caribou descend to lower elevations at or below treeline where snow conditions (depth and hardness) are more favourable for accessing winter forage. In winter, they inhabit lichen-rich mature and old coniferous forests where snow is relatively shallow. Farnell et al (1991) found that approximately 80% of the winter diet of the Klaza herd consists of lichens, which are most abundant in mature and old forests. Consequently, wildfires can displace caribou for decades. During winter their available habitat is limited by snow conditions and winter forage availability.

Fall composition surveys conducted since 1987 indicate that the population has normal recruitment and sex ratios. Predators of caribou in the region include wolf, wolverine, and grizzly and black bear. Caribou are an important subsistence species for some First Nations and other residents in the Yukon. Harvest records indicate that pressure on the KCH has been relatively low. The 2012 KCH harvest is less than 1% of the 2012 population estimate. Yukon's 2013/2014 hunting regulations restrict caribou harvest in all GMSs that intersect the Project PDA: two GMSs are closed to caribou hunting and licensed hunters require a lottery permit to harvest caribou in the remaining five (which are in the KCH range).

12.3.3.2 Potential Project Interactions with the Klaza Caribou Herd

Section 12.3.1 identifies all Project components and activities that are likely to interact with wildlife KIs. This discussion focuses on the key issues related to potential Project interactions with caribou.

The potential effects of industrial development on caribou are summarized concisely in Wolfe et al.'s (2000) literature review of caribou responses to anthropogenic disturbance:

- Caribou will avoid or reduce use of areas near the source of disturbance and avoid areas of widespread and concentrated development;
- Caribou may delay crossing or avoid crossing linear infrastructure;
- Caribou mortality may increase as a result of vehicle collisions and increased hunter access along roads; and
- Overall energy expenditure increases near disturbance.

The Project includes the new Freegold Road Extension and requires the upgrade of the existing Freegold Road. The Freegold Road Extension has the potential to interact with caribou within the KCH range; however, not all areas are used equally or during all seasons. The section of the Freegold Road Extension that runs parallel to Hayes Creek was identified as one of several locations where caribou concentrate during late-winter (Farnell et al. 1991). Caribou have been documented using this area since the original herd inventory and were observed in the area during recent baseline surveys (Error! Reference source not found.). Project effects on caribou are most likely to occur within this area of the Freegold Road Extension, at a time when caribou are most limited by habitat availability. The mine site is located outside the current annual range of the herd (as delineated by the Yukon Government in 2007), and the mine site itself will likely only interact with a small proportion of the caribou from the Klaza herd.

Yukon roads have traditionally had detrimental effects to caribou by facilitating hunting and vehicle collisions. Both primary and secondary roads, spur roads and trails provide hunting access, potentially lead to caribou's range avoidance. Many Yukon caribou herds have had roads constructed within or adjacent to their annual range (Table 12.3-3); however, little investigation has been conducted to examine the effects of these roads on caribou. The presence of the Dempster Highway in northern Yukon has affected the Porcupine and Hart River herds by providing access to hunters, potentially causing an avoidance of adjacent range. The Robert Campbell Highway in eastern Yukon bisects the winter range of the Finlayson herd, resulting in an additive effect from increased hunting to the population decline in the 1980s (Farnell et al. 1998). The Alaska Highway is a source of direct mortality for the Little Rancheria and Carcross herds due to vehicle collisions (O'Donoghue 1996; Florkiewicz et al. 2007). The influences of the Alaska Highway also contributed to the need for intensive management of the Chisana herd (Farnell and Gardner 2002). One of the most notable cases of population decline due to over-exploitation in the Yukon was the internationally ranging Fortymile herd. Once estimated in the 100,000s, the herd declined to ~5,000 throughout the 20th century, largely as a result of increased hunter access via the Steese, Taylor, Top of the World, and Klondike highways in Yukon and Alaska (Davis et al. 1978).

The effects of roads are seen as a root cause to many wildlife management challenges as there appears to be a correlation between road access and the level of effort required for management of caribou herds. Overexploitation facilitated by road access was identified as a contributing factor leading to long-term and high cost recovery programs for the Finlayson, Carcross, Aishihik, and Chisana herds over the last three decades. Subsequently, management strategies have required strict harvest management actions and annual caribou monitoring surveys to insure sustainable populations.

Table 12.3-3 Yukon Caribou Herds with Primary and/or Secondary Roads Within or Adjacent to their Annual Range

Yukon Caribou Herd(s)	*Associated Road(s) within Annual Range*
Porcupine; Hart River	Dempster Highway
Finlayson; Tay River	Robert Campbell Highway
Little Rancheria; Carcross; Chisana; Kluane	Alaska Highway
Fortymile	Steese; Taylor; Top of the World; Klondike highways
Nahanni; Coal River	Nahanni Range Road
Aishihik	Aishihik Road
Ethel Lake	Ethel Lake Road
Finlayson; Redstone	North Canol Road
Klaza	Mount Nansen Road

Habitat Availability — Habitat availability can be affected through direct loss within the PDA, indirect loss from Project activities or infrastructure that create sensory disturbances and temporarily reduce the effectiveness (usefulness) of adjacent habitats, or by filtering movement (i.e., semi-permeable barrier effect) among habitat patches. Mitigating habitat loss is accomplished mostly through reducing the Project footprint size, reducing sensory disturbance associated with Project activities, and ensuring that movement through Project infrastructure is facilitated.

Caribou have been documented reducing habitat use in response to disturbances at scales of 250 metres to 14 kilometres (Dyer et al. 2001; Polfus et al. 2011; Boulanger et al. 2012). The distance of the response varies by species (e.g., mountain versus woodland versus barren ground), terrain, vegetation types, and intensity and frequency of disturbance. Much of this research is based on the boreal population of woodland caribou or barren-ground caribou whose ecology differs from NMP woodland caribou. Barren-ground caribou differ from woodland caribou in that they typically make large seasonal migrations, gather in calving “grounds”, and range within large tracts of open tundra habitat. Extensive research on boreal caribou shows that they are sedentary and range in very sparse numbers within closed, low elevation peat land habitats (Fuller 1981; Bradshaw et al. 1995; Mallory and Hillis 1998; Gray 1999; Dzus 2001; McLoughlin et al. 2003). They have developed cryptic behaviours as anti-predation tactics and appear vulnerable to higher predation rates as a result of elevated alternative prey from habitat modification (James et al. 2004). Boreal caribou are sensitive to stresses caused by human encroachment and are declining throughout most of their range (Ferguson and Gauthier 1992; Bradshaw et al. 1995; Rettie and Messier 1998; Dyer et al. 2001; Oberg 2001; Vors and Boyce 2009). Conversely, NMP caribou occur in diverse multiple predator-prey systems, exhibit gregarious behaviour, and make extensive use of open upland habitats. The NMP ranges in northern latitudes have generally not been altered by the spread of human settlement and development. Consequently, there is less known about potential adverse effects to NMP caribou from anthropogenic disturbance and results from research on boreal or barren-ground caribou in other parts of Canada may not be entirely applicable to NMP caribou.

Barren-ground caribou were documented avoiding habitat up to 14 km from industrial infrastructure (Cameron et al. 1992, 2005; Joly et al. 2006; Boulanger et al. 2012), while NMP woodland caribou have been documented avoiding habitat up to 9 km from towns in a study near Atlin BC (Polfus et al. 2011). Weir et al. (2007) examined a

mine project in Newfoundland that is comparable to the proposed project, providing relatively comparable information regarding caribou distribution before and after mine construction, and before and during mine operation. They detected up to 36% reduced caribou distribution within 4 km of the mine site during late winter (Weir et al. 2007). In a similar region as the Casino Project, Polfus et al. (2011) found an avoidance of areas within 2 km of high use roads in the Atlin, BC area, while mines (not clearly defined) were avoided by 250 m in summer, and not at all in winter. In considering Polfus et al.'s (2011) results, the mines evaluated were generally not active during winter and they likely operated at smaller scales than the proposed project. Also, Polfus et al. (2011) characterized high use roads as those that were paved or plowed during winter and low use as dirt or gravel roads, and did not consider traffic volumes. The proposed Freegold Road Extension likely falls somewhere between Polfus et al.'s high and low use roads, as the Freegold Road Extension will be gravel and have a relatively low traffic volume (128 vehicles daily at peak operation) compared to most paved Yukon roads (Table 12.3-4; Yukon Highways and Public Works 2011). In a similar study, Dyer et al. (2001) found maximum avoidance distances of 1 km from oil wells and 250 m from roads and seismic lines.

Table 12.3-4 Yukon Road Traffic Volumes Expressed as a Percent of the Proposed Freegold Road Traffic Volumes

Highway (Location Description)	*Surface*	*Average Daily Traffic Volume (Year of Data)*	*Freegold Traffic Volume Comparison*
Alaska Highway (Carcross Cutoff)	Paved	2,045 (2011)	6%
Alaska Highway (Champagne)	Paved	494 (2011)	26%
Alaska Highway (Beaver Creek Border)	Paved	218 (2011)	59%
Atlin Road (km 13)	Gravel	296 (2007)	43%
Klondike Highway (Carcross)	Paved	625 (2011)	20%
Klondike Highway (Braeburn)	Paved	460 (2011)	28%
Robert Campbell Highway (Tuchitua)	Gravel	29 (2011)	441%
Dempster Highway (Klondike Camp)	Gravel	63 (2011)	203%
Nahanni Range Road (Francis River)	Gravel	30 (2009)	427%
Tagish Road (Jakes Corner)	Paved	298 (2011)	43%
Aishihik Road (km 0.1)	Gravel	53 (2009)	242%
Ethel Lake Road (at N. Klondike Hwy.)	Gravel	22 (2007)	582%
Mount Nansen Road (km 0)	Gravel	12 (2009)	1067%
Data source: (Yukon Highways and Public Works 2011)			

Fire history within a herd's range is also an important factor when considering potential effects on caribou habitat. While a natural wildfire regime is important for regeneration and productivity of the boreal forest, extensive fires could limit winter habitat availability for caribou because lichens take many decades to recover (Klein 1982; Thomas and Kiliaan 1998). Lichen regenerates sufficiently for caribou to start selecting the habitat greater than 60 years after a fire (Joly et al. 2003; Collins et al. 2011). Wildfire monitoring is an important consideration for caribou herd management. Fire history for the KCH range and adjacent areas includes fires from 1951 to 2006, corresponding to burns aged 6–61 years before 2012.

Movement — Another component of habitat availability is the accessibility of habitat adjacent to Project infrastructure. Movement across infrastructure may not be blocked by a physical barrier; however, it can be filtered by a physical structure or sensory disturbances (i.e., caribou are able to cross a road but do not because of stress associated with unknown stimuli). Roads can also act as semi-permeable barriers to caribou movement across the landscape resulting from vehicle use, embankment characteristics, and snow clearing practices. Less

disruptive linear features, such as seismic lines, are typically not barriers to movement; however, roads with moderate traffic levels can filter caribou movement, especially during late winter (Dyer et al. 2002). Woodland caribou in Alberta crossed roads (with traffic) in late-winter six times less frequently than simulated roads (Dyer et al. 2002). At the Ekati diamond mine in Norwest Territories, snow track surveys found 57% of caribou tracks deflected from the mine road during spring migration (April and May), and found that snow bank heights >0.5 m were the most important deflection factor, while the road did not act as barrier during snow-free periods (Rescan 2012). Allowing caribou to easily travel between habitats on either side of the road will maintain their distribution and reduce the chance of caribou avoiding road crossings and adding to individual energetic costs.

Mortality — Caribou mortality may increase as a direct result of the Project through vehicle collisions along the Freegold Road Extension, or indirectly through increased harvesting access into hunting areas or greater knowledge about caribou in the area. Direct mortality risk may increase along sections of the road that are known to be currently used by Klaza caribou (based on collar data, aerial surveys, and snow track data) and represent high quality late winter habitat.

12.3.3.3 Effects Assessment Methods for Caribou

Caribou were assessed within the spatial boundary of the Klaza caribou herd range. Based on the determination of potential interactions and effects between the Project and the Klaza caribou herd (Section 12.3.3.2), two categories of effects have been identified for further assessment:

- Habitat availability within the late winter range; and
- Mortality risk along the Freegold Road Extension.

Habitat availability is a broad category that encompasses direct habitat loss, reduced habitat effectiveness due to sensory disturbances, and the potential for Project infrastructure to create a filter effect to movement resulting in reduced accessibility to habitat. The measureable parameters for habitat availability include:

- Area of direct late winter habitat loss within the PDA; and
- Area of reduced late winter habitat effectiveness within the ZOI.

Project infrastructure as a potential barrier or filter to movement was assessed qualitatively. The magnitude of the effect was determined relative to the scale of caribou occurrence within the late winter range of the KCH.

The assessment of mortality risk includes consideration of the cumulative loss due to direct mortalities as a result of Project infrastructure or activities, and indirect mortality as a result of improved or increased harvester access. The measureable parameter for mortality risk is the percent of the total Klaza caribou herd killed per year.

The magnitude of the effect was determined relative to the entire KCH population.

Spatial and Temporal Boundaries

The spatial boundary for the assessment of potential Project effects on the KCH is the herd's late winter range as detailed in the **Error! Reference source not found.** (**Error! Reference source not found.**) and illustrated in Section 12.3.3.5 below. The Project's primary spatial and temporal interaction with the Klaza caribou herd occurs along the Freegold Road Extension during late winter. The KCH occupies primarily alpine and subalpine habitat during the majority of the year, but descend below treeline during winter, especially late winter, for easier access to forage. The mine site is located outside of the KCH's defined range; however, caribou have been observed near the proposed mine site during late winter aerial surveys. For the purposes of this assessment, all potential Project effects on the Klaza caribou are assumed to occur within the caribou herd's range; however, caribou

presence at and near the mine site will be considered in mitigation and monitoring plans for anything other than general wildlife mitigation activities.

The temporal boundaries of the assessment include a comparison between the baseline and maximum disturbance conditions (Section 12.1.4.3), with a focus on interactions occurring during the late winter season. The late winter season is considered the most limiting time of year for woodland caribou due to poor forage quality and availability, and greater energetic demands from travel and foraging through snow-covered habitats.

Criteria for Significance

Habitat — There are no known habitat loss or disturbance thresholds specific to the northern mountain population of woodland caribou. However, there is some threshold-related information for other caribou in Canada. In response to its listing as Threatened under the *Species at Risk Act*, and in an effort to link habitat loss to population demographics, Environment Canada (2008) developed a framework to identify critical habitat for the boreal population of woodland caribou. To examine the condition of critical habitat, disturbance states were determined at the scale of the herd range (Environment Canada 2008). Disturbance states, determined by the combined total percent of anthropogenic and fire disturbance within the range, are classified as very low to very high and are linked to the population's probability of persistence (based on a stable population recruitment threshold of 28.9 calves/100 cows; Table 12.3-5).

Although measures of total percent disturbance within a herd's range provide quantifiable thresholds that link directly to the herd's probability of persistence, considering persistence probability alone may not be considered a conservative approach to effects assessment. Persistence suggests that population decline is acceptable as long as the herd persists. Regardless, these thresholds, in combination with consideration for the herd's population trend (e.g. decreasing, stable, or increasing), can provide a parameter for evaluating the magnitude of the Project's effect on caribou late winter habitat; however adjustments must be made to adequately evaluate effects.

Although population trends for the Klaza herd cannot be fully quantified there is good evidence that the herd is stable and likely increasing (see **Error! Reference source not found.**).To approach the assessment conservatively, Environment Canada's (2008) very low disturbance state (15%) was considered as a high magnitude of effect for this assessment (Table 12.3-6).

Table 12.3-5 Boreal Caribou Probability of Persistence Relative to Range Disturbance States

Disturbance State[1,2]	Total Disturbance	Probability of Persistence
Very low	≤15%	0.9
Low	16–23%	0.7
Moderate	24–49%	0.5
High	50–58%	0.3
Very high	≥59%	0.1

Notes:
Disturbances include anthropogenic and fire
Source: Environment Canada (2008) Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada.

Table 12.3-6 Thresholds for Total Disturbance (including Potential Project Effects, Existing Anthropogenic Features, and Fire) within the Klaza Caribou Herd Range

Magnitude of Effect	Total Range Disturbance Threshold
Low	0–10%
Moderate	10–15%
High	>15%

Movement — There are no prescribed thresholds for evaluating the Project effect's on movement. Based on existing information on caribou behaviour and movement, a qualitative assessment of Project infrastructure as a potential semi-permeable barrier or filter to movement will be discussed in association with the determination of the Project's direct and indirect habitat effects.

Mortality Risk — Thresholds for both direct and indirect caribou mortality were based on Environment Yukon's sustainable harvest levels. Environment Yukon's (1996a) *Woodland Caribou Management Decision Guidelines* state that if a harvest management objective is to have negligible or zero harvest in an area, then a harvest rate of less than 2% of the herd's current population is considered acceptable, while a harvest rate of 2 to 3% is considered acceptable for a herd that is stable, naturally regulated, and is being managed for active harvest (Environment Yukon 1996a). From these guidelines, the magnitude of potential Project effects on mortality risk can be characterized (Table 12.3-7). The context for the assessment of Project effects on caribou is the sustainability of the Klaza caribou herd.

Table 12.3-7 Thresholds for Potential Project Effects to Mortality Risk to Klaza Caribou

Magnitude of Effect	Mortality Threshold (% of Population)
Low	<2%
Moderate	≥2 and ≤3%
High	>3%

Habitat Effects Methods

Direct habitat loss was quantified by calculating the area lost to the PDA (Table 12.3-11), while reduced habitat effectiveness was quantified using a ZOI approach. Overall Project effects on habitat availability were assessed using a quantitative analysis of the change in the available area of low, moderate, or high value late winter habitat from baseline to potential disturbance area to the ZOI. The ZOI defines the area beyond the PDA where effects from Project activities could result in reduced habitat effectiveness. These effects are the result of sensory disturbances (e.g., noise, smells, human presence, etc.). The magnitude of the effect varies depending on the proximity to the disturbance source.

The widths of the ZOIs for different Project components were based on multiple sources that provided information on the sensitivity of caribou to certain Project activities (Table 12.3-8). The ZOI selected for Project activities occurring within the KCH range is a maximum of 4 km, with levels of reduced habitat effectiveness ranging from 40 to 80% within the 4 km ZOI (Table 12.3-8). The analysis undertaken to determine the caribou ZOI and the magnitude of reduced habitat effectiveness within the ZOI is described below.

Vistnes and Nellemann (2008) provided a summary of 85 studies looking at caribou avoidance since the 1970s. Within most studies, caribou densities decreased by 50–95% within 5 km of human disturbance (Vistnes and Nellemann 2008). More importantly, Vistnes and Nellemann (2008) demonstrated that examining larger scales of avoidance is critical, as many studies looking at small scales (0–2 km from disturbance) did not find any avoidance, while the same data examined at a larger scale often detected reduced use. Although relatively large

ZOIs have been detected for barren-ground caribou (e.g., up to 14 km; Boulanger et al. 2012), the suspected mechanism is the deposition of fugitive dust on forage vegetation (Boulanger et al. 2012) — something that is much more prevalent in open arctic tundra habitats where winds are high and barriers to dust dispersal are limited (e.g., low terrain relief and no tall vegetation). Also, the low relief and treeless topography in arctic habitats increases the line of sight for caribou, potentially leading to habitat avoidance at greater distances than would be observed in forested habitats.

Cameron et al. (1992) found that caribou density decreased by 78% within 1 km from an oil field access road, while density increased by over 200% within 5–6 km from the road. Building upon Cameron et al.'s (1992, 2005) findings and disputing Noel et al.'s (2004) conclusion that caribou distribution was not influenced by roads, Joly et al. (2006) re-iterated that total caribou density is indeed reduced by at least 24% in all areas within 0–4 km of the road, and upwards of 84% between 2 and 4 km of a road — an area where pre-construction densities were highest. Within 2 km of disturbance, Cameron et al. (1992, 2005) reported a reduction in the mean density of caribou between 43 and 67%. These studies (Cameron et al. 1992, 2005; Noel et al. 2004; Joly et al. 2006) were examining avoidance of calving barren-ground caribou — a group that is regarded as being particularly sensitive to disturbance and whose ecology differs greatly from NMP caribou. Nonetheless, in consideration of these studies and in an effort to conservatively predict the Casino Project potential effects, habitat quality (derived from the late winter RSF model) between 0 and 1 km of the road was reduced by a factor of 0.2, reflecting a potential reduction in use of 80%, and habitat quality between 1 and 2 km was reduced by a factor of 0.4, reflecting a potential 60% reduction in use.

Studies regarding the response of woodland caribou to human disturbance have typically focused on roads and other linear features related to development (e.g., seismic lines, pipelines, etc.); however, Weir et al. (2007) observed reduced habitat use in areas within 0–4 km of a mine site in Newfoundland. The greatest levels of avoidance by woodland caribou were detected during late winter, when 50.5% and 41.1% fewer collared caribou were distributed between 0–4 km from the mine centre during construction and operation phases, respectively, compared with distribution during pre-disturbance. Similarly, Nellemann et al. (2003) found reindeer densities within a 4 km radius of a hydroelectric reservoir (which included associated road and power line infrastructure) declined to 8% during winter and 36% during summer of pre-development densities. This study comes from a highly developed landscape (Norway), where more than 70% of mountain areas are located <5 km from human infrastructure (Nellemann et al. 2003). Vistnes et al. (2001) concluded that caribou range availability is not simply affected by the presence of development, but the degree of development as well. Based on these studies and in consideration of regional ecological variables, habitat values (derived from the late winter RSF model) were reduced by 40% (i.e., multiplied by 0.6) within 2–4 km of the proposed PDA (Table 12.3-8). Although no magnitudes of reduced habitat effectiveness were quantified, Polfus et al.'s (2011) determination that woodland caribou avoided mine disturbances by 250 m and roads by 2 km demonstrates the conservative approach to the ZOI development.

To quantify the potential loss and reduced effectiveness of habitat, a habitat suitability index (HSI) was developed from the late winter RSF model by scaling RSF values to 1. The values on a scale of 0 to 1 were further classified into habitat quality classes (Table 12.3-9). Three ZOI buffers (0–1 km, 1–2 km, and 2–4 km) representing the different magnitudes of avoidance/reduced habitat use were then applied to the PDA and the habitat effectiveness reduction multipliers were applied to each ZOI buffer.

Once the habitat effectiveness reduction multipliers were incorporated, the total area of changed habitat within the late winter range was determined for each habitat class, providing the total percent change in each class from baseline conditions to maximum disturbance. Another measure of overall habitat effects was a summation of the scaled RSF values for each pixel in late winter range, comparing baseline to maximum disturbance.

Movement Effects Methods

In addition to loss and/or reduction of habitat effectiveness, the Project's potential to cause semi-permeable barrier (filter) effects to caribou was also assessed. The filter effect was assessed qualitatively by determining the sections along the Freegold Road that were most likely to be used by Klaza caribou during late-winter, and quantitatively by calculating the total time per day that Project-related vehicle traffic could result in a barrier to caribou crossing the road. The water pipeline located between the Yukon River and the Mine Site was not assessed as a barrier to caribou as it is located outside the KCH range.

To determine where the road interacts with caribou, the early and late winter RSF habitat models, late-winter snow track data, and GPS collar data were examined. To identify where the highest quality habitat exists, an HSI was prepared by classifying the RSF models into ten classes using quantile classification methods, and then was further grouped in low, moderate, and high habitat quality classes (described above).

Table 12.3-8 Summary of Habitat Effectiveness Reductions within the Project Zone of Influence for Klaza Caribou

ZOI	Habitat Use Reduction	Habitat Reduction Multiplier	References
PDA	All habitat within the PDA is rated as nil	0	N/A
0–1 km	-80%	0.2	Cameron et al. (1992); Dyer et al. (2001); Nellemann et al. (2003); Cameron et al. (2005); Joly et al. (2006); Weir et al. (2007); Polfus et al. (2011)
1–2 km	-60%	0.4	Cameron et al. (1992, 2005); Joly et al. (2006); Polfus et al. (2011)
2–4 km	-40%	0.6	Cameron et al. (2005); Joly et al. (2006); Weir et al. (2007); Vistnes and Nellemann (2008); Polfus et al. (2011)
>4 km	0%	1.0	Cameron et al. (1992); Joly et al. (2006); Weir et al. (2007)

Table 12.3-9 Habitat Suitability Index (HSI) Values Created from the reclassified Caribou Late Winter RSF Model

Late Winter Habitat Quality Class	Value Range
Low	0–0.3
Moderate	>0.3–0.7
High	>0.7–1.0

Locations assumed to represent where caribou are most likely to interact with the Project included areas where:

- The road intersects high quality winter habitat (it is assumed that caribou have the potential to occur anywhere in KCH range, but are most likely to occur within high value habitat);
- Caribou sign (tracks or pellets) was directly observed, and
- Caribou collar location data indicated caribou using or crossing the proposed road.

Traffic along the Freegold Road Extension will result in barriers to caribou movement while vehicles are travelling along the corridor. A moving barrier to caribou movement was assessed by considering a caribou on one side of the road and estimating the quantity of time they will be unable to cross due to Project traffic. This underestimates the actual barrier effect because caribou are unlikely to cross immediately before or after a truck passes. Traffic along the Freegold Road during a normal day of mine operation will include 56 inbound and up to 72 outbound

loads (based on peak operations). The assessment assumed vehicles are a maximum of 35 m long and travel 50 km/h. To account for the likelihood that caribou will not cross 100 m before and after a vehicle passes, the "length" of vehicles was increased to 235 m. The following equations describe how a 36 minute moving barrier was determined:

- $\frac{50{,}000\ m}{3600\ s} = 13.89\ m/s$
- $\frac{0.235\ m}{x} = \frac{13.89\ m}{s} \rightarrow\ x = 2165.74\ \text{seconds}$
- $\frac{2165.74\ s}{60\ s} = 36.10\ minutes\ \rightarrow 0.10\ minutes\ \times 60\ seconds = 6\ seconds\ \rightarrow \mathbf{36\ minutes\ 6\ seconds}$

Mortality Effects Methods

The Project's effect on direct mortality on caribou was assessed qualitatively as the probability of increased risk of activities killing caribou, primarily the direct mortality of caribou from vehicle collisions on the Freegold Road Extension. The assessment involved reviewing literature and evaluating the various factors that can influence the risk of collisions (e.g., traffic volumes, embankment characteristics, roadside attractants, speed limits, areas of the road within high quality late winter caribou habitat, etc.). The Mine Site was not included within this assessment as the KCH range does not overlap with this infrastructure. Similarly, indirect caribou mortality was assessed qualitatively by considering current harvest regulations and rates, and by examining the likelihood of the effect mechanism applying to the Project.

The 2013/2014 regulations restrict caribou harvest in all GMSs that intersect the Project footprint: GMSs 509 and 510 are closed to caribou hunting, and licensed hunters require a lottery draw permit to harvest caribou in the GMSs 511 and 522 to 526. Current licenced harvest of the KCH is concentrated in GMSs 523 and 526, with the majority of resident harvest in GMS 523, likely because of access to caribou along the Mount Nansen Road. Non-resident harvest pressure is mostly within GMS 526, presumably from guided hunters accessing more remote areas using aircraft. The assessment of caribou mortality was considered within the framework of CMC's mitigation and monitoring plans.

12.3.3.4 Potential Effects and Mitigation Measures for Caribou

General Project mitigation measures are described above in Section 12.3.2 address a number of potential impacts to all wildlife species and habitat. Caribou-specific mitigation measures that address potential effects to habitat availability and mortality to caribou are outlined below. More detail on mitigation and monitoring for caribou is available in the WMMP (Appendix 12C).

The direct loss of caribou late-winter habitat will be minimized to the extent that is practical, and will result in a relatively small loss of winter habitat. The indirect loss of winter habitat will be larger and could cause a considerable loss of functional habitat. Indirect loss of winter habitat would be the result of human caused disturbance and is entirely reversible once the disturbance is stopped. Snow management along the road will aim to reduce filter and barrier effects to caribou movement during winter. To avoid snow banks acting as barriers to movement on roads in the KCH winter range (km 98 to 130 on the Freegold Road Extension), CMC will smooth the snow piles on the edges of the roadways. Snow removal along the Freegold Road Extension will ensure high banks are avoided, or low snow banks will be left every 100 m to facilitate caribou movement across the road.

CMC proposes to mitigate the risk of reduced habitat availability within the winter range of the KCH by:

- Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range high quality habitat;
- Implementing a policy to ensure caribou approaching the road are given the right-of-way, if safe to do so;
- Implementing snow bank management measures to facilitate caribou movement across the roadway;
- Designing road embankment heights and materials to allow for caribou movement; and
- Placing construction camps and borrow pits to minimize or avoid disturbance to the KCH.

A more list of mitigation actions and details are discussed in the WMMP (Appendix 12C).

A number of measures exist for mitigating the Project's potential effect on caribou mortality. Collisions with vehicles travelling along the road and increased hunter access are the primary mechanisms that could increase caribou mortality. CMC will institute a no-hunting policy for staff on site, including while on the Freegold Road Extension.

The Freegold Road Extension has the potential to interact with caribou anywhere within the KCH range; however, not all areas are used equally. The section of the Freegold Road Extension that runs parallel to Hayes Creek has been identified as one of several locations where caribou concentrate during late winter (Farnell et al. 1991). To address the risk of vehicle collisions along the road, available data were used to identify areas where the road has a greater potential to interact with caribou. This resulted in identifying a section of road from km 98 to 130 that will be the focus of CMC's mitigation measures.

CMC will partially mitigate the risk of increased caribou mortality due to collisions with vehicles travelling the road by:

- Installing signage that warns drivers of known caribou crossing or foraging areas along the road;
- Reducing speed limits where caribou interact with the road during the winter;
- Enforcing road speed limits by remotely tracking (e.g., GPS tracing) truck traffic
- Snow plowing escape routes for caribou;
- Reporting of caribou sightings along the road to a wildlife monitor;
- Ensuring constant radio communication among trucks to identify wildlife locations on an ongoing basis;
- Employing a seasonal wildlife monitor to coordinate implementing caribou mitigations;
- Reporting and investigating all Project-related caribou near-misses and mortalities, and
- Triggering adaptive management strategies if there is a Project-related caribou mortality.

CMC will mitigate the risk of increased mortality from harvest by managing the Freegold Road Extension as a resource road by:

- Restricting access to the road during operation by installing a continuously manned gate at Big Creek;
- Decommissioning the road during the reclamation and closure phase; and
- Development of a wildlife management working group including regulators, First Nations governments and stakeholders, to provide advice to governments on mitigation, monitoring and adaptive management strategies.

Details of the mitigation and monitoring actions are provided in the WMMP (Appendix 12C). A summary of the mitigation actions specific to reducing the effects on the Klaza caribou are identified in Table 12.3-10.

Table 12.3-10 Proposed Mitigation Measures and Potential Residual Effects Specific to Klaza Caribou

Potential Effect	Project Phase (C, O, DC, PC)	Direction (Adverse/Beneficial)	Proposed Mitigation Measure (or Enhancement Measure)	Predicted Effectiveness (Low, Moderate, High, Unknown)	Residual Effect (Yes/No)
Habitat availability (loss)	C	Adverse	Placing construction camps outside of the KCH winter range, and borrow pits outside of KCH winter range where possible	High	Yes
Habitat availability (reduced effectiveness)	C, O	Adverse	Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range	Moderate	Yes
Movement	O	Adverse	Implementing a policy to ensure caribou approaching the road are given the right-of-way Implementing snow bank management measures to facilitate caribou movement across the roadway; Designing road embankment heights and materials to allow for caribou movement	Moderate	No
Mortality risk	O, DC, PC	Adverse	Restricting access to the road during operation by installing a continuously manned gate at Big Creek	High	No

12.3.3.5 Potential Residual Effects on Caribou

Habitat Residual Effects

The direct loss of 4.53 km² of late winter habitat within the PDA will result in a residual effect because the habitat will not be reclaimed within a generation of caribou (Table 12.3-11). The effectiveness of high and moderate quality late winter habitat within the KCH range may be reduced by 4.75% and 2.91%, respectively (Table 12.3-11); however, the effect of the ZOI is not permanent (will last throughout the life of the mine) and will cease as soon as operations are complete and sensory disturbances are diminished. Considering the value of all habitat

classes combined, there is a maximum overall reduction of 2.75% of the late winter habitat quality (Sum RSF values, Table 12.3-11). An illustration of the Project effects on the Klaza caribou herd late winter habitat, considering habitat loss within the PDA, reduced effectiveness within the ZOI, and the winter range RSF is found in Figure 12.3-1.

Table 12.3-11 Change in Caribou Late Winter Habitat Quality Due to Project Effects in the RSA

Habitat Quality	Baseline	Loss to PDA (km²)	Reduced Effectiveness in ZOI (km²)	Maximum Disturbancea	% Changeb
Nil	0.00 km²	+4.53	n/a	4.53 km²	
Low	1,762.11 km²	-4.13	+45.50	1,803.48 km²	+2.35%
Moderate	959.69 km²	-0.40	-27.54	931.75 km²	-2.91%
High	378.19 km²	0.00	-17.96	360.23 km²	-4.75%
Sum HSI	2,370,712			2,305,434	-2.75%

Notes:

Maximum disturbance represents the remaining habitat once habitat loss to PDA and reduced effectiveness in the ZOI are accounted for.

% change is the difference in habitat conditions at maximum disturbance from baseline conditions.

Movement Residual Effects

The assessment of the road as a barrier to movement resulted in the identification of 32 km (km 98 to 130) where caribou are most likely to interact with the road. The Freegold Road Extension does not intersect any continuous areas of high quality habitat in the Hayes Creek valley during early winter; however, during late winter, the Freegold Road Extension is adjacent high quality habitat at km 106.8–120.5. Caribou tracks were observed intermittently between km 107–129 during 2012 snow track surveys. No caribou tracks were observed during the 2013 survey. The 2012/2013 collar data indicate that one of the 28 collared caribou crossed the proposed Freegold Road Extension. This caribou (2012KCH028) crossed the road 23–31 November 2012 and remained in the hills northeast of the extension until 31 January to 2 February 2013. Identifying the precise location of the crossing point along the proposed road is not possible because the GPS locations are approximately eight hours apart (exact interval varies) which does not provide enough detail to identify specific crossing points. While the steps (lines connecting points) between collar fixes do not provide accurate crossing locations, the steps roughly coincide with the snow track data. With mitigation measures that aim to reduce filter effects focused in this area, the potential for the road to act as a filter to caribou movement will be limited.

The moving barrier to caribou that road traffic may impose is a maximum of 36 minutes and 6 seconds per day. This represents total time per day and will not occur concurrently. Although caribou movement may be filtered during these times (i.e., slower approaches, hesitation, etc., resulting in deflection), the likelihood of road traffic resulting in a complete barrier to movement is very low. However, behavioural responses to truck traffic suggest that the filter (semi-permeable barrier) effect will occur to some degree, deflecting some caribou from initial crossing attempts. Experience with barren-ground caribou in a tundra setting suggest group size, berm and bank height, and nursery versus non-nursery group composition all affect crossing rates (Rescan 2012).

Mortality Risk Residual Effects

Vehicle-related mortalities to caribou are expected to be few to none throughout the life of the mine. From 1997 to 2011, no vehicle-related caribou mortalities occurred at the Ekati diamond mine (Rescan 2012). Vehicle-related

mortalities to wildlife were primarily limited to birds and small mammals (except for one wolf killed in 2002; Rescan 2012). Although those data are from a very different environmental setting, it demonstrates the ability of mitigation and monitoring efforts to minimize effects to caribou mortality. Based on the current population estimate, a sustainable harvest rate for the KCH is 24–35 caribou per year. Harvest from licensed hunters during the previous 5 years has been 7–10 caribou per year, which is equivalent to 0.6–0.8% of the 2012 population estimate. Based on the assessment of potential Project effects to caribou mortality risk, and in consideration of the proposed mitigation measures, it is expected that Project-related mortalities will not exceed identified thresholds. Nonetheless, there remains a low probability that caribou mortalities will occur as a result of the Project. A conservative estimate of Project–related mortalities is one caribou per year. If a caribou death is directly linked to the Project, adaptive management measures will be triggered, resulting in a review of practices and potential modifications to Project activities.

12.3.3.6 Significance of Residual Effects on Caribou

The assessment of potential effects on caribou suggests that the proposed Project will have a not significant effect on the Klaza caribou herd. This determination is based on conservative analyses of the effects to measureable ecological parameters for the Klaza caribou herd.

Significance of Effects on Habitat

Project-related effects to caribou habitat availability will occur; however, due to the conservative approach taken throughout the assessment, the reduction of late winter habitat effectiveness is likely over-estimated. By minimizing the Project footprint, actively managing for sensory disturbances, and facilitating caribou movement, effects to habitat availability can be minimized. Upon mine closure, the effectiveness of habitat within the ZOI will return to baseline levels.

Residual effects of the Project on caribou habitat availability are quantified in Table 12.3-11. The area of habitat within the KCH winter range that will be directly lost, totals 4.53 km², while late winter habitat quality within the identified ZOIs will be reduced depending on proximity to the PDA. The predicted levels of Project effects on late winter caribou habitat availability based on the evaluation criteria summarized in Table 12.1-4. The effect of the Project on KCH late winter habitat availability is not significant. In consideration of uncertainty due to natural regimes (e.g., forest fires) the confidence in this prediction is moderate.

Significance of Effects on Movement

The Freegold Road Extension will act as a filter to caribou movement. Mitigation measures (e.g., snow management) can reduce effects to caribou movement. The overall effect of the Project on caribou movement is not significant. In consideration of uncertainty due to natural regimes (e.g., snow depth and icing affecting movement) and the untested success of caribou crossing the road during operations, the confidence in this prediction is moderate.

Significance of Effects on Mortality Risk

Project-related mortality will be reduced by adjusting speed limits in the identified high risk zones, regular monitoring and communication of caribou in proximity to the road infrastructure, the installation of a continually manned access gate on the Freegold Road Extension, and a no-hunting policy for staff while on-site. The risk of caribou being unable to move off the road when encountering vehicle traffic is considered low and mitigable because embankments and snow banks will be designed and managed to allow for wildlife movement.

Residual effects of the Project on caribou mortality are not expected. Mortality, if it occurs, will be limited to individuals (an estimated one animal per year), within the PDA and will not extend to indirect effects such as improved hunter access. The predicted levels of mortality effects based on the evaluation criteria are summarized in Table 12.3-12. The effect of the Project on caribou mortality is not significant at the scale of the Klaza caribou herd. Although consideration of the mechanisms that could lead to increased caribou mortality and the commitment of mitigation measure enactment suggest high confidence in this prediction, some uncertainty exists regarding the legality of CMC operating and managing a private resource road. Therefore, there is moderate confidence in this prediction.

The significance of residual effects of the Project on Caribou is summarized in Table 12.3-12.

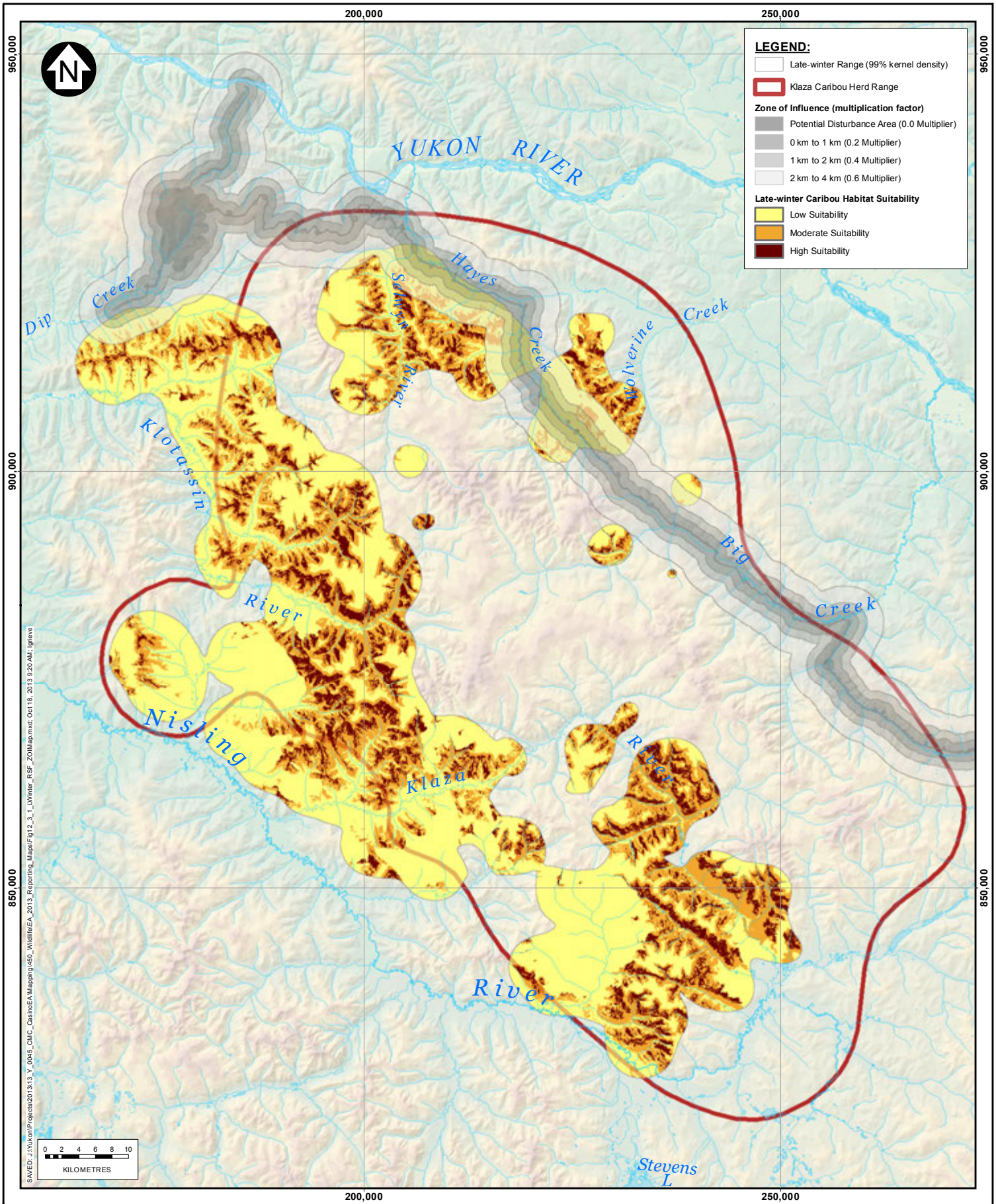
Table 12.3-12 Significance of Residual Effects -- Klaza Caribou

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat availability (loss)	Adverse	Low (4.75% of high quality habitat or 2.75% of all habitat combined)	Localized	Permanent	Infrequent	Reversible	High resilience	High	Not significant
Habitat availability (reduced effectiveness)	Adverse	Low	Widespread	Long term	Frequent	Reversible	High resilience	Moderate	Not significant
Movement	Adverse	Low	Widespread	Long-term	Infrequent	Reversible	Low resilience	Moderate	Not significant
Mortality risk	Adverse	Low	Widespread	Long term	Infrequent	Reversible	High resilience	Low	Not significant

Note:
Criteria definitions are detailed in Table 12.1-4

12.3.3.7 Follow-up Monitoring for Caribou

Some of the key information needs for caribou include response to Project roads and road traffic, distribution within the ZOI relative to within the RSA, and updating habitat use as more data become available and that analysis is relevant to Project mitigation and management. Initial monitoring goals will be to test effects predictions that were made with moderate to weak confidence, and collect information that is relevant to further monitoring triggers. General monitoring initiatives for wildlife and specific initiative for caribou are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC is committed to supporting any further studies of the KCH.



PREPARED BY:

EDI

DESIGNED	MP
DRAWN	MP
CHK'D	MS
APP'D	MS
REV	1
DATE	18/10/2013

NOTES:

SOURCES:
Potential Disturbance area: Knight Piesold, Sept. 2013.
RSF and ZOI developed by EDI, Sept. 2013.
2007 Klaza caribou herd range: YG - Environment

1. BASE MAP: Geomatics Yukon - YG, NRCan
2. PROJECTION: NAD 1983 CSRS Yukon Albers
3. COORDINATE GRID: Metres

CASINO COPPER AND GOLD

CASINO PROJECT

Klaza caribou herd late-winter habitat at Project maximum disturbance

FIGURE # 12.3-1

REF REPORT 1
P/A VA101-325/15

12.3.4 Moose Effects Assessment

12.3.4.1 Baseline Summary

The average density of moose in the Yukon typically ranges from 150 to 249 moose/1,000 km² (Yukon Fish and Wildlife Management Board 1996), while estimates of moose in the Casino area have ranged from 40 to 127 moose/1,000 km². Baseline studies from 1987 to 2013 detected moose distributed unevenly throughout the RSA. During late-winter surveys (2011–2013) moose were observed in areas around the proposed mine site (concentrated around Dip Creek) and along the proposed Freegold Road Upgrade and extension, with many observations concentrated northeast of the road alignment between Big Creek and Hayes Creek. Another concentration of moose observations was in the southwest side of the RSA around the Nisling River. Snow tracking surveys detected moose use along the entire surveyed area of the road upgrade and extension, especially in areas of human disturbance (e.g., placer mines) where willow growth was prominent. Moose were typically observed in burned habitats and river valleys.

Moose are an important food source and sport-hunting species in the Yukon. Four of the seven Game Management Subzones that overlap with the Project (522–524, and 526) have been closed to licenced hunting since 1987. GMSs 509–511 are closest to the Mine Site and have historically had relatively low levels of moose harvest (≤1 moose harvested per year).

12.3.4.2 Potential Project Interactions with Moose

Section 12.3.1 identifies all Project components and activities that interact with wildlife KIs. This discussion focuses on the key Project interactions with moose — habitat loss and mortality risk. The mechanisms for habitat loss include direct loss from Project footprint clearing and indirect loss from sensory disturbances. Mortality risk may be increased by vehicle collisions on the Freegold Road Upgrade and extension, or by increased hunter access. Facilitated predation (e.g., wolves using linear anthropogenic features to travel and hunt for prey) was also suggested as a mechanism for increased predation risk. These mechanisms are explored further by incorporating supporting literature and baseline study results.

Habitat availability — Similar to caribou, habitat availability can occur as direct loss within the PDA, or as indirect loss from Project activities or infrastructure that create sensory disturbances and temporarily reduce the effectiveness (usefulness) of adjacent habitats, or by filtering movement (i.e., barrier or filter effect) between habitat patches. Moose are present in the RSA throughout the year in a variety of habitat types. Moose use habitat differently depending on season and life stage (i.e., adult versus cow/calf group), thus it is important to consider these factors when evaluating potential Project interactions with moose. Winter can be a critical time for moose, as snow depth creates greater energetic costs and forage diversity and availability are reduced, ultimately influencing the longevity of summer reserves. Cow/calf groups tend to use habitat differently than lone adults, as the risk of predation and energetic needs are greater.

During construction, loss of suitable habitat will occur as a result of PDA clearing at the Mine Site, Airstrip Road, Yukon River Access Road, and along the Freegold Road Upgrade and extension. One of the major components of the Project is the Freegold Road Upgrade and extension. For moose, the creation of roads could be beneficial, as disturbed areas promote early successional vegetation growth and create refuges from predators (Beyer et al. 2013). Moose have been found to select disturbed areas (e.g., near towns or river margins) likely due to the availability of high-quality forage (e.g., willows; Maier et al. 2005). This is consistent with observations during baseline snow tracking surveys, where the highest densities of moose tracks and browse were found around existing placer mine operations along the Freegold Road. North of the RSA in the Dawson Land Use Planning Region, moose late winter habitat was examined using habitat suitability models (Morrison and Wong 2013).

Disturbance features examined included distance to burns, areal disturbances, and linear disturbances. Cow/calf groups selected habitat close to small roads, whereas adult moose tended to use wider linear features (>8 m), suggesting both groups did not avoid linear features and may in fact use them to reduce energetic costs in winter (Morrison and Wong 2013).

Moose may also experience reduced habitat effectiveness as a result of sensory disturbances from Project activities. Moose have been found to avoid active roads, humans, and other mechanical stimuli between 100 m and 3 km (Andersen et al. 1996; Burson III et al. 2000; Yost and Wright 2001; Jiang et al. 2009). All Project components are expected to result in temporary sensory disturbances to moose.

Movement — Habitat availability can also be reduced by Project components creating filters or barriers to movement. In general, movement rates for moose are greatest during the spring and summer (cow moose) and rut (bull moose), and the lowest movement rates occur during winter when energetic costs are the greatest (Henriksson 2007). All Project components may interfere with moose movement; however it is the roads and the 17 km long water pipeline that have the greatest potential to acts as filters or barriers to movement.

The water pipeline from the Mine Site to the Yukon River could act as a barrier to moose movement. Moose have been identified as a large-ranging species with low resilience to habitat fragmentation (Dunne and Quinn 2009). When approaching a potential movement barrier, moose may either cross it, deflect from it, or move parallel to it (Dunne and Quinn 2009). By examining the effectiveness of different pipeline clearances and crossing structures for moose, Dunne and Quinn (2009) found that a 140 cm clearance (bottom of pipeline to the ground) was a critical threshold for moose movement under pipelines. By ensuring the pipeline is built to allow moose to easily travel between habitats on either side of the pipeline, moose can maintain their distribution and reduce the chance of avoiding pipeline crossings and incurring additional energetic costs.

Mortality risk — The road will be the main Project component that will interact with moose mortality risk. Moose-vehicle accidents are typically higher at night (in darkness), during early to mid-winter, in areas of high moose density, and in areas where roadways cross valleys or movement corridors (Child et al. 1991; Del Frate and Spraker 1991; Dussault et al. 2006).

The mine site will have little to no interaction with moose mortality as vehicles and equipment will be operated to meet human safety standards. The only mine site component that could increase moose mortality risk is the open pit during the Operation Phase. There is potential for moose to fall into the pit; however, continuous activity and onsite monitoring will likely reduce the possibility of this occurrence.

The creation of road and/or trail networks may trigger increased predation pressure by wolves. While examining the effects of wolf predation on moose in a forestry context (i.e., forest removal, road creation), Kunkel and Pletscher (2000) found that logging activities did not significantly increase moose predation vulnerability, although wolves did use newly created roads for travel. Moose kill sites were in fact found in areas with a lower density of roads (Kunkel and Pletscher 2000). Habitat suitability models created for late winter moose habitat in the Dawson Land Use Planning Region also found moose did not avoid linear disturbance features, suggesting wolf predation pressure may not be strong enough for moose to avoid these areas (Morrison and Wong 2013).

12.3.4.3 Effects Assessment Methods for Moose

Moose were assessed within the spatial boundary of the moose RSA, which encompasses GMSs that intersect with Project infrastructure. Based on the determination of potential interactions and effects between the Project and moose (Section 12.3.4.2), two categories of effects were identified for further assessment:

- Late winter habitat availability; and

- Mortality risk within or along Project infrastructure (e.g., Freegold Road Upgrade and extension).

Habitat availability encompasses direct habitat loss, reduced habitat effectiveness due to sensory disturbances, and the potential for Project infrastructure to create a barrier/filter effect on movement resulting in reduced accessibility to habitat. The measureable parameters for habitat availability include:

- Area of direct late winter habitat loss within the PDA; and
- Area of reduced late winter habitat effectiveness within the ZOI.

Project infrastructure as a potential barrier or filter to movement was assessed qualitatively. The magnitude of the effect was determined relative to the scale of occurrence within the late winter habitat of moose within the RSA.

The assessment of mortality risk includes direct mortalities as a result of Project infrastructure or activities, and indirect mortality as a result of improved or increased harvester access. The measureable parameter for mortality risk is:

- Percent of moose killed within each GMS (a reflection of annual allowable harvest rates).

The magnitude of the effect was determined relative to the scale of the moose population in each GMS.

Spatial and Temporal Boundaries

As described in Section 12.1.4, the RSA was chosen to represent wildlife and habitat at an ecologically relevant scale. Since moose do not move in discrete units such as herds, but use a relatively large expanse of habitat annually, the most appropriate scale to assess the potential Project effects on moose is Game Management Subzones (GMSs). GMSs that overlapped with proposed or existing Project infrastructure were included in the assessment area (509–511, 522–524, and 526; Figure 12.1-1). Moose are present within the RSA year-round, thus Project activities during the construction, operations, closure and reclamation, and post-closure monitoring and inspection phases have the potential to affect moose.

Criteria for Significance

Habitat availability — There are no prescribed thresholds for evaluating the Project effects on available moose habitat. For most bird and mammal species, evidence suggests that with less than 10–30% of remaining suitable habitat, habitat fragmentation compounds the effects of habitat loss on population size (Andrén 1994; Swift and Hannon 2010). Similar to the habitat thresholds for caribou, these values largely consider the population viability or persistence of a species, which is not considered to be a conservative approach to effects assessment. Persistence and viability suggests that population decline is acceptable as long as the herd persists. These thresholds can provide a parameter for evaluating the magnitude of the Project's effects to habitat; however, they must be adjusted to reflect a more conservative approach. In consideration of this evidence and to reflect the inherent variability in these values (e.g., differences between species, landscapes, and population status) a difference of 15% from baseline to maximum disturbance (i.e. 85% residual habitat) is considered a high magnitude effect (Table 12.3-13). This threshold reflects a conservative approach to the assessment.

Table 12.3-13 Thresholds for Project Effects on Moose Late Winter Habitat

Magnitude of Effect	Total Range Disturbance Threshold
Low	0–10%
Moderate	10–15%
High	>15%

Movement — There are no prescribed thresholds for evaluating the Project effect's on movement. Based on existing information on moose behaviour and movement, a qualitative assessment of Project infrastructure as a potential barrier or filter to movement will be discussed in association with the determination of the Project's direct and indirect habitat effects. Additionally, moose have been shown to exhibit a functional response in road-crossing behaviour when road density exceeds a threshold of 0.2 km/ km² and 0.4 km/ km² in summer and winter, respectively (Beyer et al. 2013). Although the assessment focuses on late-winter moose habitat, a more conservative approach is to consider the summer range road density threshold of 0.2 km/ km² (within each GMS) as having a high magnitude effect.

Mortality risk — Thresholds for both direct and indirect moose mortality were based Environment Yukon's sustainable harvest levels. Environment Yukon's (1996b) Moose Management Guidelines state that annual allowable harvest rates for Yukon moose populations range from 2 to 5%. If a harvest management objective is to have negligible or zero harvest in an area, then a harvest rate of less than 2% of the GMS' current population is considered acceptable, while a harvest rate of 3 to 4% is considered acceptable for a GMS population that is stable, naturally regulated, and is being managed for active harvest (Environment Yukon 1996a). Generally, unless a population is very high density or experimental management programs are occurring, annual allowable harvest will not exceed 4% (Environment Yukon 1996b). From these guidelines, the magnitude of potential Project effects on mortality risk can be characterized (Table 12.3-14). The context for the assessment of Project effects on moose is the sustainability of the moose population in each GMS.

Table 12.3-14 Thresholds for Potential Project Effects on Mortality Risk to Moose

Magnitude of effect	Mortality threshold (% of population)
Low	<2%
Moderate	≥2 and ≤4%
High	>4%

Habitat Effects Methods

To assess potential Project effects on moose habitat, direct habitat loss was quantified by calculating the area lost to the PDA, while reduced habitat effectiveness was quantified using a ZOI approach. It was assumed habitat within the PDA will become unavailable to moose. The ZOI defines the area beyond the PDA in which effects from Project infrastructure or activities could result in reduced habitat effectiveness. These effects, as described above, manifest as sensory disturbances (e.g., noise, lights, smells, human presence, etc.). Overall Project effects on habitat availability were assessed using a quantitative analysis of the change in the available area of low, moderate, or high value late winter habitat from baseline to potential disturbance area to the ZOI. Effects to habitat availability will begin at the construction phase and continue throughout the life of the Project.

The width of the ZOI was based on multiple sources which provided information regarding the sensitivity of moose to certain Project components (Table 12.3-15). In Alaska, Yost and Wright (2001) found significantly fewer (55% less) groups of moose than expected within 300 m of a paved road through Denali National Park; however, they suspected these results were largely influenced by the spatial pattern of preferred forage and cover. Similarly, Burson III et al. (2000) found proportionally fewer moose within 100 m of the Denali Park road between 1972 and 1997; however, similar to Yost and Wright's (2001) findings, the mechanism for the decline may have been related to poorer visibility of moose near the road due to vegetation growth. In Norway, Andersen et al. (1996) found moose were more responsive to human stimuli (e.g., people walking or skiing) than to mechanical stimuli (e.g., jet overflights), fleeing from human stimuli at distances of 200 to 400 m. Moose in northeastern China were found to avoid roads at a distance of up to 3 km; however, the authors state that the influences on moose

decision-making in China is a result of many decades of disturbance from high density road networks and is likely quite different for moose in Canada (Jiang et al. 2009).

In consideration of these findings and precedence from similar mining projects in the Yukon and British Columbia (Table 12.3-15), and in an effort to maintain a conservative approach to Project effects, a ZOI of 300 m was determined for potential indirect effects to late winter moose habitat. There is very limited existing information that quantifies the magnitude of moose avoidance of human disturbance. To quantify the reduction in habitat effectiveness, it was assumed that all habitat classes within 300 m of the PDA experienced a 50% reduction in quality. Each HSI value was multiplied by 0.5, resulting in a reduced index value and generally, a reduction in habitat quality class to a minimum of low (Table 12.3-17).

Table 12.3-15 Summary of Disturbance Zones of Influence for Moose Reported in Literature or Used in Other Mining Projects

ZOI detected or used	Context	References
300 m	Reduced use near road	Yost and Wright (2001)
100 m	Reduced use near road	Burson III et al. (2000)
200–400 m	Response to human and mechanical stimuli	Andersen et al. (1996)
3000 m	Avoidance of roads	Jiang et al. (2009)
200 m	ZOI used for sensory disturbance at Yukon mining projects	Eagle Gold Project
None	ZOI used for sensory disturbance of Yukon and NWT mining projects	Ketza River Project; Prairie Creek Project, Mactung Mine Project
100 m and 250 m	ZOIs used for low and high use features of B.C. mining project	Prosperity Gold-Copper Project
300 m	ZOI used for sensory disturbance of B.C. mining project	Seabridge Gold Inc.

Movement Effects Methods

In addition to loss and/or reduction of habitat effectiveness, the Project's potential to cause filters or barriers to moose movement was also assessed. The filter effect was assessed qualitatively by areas that were most likely to affect moose during winter, and quantitatively by calculating the total time per day that Project-related vehicle traffic could result in a barrier to moose crossing the road. The water pipeline located between the Yukon River and the Mine Site and the Freegold Road Upgrade and extension are the Project components most likely to result in a filter or barrier to moose movement. Traffic on the Airstrip Road and Yukon River Access Road will be infrequent. The Mine Site is unlikely to result in detectable effects to movement, as its spatial extent is relatively small.

Traffic along the Freegold Road Extension will result in barriers to moose movement while vehicles are travelling along the corridor. A moving barrier to moose movement was assessed using the same methods as caribou (Section 12.3.3.3).

Additionally, road density within each GMS that intersects the Project was calculated to determine if Project roads will affect moose road crossing rates (after Beyer et al. 2013). In winter, moose are expected to cross roads less frequently [not quantified] than expected (compared to simulated crossings) at road densities greater than 0.4 km/km² (Beyer et al. 2013). Calculating the road density within each GMS provides an indication of movement effects to moose and can indicate which GMSs to focus mitigation and monitoring efforts.

Mortality Effects Methods

Potential Project effects on moose mortality were assessed by considering the probability of Project activities increasing the risk of moose mortality. This includes collisions with moose on the Freegold Road Upgrade and extension and potential interactions with Project infrastructure (e.g., falling into an open pit). Winter is considered the highest risk season as snow banks on the plowed road could make it difficult for moose to leave the road to avoid traffic. Also, moose may use the road more in winter to take advantage of the reduced energy costs associated with travelling on the plowed road. The Project's effect on moose indirect mortality was assessed as the potential for increased harvest of moose in each GMS through increased access (e.g., roads and accommodation) and improved knowledge of the region that could increase harvester success.

The assessment involved reviewing the literature and evaluating the various factors that can influence the risk of collisions (e.g., traffic, embankment characteristics, roadside attractants, speed limits, areas of the road within high quality late winter habitat, etc.). Similarly, indirect moose mortality was assessed qualitatively by considering current harvest regulations and rates, and by examining the likelihood of the effect mechanism applying to the Project.

The 2013/2014 regulations regulate moose harvest in all GMSs that intersect the Project footprint: GMSs 509–511 are open, with a bag limit of one, while GMSs 522–524 and 526 are closed to moose hunting. Current licenced harvest of moose is concentrated in GMSs 509 and 510, with the majority of resident harvest in GMS 509 (accessible from the Yukon River) and the majority of non-resident harvest pressure within GMS 510, presumably from guided hunters accessing more remote areas using aircraft. The assessment of moose mortality was considered within the framework of CMC's Wildlife Mitigation and Monitoring Plan (Appendix 12C).

12.3.4.4 Potential Effects and Mitigation Measures for Moose

General Project mitigation measures for wildlife are described above in Section 12.3.2 (Mitigation Measures for Wildlife). These measures address a number of potential impacts to all wildlife species and habitat. The mitigation measures established to decrease the risk of caribou habitat loss and mortality (Section 12.3.3.4) address potential effects to moose habitat and mortality. More details are available in the Wildlife Mitigation and Monitoring Plan (Appendix 12C).

Moose-specific mitigation measures that address potential effects to habitat availability and mortality to caribou are described below.

- Manage roadside vegetation along Project roads to discourage moose foraging (e.g., cutting roadside vegetation in spring, not mid-summer) (Rea 2003).

The 17 km water pipeline may pose the greatest risk to reduced moose movement. Pending final design of the pipeline, design considerations could include the following design and build components to mitigate effects to moose movement:

- Pipeline clearance (distance from bottom of pipeline to ground) could be a minimum of 180 cm every 400 to 700 m (depending on terrain) (Dunne and Quinn 2009).
- Portions of the pipeline could be completely buried (not visible aboveground) to prevent a barrier to movement.
- Pipeline crossing structures (made of vegetated fill or soil) may be constructed in high density crossing/movement areas or areas where the pipeline cannot be raised to sufficient height or buried completely.

Mitigation actions specific to reducing effects on moose are summarized in Table 12.3-16

Table 12.3-16 Proposed Mitigation Measures and Potential Residual Effects Specific to Moose

Potential Effect	Project Phase (C, O, DC, PC)	Direction (Adverse/Beneficial)	Proposed Mitigation Measure (or Enhancement Measure)	Predicted Effectiveness (Low, Moderate, High, Unknown)	Residual Effect (Yes/No)
Habitat loss	C	Adverse	Manage roadside vegetation along Project roads to discourage moose foraging	High	Yes
Reduced movement	C, O	Adverse	Pipeline clearance (distance from bottom of pipeline to ground) could be a minimum of 180 cm every 400 to 700 m (depending on terrain) Portions of the pipeline could be completely buried (not visible aboveground) to prevent a barrier to movement. Pipeline crossing structures (made of vegetated fill or soil) may be constructed in high density crossing/ movement areas or areas where the pipeline cannot be raised to sufficient height or buried completely	Moderate	Yes

12.3.4.5 Potential Residual Effects on Moose

Habitat Residual Effects

The direct loss of 80.46 km² of late winter habitat within the PDA will result in a residual effect because the habitat will not be reclaimed within one generation of moose (Table 12.3-17). The effectiveness of high and moderate quality late winter habitat may be reduced by 0.8% and 2.72%, respectively (Table 12.3-17); however, the effect of the ZOI is not permanent and will cease as soon as operations are complete and sensory disturbances are diminished. Considering the value of all habitat classes combined, there is a maximum overall reduction of 0.003% of the late winter habitat quality within the RSA (Sum HSI values; Table 12.3-17).An illustration of the Project effects on moose late winter habitat, considering habitat loss within the PDA, reduced effectiveness within the ZOI, and the winter range HSI is found in Figure 12.3-2. Project effects on habitat within the ZOI may be overestimated — in some cleared areas such as the Freegold Road Upgrade and extension, moose could be drawn to the roadside as the growth of willow is often promoted by disturbance (Maier et al. 2005).

Table 12.3-17 Change in Moose Late Winter Habitat Quality Due to Project Effects in the RSA

Habitat Quality	Baseline (km²)	Loss to PDA (km²)	Reduced Effectiveness in ZOI (km²)	Maximum Disturbance (km²)a	% Changeb
Nil	0.00	+80.46	-	80.46	
Low	2,399.05	-20.35	+110.05	2488.75	+3.74
Moderate	6,153.15	-59.23	-107.97	5985.95	-2.72
High	369.43	-0.89	-2.08	366.46	-0.80
Sum HSI	53,516,128			53,514,484	-0.003

Notes:
Maximum disturbance represents the remaining habitat once habitat loss to PDA and reduced effectiveness in the ZOI is accounted for.
% change is the difference in habitat conditions at maximum disturbance from baseline conditions.

Movement Residual Effects

Without design mitigation, the pipeline could act as barrier to moose movement; however, the design of the water pipeline is in the preliminary stages and adjustments to facilitate movement will be incorporated. By ensuring the pipeline is designed to allow for moose movement, especially in areas of high habitat quality or in potential movement corridors no residual effects to moose movement are expected. Monitoring efforts (i.e., snow tack surveys, motion-sensing wildlife cameras) will help to identify high habitat quality and movement corridors.

The moving barrier to moose that road traffic may impose could be a maximum of 36 minutes and 6 seconds per day. This represents total time per day and will not occur concurrently. Although moose movement may be filtered during these times (i.e. slower approaches, hesitation, etc.), the likelihood of road traffic resulting in a barrier to movement is very low. Road density in each GMS and within the entire RSA does not exceed the 0.2 km/ km² threshold at Project maximum disturbance (Table 12.3-18).

Table 12.3-18 Road Densities (km/ km²) within GMSs at Baseline, Project Road Footprint, and Project Maximum Disturbance

GMS	Baseline	Project Road Footprint	Maximum Disturbance
509	0.03	0.03	0.06
510	0.00	0.02	0.02
511	0.00	0.05	0.05
522	0.01	0.02	0.03
523	0.01	0.02	0.03
524	0.08	0.02	0.10
526	0.07	0.02	0.08
Total RSA density	0.03	0.02	0.05

Mortality Residual Effects

Current moose densities in the GMSs that interact with the Project range from 100–200 moose/1,000 km², translating to between 47 and 319 total moose in each GMS (as of 2007; Table 12.3-19). In the last five years of available data (2007–2011), harvest rates have ranged from 0 to 1.3% of the current GMS population (Table 12.3-19). Only the most accessible zones, GMSs 509 and 511, are nearing the 2% threshold at baseline conditions (2.0 out of a 4.1 moose AAH and 0.6 out of a 0.9 moose AAH, respectively); however, it is believed the Project will not facilitate harvest in this GMS (Table 12.3-19).

Based on the assessment of potential Project effects to moose mortality risk, and in consideration of the proposed mitigation measures, it is expected that Project-related mortalities will not exceed identified thresholds. Nonetheless, there remains a low probability that moose mortalities will occur as a result of the Project. A conservative estimate of Project –related mortalities is one moose per year. If a moose death is directly linked to the Project, adaptive management measures will be triggered, resulting in a review of practices and potential modifications to Project components.

Table 12.3-19 Current Population and Harvest Rates for Moose for each GMS, with 2–5% Annual Allowable Harvest (AAH) Rates.

GMS	Total Moose	Current Harvest Ratea (%)	Average Killb (2007–2011)	2% AAH	3% AAH	4% AAH	5% AAH
509	205.3	1.0	2.0	4.1	6.2	8.2	10.3
510	141.8	0.1	0.2	2.8	4.3	5.7	7.1
511	47.4	1.3	0.6	0.9	1.4	1.9	2.4
522	251.8	0.1	0.2	5.0	7.6	10.1	12.6
523	318.6	0.0	0.0	6.4	9.6	12.7	15.9
524	117.1	0.2	0.2	2.3	3.5	4.7	5.9
526	165.7	0.0	0.0	3.3	5.0	6.6	8.3

Notes:
Current harvest rate is equal to the percent of the current population estimate (as of 2007).
Average kill is the sum of the average resident, non-resident, and non-resident special guided harvest from the last five years (2007–2011) of available data.

12.3.4.6 Significance of Residual Effects on Moose

Significance of Effects on Habitat

Project-related effects to moose habitat availability will occur; however, due to the conservative approach taken throughout the assessment, the reduction of late winter habitat effectiveness is likely over-estimated. By minimizing the Project footprint, actively managing for sensory disturbances, and minimizing impacts to moose movement, effects to habitat availability can be minimized. Upon mine closure, the effectiveness of habitat within the ZOI will return to baseline levels.

Residual effects of the Project on moose habitat availability are quantified in Table 12.3-17. The area of late winter habitat within the moose RSA that will be directly lost totals 80.46 km², while high quality late winter habitat within the 300 m ZOI will be reduced by 2.08 km². The effect of the Project on late winter moose habitat availability is not significant at the scale of the moose RSA, as the loss is less than the identified low threshold (Table 12.3-13). In consideration of uncertainty due to natural regimes (e.g., forest fires), the confidence in this prediction is moderate.

Significance of Effects on Movement

The Project roads and water pipeline will act as filters to moose movement. Road densities in each GMS and the RSA will not exceed identified road-crossing rate thresholds. Mitigation measures (e.g., snow management) and Project design features (e.g. pipeline clearance heights) can reduce effects to moose movement. In consideration

of uncertainty due to natural regimes (e.g., snow depth and icing affecting movement), the confidence in this prediction is moderate.

Significance of Effects on Mortality

Project-related mortality will be minimized by managing speed limits, managing roadside vegetation, managing snow bank height, regular monitoring and communication of moose in proximity to the road infrastructure, the installation of a continually manned access gate on the Freegold Road, and a no-hunting policy for staff while on-site. The risk of moose being unable to move off the road when encountering vehicle traffic is considered low and mitigable because embankments and snow banks will be designed and managed to allow for wildlife movement.

Residual effects of the Project on moose mortality are not expected. Mortality, if it occurs, will be limited to individuals, within the PDA and will not result from indirect effects such as improved hunter access. The predicted levels of mortality effects based on the evaluation criteria are summarized in Table 12.3-19. The effect of the Project on moose mortality is not significant at the scale of individual GMS populations. Although consideration of the mechanisms that could lead to increased moose mortality and the commitment of mitigation measure enactment suggest high confidence in this prediction, some uncertainty exists regarding the legality of CMC operating and managing a private industrial road. Therefore, there is moderate confidence in this prediction. The significance of residual effects of the Project on moose is summarized in Table 12.3-20.

Table 12.3-20 Significance of Residual Effects – Moose

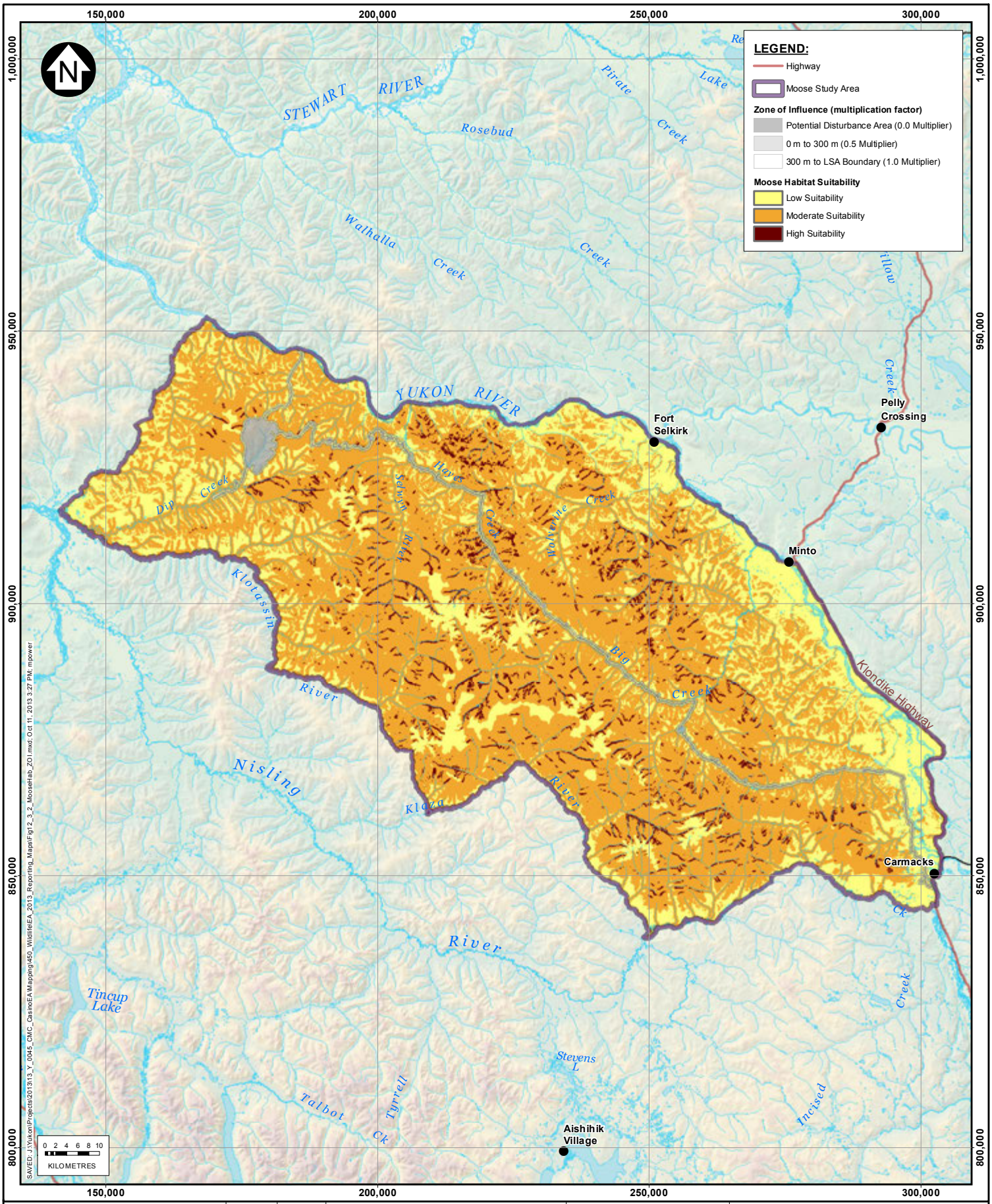
Residual Effect	**Predicted Degree of Effect After Mitigation Measures**								**Significance of Residual Effect** (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat availability (loss)	Adverse	Low (0.80% of high and 2.72% of moderate quality habitat)	Localized	Permanent	Infrequent	Reversible	High resilience	High	Not significant
Habitat availability (reduced effectiveness)	Adverse	Low	Widespread	Long term	Frequent	Reversible	High resilience	Moderate	Not significant
Movement	Adverse	Low	Widespread	Long-term	Infrequent	Reversible	High resilience	Moderate	Not significant
Mortality risk	Adverse	Low	Widespread	Long term	Infrequent	Reversible	High resilience	Low	Not significant

Note:
Criteria definitions are detailed in Table 12.1-4

12.3.4.7 Follow-up Monitoring for Moose

Some of the key information needs for moose include response to Project roads and road traffic, distribution within the ZOI relative to within the RSA, and updating habitat use as more data become available and that analysis is relevant to Project mitigation and management. Initial monitoring goals will be to test effects

predictions that were made with moderate to weak confidence, and collect information that is relevant to further monitoring triggers. General monitoring initiatives for wildlife and specific initiative for moose are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC is committed to supporting any further studies of moose in the Project area.



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PREPARED BY:

EDI

DESIGNED	MP
DRAWN	MP/LG
CHK'D	MS
APP'D	MS
REV	-
DATE	11/10/2013

NOTES:

SOURCES:
Potential Disturbance area: Knight Piesold, Sept. 2013.
RSF and ZOI developed by EDI, Sept. 2013.

1. BASE MAP: Geomatics Yukon - YG, NRCan
2. PROJECTION: NAD 1983 CSRS Yukon Albers
3. COORDINATE GRID: Metres

CASINO COPPER AND GOLD

CASINO PROJECT

Moose late-winter habitat at Project maximum disturbance

FIGURE #12.3-2

REF REPORT 1

P/A VA101-325/15

12.3.5 Grizzly Bear Effects Assessment

12.3.5.1 Baseline Summary

In Canada, the grizzly bear is listed as a species of Special Concern (COSEWIC 2012), but is not listed under the federal *Species at Risk Act*. Risks to the population include human-caused mortalities (including hunting, poaching, defense of life and/or property, and accidental mortality); incursions into grizzly bear habitat; habitat loss and genetic isolation (COSEWIC 2012). In the Yukon, grizzly bears are listed as Sensitive by the Canadian Endangered Species Conservation Council (CESCC 2011).

In 2000, it was estimated that 6,000 to 7,000 grizzly bears live in the Yukon (COSEWIC 2012). Grizzly bears occupy the entire territory from the BC border to the Beaufort Sea. Yukon's grizzly bear population represents about 25% of Canada's total grizzly bear population (COSEWIC 2012). Grizzly bears have been extirpated from much of their North American range and are in decline in some areas of their current range (YFWCM 1997). Although there are local exceptions, the Yukon grizzly bear population is considered to have remained stable since 1991 (COSEWIC 2012).

There is limited information available on grizzly bear distribution or abundance in the Project area. Grizzly bear densities for the Project area are unknown; however, Markel and Larsen (1989) estimated densities between 10 to 16 bears/1,000 km², based on two studies completed approximately 150 km away (Whitehorse, Yukon and Tok, Alaska). The working estimate for the two ecoregions that overlap the study area is 15 grizzly bears/1,000 km² (Maraj pers. comm.). Grizzly bears are assumed to use the entire RSA as they have been harvested from all GMSs that intersect the Project footprint, with the exception of GMS 510. Between 1979 and 2012, a total of 22 grizzly bears were harvested in these GMSs (Appendix 12A). All GMSs that interact with the Project are open to grizzly bear hunting. The bag limit is one grizzly bear every three license years (Environment Yukon 2013).

As part of the baseline data collection, grizzly bear habitat modeling and bear den surveys were completed. The results from both of these assessments are further described in the wildlife baseline report (Appendix 12A). The grizzly bear habitat modeling included analysis of habitat effectiveness, security areas, linkage zones and suitable denning habitat within the grizzly bear study area. Habitat effectiveness compares habitat quality for bears with disturbance in the area. Areas with high effectiveness have good quality forage habitat for grizzly bears and are isolated from human disturbance. At baseline, the habitat effectiveness model indicates that 78% of the grizzly bear study area is effective during the spring, 100% effective during the summer and 80% effective during the fall. The security areas model identified that 95% of the grizzly bear study area is currently rated as 'secure' and the linkage zone model identified that 98% of the grizzly bear study area is of 'minimal danger'. Areas categorized as 'minimal danger' are considered to be linkage zones. Through the denning habitat spatial analysis, we estimated that 19% of the grizzly bear study area currently contains suitable denning habitat.

A total of 15 grizzly bears were observed during baseline studies between 2010 and 2013 and 25 grizzly bear observations were recorded by staff in the Casino Project wildlife log between August 2008 and 2013. Nine potential bear dens were identified during the bear den surveys conducted in the spring of 2012. Since those dens were not assessed on the ground recent use was not confirmed, and the dens may have been used by either grizzly or black bears.

12.3.5.2 Potential Project Interactions with Grizzly Bear

Section 12.3.1 identifies all Project components and activities that interact with wildlife KIs. This section focuses on key issues related to potential Project interactions with grizzly bear. The potential effects of industrial

development on grizzly bear are summarized in McLellan's (1990) paper titled "Relationship between human industrial activity and grizzly bears", which include:

- Disruption from normal behavior;
- Displacement from areas of human use;
- Habitat loss or alteration;
- Social disruption; and
- Direct mortality because of increased access.

To determine Project effects on grizzly bears, three key issues were identified which encompass the effects summarized by McLellan (1990): (1) habitat availability; (2) restrictions on movement patterns; and (3) increased mortality risk.

Habitat availability — The Project has the potential to affect habitat availability for grizzly bears both directly and indirectly. Direct habitat loss will occur from the clearing and constructing mine site infrastructure and from clearing and upgrading/constructing the Freegold Road. Indirect habitat loss is expected to occur through sensory disturbances, which will temporarily reduce the effectiveness of grizzly bear habitat. Sensory disturbance is expected to occur from vehicle use of the Freegold Road, human presence and equipment use at the mine site, human presence in the camp and human presence and aircraft use at the airstrip.

There are two main habitat types important to bears: foraging and denning. Important foraging habitats vary by season and region. In the Project area, important foraging habitat during the spring include areas with overwintered berries, roots, avalanche chutes (potentially with winter carcasses) and riparian areas. Some grizzly bears also hunt and kill young moose calves (Larsen et al. 1989). During the summer, key forage habitats include riparian areas, alpine and subalpine habitats where grasses, horsetails and *Hedysarum alpinum* are abundant, and habitat for small mammals such as ground squirrels and marmots. In the fall, important foraging habitats for bears include areas with berries and salmon spawning streams. Chinook salmon, and in some cases chum salmon, have been noted to spawn in Big Creek, Selwyn River, Nordenskiold River and Hayes Creek (Fish and Aquatic Resources Baseline Report; Appendix 10A). Loss of foraging habitat in the PDA will be an effect of the Project.

In the Yukon, denning occurs between October and April–May. Suitable denning habitat is critical for bears to survive the long, cold Yukon winters. Denning habitat is typically located at high elevation, sloped areas that have dry, stable soil conditions that remain frozen during the winter and areas with natural caves (Bunnell and McCann 1993). This Project has the potential to remove denning habitat in the PDA.

Grizzly bears usually avoid areas with human activity, such as active roads and industrial sites by enough distance so that they are not disturbed (Harding and Nagy 1980, Aune et al. 1984, Mattson et al. 1987). The distance of avoidance is largely dependent on the individual bear and its past experience with humans (McLellan 1990). Numerous studies have shown that grizzly bears will often avoid roads. In Yellowstone National Park, Mattson et al. (1987) noted that grizzly bears avoided habitat within 500 m of roads during the spring and summer and within 3 km of a road during the fall. In Montana, grizzly bear use was substantially reduced in areas within 500 m of roads during the spring and summer and in the fall, avoidance was observed up to 1,000 m from a road (Aune et al. 1986). When a seasonal closed road was opened, the mean distance of bears from roads increased from 655 m to 1222 m (Kasworm and Manley 1990). Grizzly bears have also been observed avoiding trails — Kasworm and Manley (1990) noted that bears avoided habitat within 274 m of trails. Roads are thought to be one the largest threats to grizzly bear habitat and to mortality related to hunting (USFWS 1993).

Bears have been documented to decrease their daytime use of an area in response to industrial activity, but resumed activity during the night (McLellan and Shackleton 1988).

Grizzly bears, particularly females with cubs, require large, intact areas where they can safely forage away from humans for 24 to 48 hours (Purves and Doering 1998). Having large, secure areas to forage promotes reduces habituation of bears to humans (Gibeau et al. 1996). An area is considered to be secure if it is greater than 9 km².

Movement — The Project has the potential to restrict natural grizzly bear movement in the RSA. Bears will typically avoid areas with human disturbance, such as the mine site and the Freegold Road. Human activity may deter bears from crossing the road or moving through Project site during the construction and operation phases. This disturbance may alter their movement patterns.

Grizzly bears are sensitive to human disturbance and can have varied reactions (McLellan and Shackleton 1988). Human disturbance, including road use, has been shown to cause individual and social disruption (Benn and Herrero 2002; Apps et al. 2004; Mueller et al. 2004); and habitat avoidance and disruption (McClellan and Shackleton 1988; Gibeau et al. 2001; Apps et al. 2004). Roads and industrial activity can disrupt bears from their natural movement patterns. Roads with regular vehicle use can act as a barrier to grizzly bear movement (EDI 2008). Proctor et al. (2002) found that female grizzly bears rarely crossed a major highway in BC (Hwy 3) and movement of bears across the road was reduced considerably.

Fresh water will be piped from the Yukon River via the Yukon River Pipeline. If not properly designed, this pipeline could act as a barrier to movement for a variety of wildlife species, including grizzly bears.

Mortality risk — Any industrial development in bear territory has the potential to increase mortality risk of bears, both grizzly and black bear. Mortality can occur as a result of human-bear conflict, from vehicle collisions, and from hunting. The survival of grizzly bears is often limited by human-caused mortality. Mattson and Merrill (2002) and Ross (2002) all suggested that human-caused mortality may be much more likely to cause extirpation than habitat loss. Even when high quality habitat is abundant, populations can still decline if harvest rates, including kills from defense of life or property, road kills and poaching, are cumulatively unsustainable (Merrill and Mattson 2003; Maraj 2007).

In the Yukon, an estimated 30–40 black bears and 10–15 grizzly bears are killed because of conflict with humans every year (MPERG 2008). Improper handling of food and garbage can attract scavengers, including bears, into camps and areas near people. Bears can be habituated to human food and garbage which often results in injury or death of bears, humans or future users of the area. Bears can seriously damage infrastructure and have the potential to affect camp operations. MPERG (2008) reported that approximately 70% of reported human-bear conflicts are due to garbage attraction. Every year, bears are destroyed at mine camps and exploration sites in the Yukon because of improper garbage management (D. McLean, pers. comm).

Vehicle use on the Freegold Road increases the potential for vehicle-wildlife collisions, including collisions with bears. Traffic projections predict that during the construction phase, the average number of vehicles per day will be between four and 28. During operation, traffic projections estimate approximately 125 vehicles per day. Although public access on the Freegold road will be restricted throughout the life of the Project, hunters may illegally use the road to gain access into the area. Although bears often avoid roads, predictable vehicle use from industry can sometimes habituate bears, making them more susceptible to being shot by hunters. Clearing along roadsides can promote growth of forage species, which also makes bears vulnerable to hunters (Simpson 1987).

12.3.5.3 Effects Assessment Methods for Grizzly Bear

Measurable parameters for assessing habitat loss or alteration from the Project are: 1) habitat effectiveness; 2) security areas; 2) road density; and 4) denning habitat. The measureable parameter for assessing restrictions to movement is linkage zones. These parameters are all quantitative.

The measurable parameter for assessing increased mortality associated with this Project is mortality rate, which is a qualitative assessment.

Spatial and Temporal Boundaries

The spatial boundaries for the assessment of habitat availability and restrictions to movement are:

- Mine site and road PDA — boundary of the potential disturbance area (PDA) of the Project as defined for wildlife in general.
- Grizzly bear study area (Figure 12.1-1) — grizzly bear have large home ranges and in recognition of this, the grizzly bear study area encompasses the mine site, the access road and all Game Management Subzones (GMS's) that interact with the Project. The total area of the grizzly bear study area is 8,921 km² and is comprised of 20 bear management units (BMUs). Additional detail on the rationale, size and boundaries of these BMUs is provided in the **Error! Reference source not found.** (Appendix 12A).

The spatial boundary for the assessment of direct mortality risk is the grizzly bear study area.

The Project's primary spatial and temporal interaction with grizzly bears would occur in key foraging areas during the spring, summer and fall. The Project also has the potential to reduce the amount of available denning habitat.

The temporal boundaries of the assessment include all five phases of the Project, referred to in Section 5.2.2, for both the foraging season (March/April to October) and the denning season (October to March/April). The foraging season is considered to be the most limiting time of year because food availability affects both reproduction and the bear's ability to survive the winter.

Criteria for Significance

Habitat availability — Habitat was assessed as a measure of habitat effectiveness, security areas, road density and denning habitat (Table 12.1-3). There are no prescribed thresholds for evaluating the Project effects on grizzly bear habitat. However, there is some information on threshold for grizzly bears in Canada.

Although no prescribed threshold for habitat effectiveness is available, other jurisdictions in North America have adopted a threshold of 80% habitat effectiveness. Below this threshold, grizzly bear use of an area declines (Parks Canada 1997, as cited in AXYS 2001). For this project, if habitat effectiveness is reduced to between 70 and 80% as a result of a Project effect, the Project is considered to have had a moderate magnitude effect and <70% is considered have had a high magnitude effect.

The minimum security area size used in this effects assessment is 9 km^2 (Purves and Doering 1998). Jasper National Park adopted a minimum threshold for security areas of 60 to 67% secure within each BMU (H. Purves, pers. comm as cited in AXYS 2001). For this project, we have used a security area threshold of 65%. If a BMU contains less than 65% secure habitat as a result of a Project effect, the Project is considered to have had a high magnitude effect.

Roads are often considered one of the largest threats to grizzly bears because bears typically avoid active roads, therefore reducing habitat effectiveness, and because of the associated increase in mortality rate, mostly due to

hunting (USFWS 1993). Thresholds for road density vary by region and management groups. In Montana, landscapes with road densities ≥ 6 km² were found to be incapable of providing habitat for grizzly bears (Mace et al. 1996). Gibeau (2001) conducted a review of existing information and concluded that the reported threshold for functioning landscape with large carnivores was approximately 0.6 km/km². For this Project, the threshold for open road density was set at 0.16 km/km². If an open road density exceeds 0.16 km/km² it is considered to be a moderate magnitude effect (Mattson 1993; Craighead et al. 1995). If open road density in any BMU that overlaps with the project exceeds 0.6 km/km², then it is considered a high magnitude effect.

For denning habitat, assessed as a measure of denning habitat suitability, a difference of 15% from baseline to maximum disturbed is observed in any given BMU, it is considered to be a high magnitude effect.

Movement — Assessed as a measure of linkage habitat (Table 12.1-3), and a difference of 15% from baseline to maximum disturbance is considered a high magnitude effect.

Mortality risk — Thresholds for both direct and indirect mortality are based on Yukon Environment's annual allowable human-caused mortality quota of 6% of the population (J. Hechtel, pers.comm; Horesji as cited in AXYS 2001). Project-related mortality (e.g., problem kills) exceeding the grizzly bear quota for the GMS where a mortality occurs is considered high magnitude. The Grizzly Bear Management Principles (YFWCM 1997) state that "100 females could sustain the loss of two females per year from all human sources if each female is taken from a different 1,000 km²; 100 males could sustain the loss of six males per year from all human sources". This mortality encompasses all mortality types including defense of life and property, collisions, permitting hunting, and illegal hunting. The working estimate for grizzly bear density in the two ecoregions that overlap the study area is 15 grizzly bears/1,000 km² (Maraj pers. comm.). The context for the assessment of Project effects on grizzly bear is the sustainability of the population within the GMSs that intersect the PDA (i.e. total mortality in these GMSs does not exceed threshold).

Habitat Effects Methods

The effects on habitat were assessed through habitat effectiveness, security areas, road density and denning habitat.

Habitat effectiveness (HE) relates habitat quality and human activity to estimate the overall effectiveness of grizzly bear habitat. A habitat effectiveness model is used to quantify the areas' potential ability to support bears (Gibeau 1998). The Casino Wildlife Baseline Report (Appendix 12A) assesses the HE of the entire grizzly bear study area, during baseline conditions, for the three feeding seasons: spring, summer and fall. This report also details the methods used to determine the HE for each BMU. To assess Project effects on HE, the baseline model was run again incorporating the PDA. Habitat within the PDA is considered to be lost. To prevent grizzly bear use in the area from declining, HE for any given BMU should be greater than 80% (Parks Canada 1997).

Secure areas, away from human disturbance, allow bears to remain undisturbed in areas for longer periods. This is an important factor for minimizing potential human-bear interactions and conflict. The habitat effectiveness model described above does not take habitat security into account. The security areas model identifies areas where a female grizzly bear can forage for 24 to 48 hours without human disturbance (Purves and Doering 1998). Security area models are run in conjunction with HE models because HE models (1) do not address habitat security; and (2) do not address the areas between zones of human influence that are considered to be too small to provide secure habitat for bears (Gibeau et al., 2001). The security model developed for the Casino project uses the methods summarized in Purves and Doering (1998) and Gibeau (2001). Like the HE model, the security areas model was run to determine the amount of secure area within the grizzly bear study area at baseline (Casino Wildlife Baseline Report; Appendix 12A). The model was then run again incorporating the PDA and the

change in secure habitat between baseline conditions and maximum disturbance was assessed to determine Project effects.

Roads often present the greatest threat to grizzly bear habitat and to grizzly bear mortality; therefore road densities are used as a threshold for establishing management objectives. Open road densities are used to measure the effects of roads on a landscape (Forman and Hersperger 1996). The allowable open road density can vary with the land-use objectives of an area. Because the Casino Project area is a relatively undisturbed area, we have set a threshold value for open road density to 0.16 km/km^2, which is a more conservative approach (Craighead et al. 1995 as cited in AXYS 2001). To determine open road density, the bear management units were used since they consider the average size of a female grizzly bears home range. A road density map was developed to measure the amount of road in each bear management unit. These metrics were then used to determine the kilometer of road per square kilometer. It is important to note that the recommended threshold of 0.16 km/km^2 is used for open road and the majority of the Freegold Road will be restricted to only mine traffic and service vehicles.

In the Casino Wildlife Baseline Report (Appendix 12A), denning spatial analysis was conducted to quantify the area of suitable denning habitat within the grizzly bear study area. The methods used for this analysis are described in the baseline report. To determine Project effects on denning habitat, the baseline denning spatial analysis was conducted again to include the PDA. The change in denning habitat availability between baseline conditions and maximum disturbance was used to quantify the loss of denning habitat as a result of the Project.

Movement Effects Methods

To assess the effects on grizzly bear movement, a linkage zone prediction model was used. Linkage zones are areas that provide foraging habitat, connectivity between home ranges and avenues of dispersal (Riddell 2005) and are important for maintaining genetic diversity (Ruediger 2000). The Linkage Zone Prediction Model assesses a combination of landscape factors that affect wildlife movement through areas impacted by human activity (Purves and Doering 1998). It also identifies potential movement corridors in areas within intense human activity that still support high quality grizzly bear habitat. The output of this model is a scored map identifying four danger levels from human disturbance: minimal danger, low danger, moderate danger and high danger. Areas with a low danger rating represent potential linkage zones.

Linkage zone prediction models were developed for baseline conditions and for maximum disturbance conditions. The method for this analysis is further described in the Casino Wildlife Baseline Report (Appendix 12A). The amount of minimal danger area determines the availability of linkage zones and the change in linkage zones from baseline to maximum disturbance is used to determine the overall Project effects on grizzly bear movement.

Mortality Effects Methods

The Project's effects on direct mortality of grizzly bear were assessed qualitatively as the probability of increased mortality risk. This assessment included a literature review of mechanisms for grizzly bear mortality. Mechanisms for grizzly bear mortality include kills as a result of defence of life or property, vehicle collision and hunting. The 2013/2014 Yukon Hunting Regulations state that hunters are permitted to kill one grizzly bear every three license years. All GMSs that intersect the Project footprint are open to hunting. All cubs (bears less than three years old) and females with cubs are protected from hunting.

12.3.5.4 Potential Effects and Mitigation Measures for Grizzly Bear

General Project mitigation measures are described above in Section 12.3.2 (Mitigation Measures). Those measures address a number of potential impacts to all wildlife species and habitat. Grizzly bear-specific mitigation measures that are not addressed under general mitigation are described below, and in detail in the **Error! Reference source not found.** (Appendix 12C)

To reduce the Project effects on grizzly bears, CMC will mitigate the risk of increased mortality of grizzly bears by:

- Active bear dens, where they are known to occur, will be avoided during the denning period(November through to mid-May); Undiscovered site-specific features (e.g., active den sites) will be dealt with on a case-by-case basis during construction;
- Blasting will be avoided within 500 m of site of specific wildlife features (e.g., active den sites) when wildlife are likely to be present; and
- Incorporating Best Management Practices for food, waste and fuel management into the design on the Project.

Mitigation actions specific to reducing effects on grizzly bear are summarized in Table 12.3-21. Additional mitigations are included in the Wildlife Mitigation and Monitoring Plan (Appendix 12C).

Table 12.3-21 Proposed Mitigation Measures and Potential Residual Effects Specific to Grizzly Bear

Potential Effect	Project Phase (C, O, DC, PC)	Direction (Adverse/Beneficial)	Proposed Mitigation Measure (or Enhancement Measure)	Predicted Effectiveness (Low, Moderate, High, Unknown)	Residual Effect (Yes/No)
Denning habitat loss	C	Adverse	Active den sites will be avoided during the denning season (November to May) Blasting within 500 m of active bear dens will be avoided Active bear dens will be avoided on a case by case basis	Moderate	Yes
Mortality	C,O,DC	Adverse	Incorporating Best Management Practices for food, waste and fuel management into the design on the Project.	Moderate	Yes

12.3.5.5 Potential Residual Effects on Grizzly Bear

Grizzly bear were assessed within the spatial boundary of the PDA. Based on the determination of potential interactions between the Project and grizzly bear, and the effects from those interactions, Project effects on habitat availability, movement and mortality were identified for further assessment.

Habitat Residual Effects

Project effects on reduction of grizzly bear habitat, including habitat effectiveness, security areas, and denning habitat are shown in Table 12.3-22. Changes in habitat availability are shown by BMU, since this is an appropriate scale to measure the effects of habitat loss, alteration or degradation.

Results from the Habitat Effectiveness model indicates that, for the overall grizzly bear study area, the Project will result in a change in habitat effectiveness from -2% in spring, -1% in the summer and -1% in the fall from baseline conditions.

From the Security Areas modelling, the amount of secure habitat in the grizzly bear study area will be reduced by up to 286 km^2 — a reduction of approximately 3% of total secure habitat available at baseline conditions. The Project will result in a 0.19% decrease in suitable denning habitat in the overall grizzly bear study area.

Road densities for each BMU are also shown in Table 12.3-22. The road density within each BMU is less than the threshold of 0.16 km/km^2.

Indirect habitat loss, as a result of sensory disturbance during the foraging season, is reversible once the disturbance has stopped.

Movement Residual Effects

The Linkage Zone Prediction Model was used to assess Project effects on grizzly bear movement within the grizzly bear study area. During baseline conditions, the total minimal danger area (linkage zone) was 8,685 km^2 (97% of the grizzly bear study area). At maximum disturbance, the total minimal danger area (linkage zone) will be 8,596 km^2 (96% of the grizzly bear study area). The Project will result in a 1% reduction of linkage zone habitat within the overall grizzly bear study area, which is far below the threshold of 15% difference between baseline and maximum disturbance conditions. Therefore, the Project effect on grizzly bear movement is considered a low magnitude effect.

Mortality Residual Effects

Through the assessment of potential Project effects to grizzly bear mortality risk, and consideration of the proposed mitigation measures, it is expected that grizzly bear mortality, as a result of the Project, will be extremely low, but has the potential to occur. If a grizzly bear is killed as a direct result of the Project, adaptive management measures will be triggered, resulting in a review of practices and potential modifications to Project components.

Table 12.3-22 Change in Grizzly Habitat Quality Availability Due to Project Effects in the Grizzly Bear Study Area

	Habitat Effectiveness									*Security Areas*			*Denning Habitat*			*Road Densities (km/km²)*	
	Spring			**Summer**			**Fall**			**Percent of Secure Habitat in BMU**			**Percent of Suitable Denning Habitat in BMU**				
BMU	**Baseline**	**Max. disturb.**	**% change**	**Baseline**	**Max. disturb.**	**% change**	**Baseline**	**Max. disturb.**	**% change**	**Baseline**	**Max. disturb.**	**% change**	**Baseline**	**Max. disturb.**	**% Change**	**Baseline**	**Max. disturb.**
1	89%	89%	0%	100%	99%	-1%	90%	89%	-1%	93.43	91.48	-1.94	43.67	43.59	-0.08	0.04	0.04
2	92%	87%	-4%	100%	95%	-5%	92%	88%	-4%	97.87	88.32	-9.55	22.10	20.43	-1.67	0.02	0.05
3	91%	83%	-7%	100%	99%	-1%	91%	90%	-1%	100.00	84.40	-15.60	43.97	43.43	-0.54	0.00	0.10
4	82%	82%	0%	100%	100%	0%	83%	83%	0%	100.00	100.00	0.00	34.43	34.43	0.00	0.00	0.00
5	53%	53%	0%	100%	100%	0%	58%	58%	0%	100.00	99.67	-0.33	17.12	17.12	0.00	0.00	0.00
6	75%	73%	-2%	100%	99%	-1%	78%	77%	-1%	100.00	86.08	-13.92	32.58	32.48	-0.11	0.00	0.08
7	100%	100%	0%	100%	100%	0%	100%	100%	0%	98.51	98.51	0.00	9.72	9.72	0.00	0.00	0.00
8	92%	92%	0%	100%	100%	0%	92%	92%	0%	98.99	98.99	0.00	12.70	12.70	0.00	0.00	0.00
9	73%	73%	0%	100%	100%	0%	75%	75%	0%	100.00	100.00	0.00	32.95	32.95	0.00	0.00	0.00
10	58%	58%	0%	100%	100%	0%	62%	62%	0%	100.00	100.00	0.00	12.41	12.41	0.00	0.00	0.00
11	60%	59%	-1%	99%	99%	-1%	65%	64%	-1%	97.96	90.82	-7.14	17.18	17.12	-0.06	0.01	0.06
12	94%	94%	0%	100%	100%	0%	94%	94%	0%	99.72	99.72	0.00	10.43	10.43	0.00	0.00	0.00
13	97%	97%	0%	97%	97%	0%	97%	97%	0%	84.86	84.86	0.00	9.07	9.07	0.00	0.08	0.08
14	51%	51%	0%	100%	100%	0%	58%	58%	0%	100.00	100.00	0.00	14.35	14.35	0.00	0.00	0.00
15	55%	55%	0%	100%	100%	0%	59%	59%	0%	100.00	100.00	0.00	2.36	2.36	0.00	0.00	0.00
16	93%	92%	0%	100%	99%	-1%	93%	92%	-1%	83.90	83.32	-0.58	5.35	5.30	-0.05	0.11	0.14
17	75%	75%	-1%	99%	98%	-1%	76%	76%	0%	90.93	89.70	-1.22	27.22	26.91	-0.31	0.06	0.09
18	64%	64%	0%	99%	99%	0%	67%	67%	0%	92.82	92.82	0.00	3.56	3.56	0.00	0.04	0.04
19	72%	72%	0%	100%	100%	0%	73%	73%	0%	80.79	80.79	0.00	4.13	4.13	0.00	0.12	0.12
20	92%	92%	0%	100%	100%	0%	92%	92%	0%	86.90	84.12	-2.78	7.44	7.34	-0.10	0.09	0.15
Total	78%	77%	-1%	100%	99%	-1%	80%	79%	-1%	95.48	92.27	-3.20	18.74	18.55	-0.19	0.03	0.05

12.3.5.6 Significance of Residual Effects for Grizzly Bear

Through the assessment of potential effects on grizzly bear, it was determined that the proposed Project will result in not significant adverse effects on grizzly bear. The assessment was based on a thorough assessment of the effects to measurable ecological parameters for grizzly bear.

Significance of Effects on Habitat and Movement

It is expected that the Project will have effects on grizzly bear, particularly through the loss of grizzly bear habitat. However, due to the conservative approach taken throughout the assessment, the reduction of grizzly bear habitat is likely over estimated and although habitat loss will occur, it is below all identified thresholds. Through implementation of the proposed mitigations, such as reducing the Project footprint, effects to habitat availability will be minimized to the extent possible.

The residual effects on grizzly bear are summarized in Table 12.3-22. The total security and denning habitat lost as a result of this Project are 286 km² (3%) and 17 km² (0.19%), respectively. The effect of the Project on grizzly bear habitat is not significant at the scale of the grizzly bear study area. However, due to the lack of grizzly bear population data in the overall grizzly bear study area, the confidence in this prediction is moderate.

Significance of Effects on Mortality

Project-related mortality will be minimized through proper food and garbage management, implementation of wildlife Right-of-Way and No Hunting Policies, and by restricting access on the Freegold Road. Residual Project effects on grizzly bear mortality are not expected. If mortality does occur, it will be limited to individuals within the PDA. The effect of the Project on grizzly bear mortality is not significant at the scale of the grizzly bear study area. Although the consideration of mechanisms of increased grizzly bear mortality and commitment of mitigation actions suggest a high confidence in this prediction, some uncertainty exists regarding grizzly bear population size and the legality of CMC operating and managing a private industrial road, therefore, there is moderate confidence in this prediction. The significance of Project residual effects on grizzly bear are summarized in Table 12.3-23.

Table 12.3-23 Significance of Residual Effects – Grizzly Bear

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat effectiveness	Adverse	Low	Localized	Long term	Frequent	Irreversible	Low resilience	Moderate	Not significant
Security habitat	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
Denning habitat	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
Linkage habitat	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
Mortality risk	Adverse	Low	Localized	Long term	Infrequent	Reversible	Low resilience	Low	Not significant

Note
Criteria definitions are detailed in Table 12.1-4

12.3.5.7 Follow-up Monitoring for Grizzly Bear

Some of the key information needs for bears include response to Project roads and road traffic, distribution and abundance in the RSA, and updating habitat use as more data become available and that analyses is relevant to Project mitigation and management. Initial monitoring goals will be to test effects predictions that were made with moderate to weak confidence, and collect information that is relevant to further monitoring triggers. General monitoring initiatives for wildlife and specific initiative for bears are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC is committed to supporting any further studies of bears in the Project area. CMC will conduct facility-wide monitoring for the presence of grizzly bear through the life of the Project.

12.3.6 Collared Pika Effects Assessment

12.3.6.1 Baseline Summary

Collared pika is a small, alpine-dwelling lagomorph that exists in relatively discrete populations in the Yukon, Northwest Territories, and British Columbia. Pika forage primarily on fresh alpine forbs and grasses during the summer months and stockpile this vegetation in bunches under boulders for the winter months (COSEWIC 2011b). They were federally listed under SARA as Special Concern in 2011, largely due to their inherent vulnerability to climate warming (COSEWIC 2011b).

During baseline studies, pikas were observed primarily in alpine habitats where they were located in small boulder fields (felsenmeer) on moderately steep slopes, adjacent to areas of herbaceous alpine vegetation (Appendix 12A).

12.3.6.2 Potential Project Interactions with Collared Pika

The Freegold Road Upgrade and extension is primarily located in low river valleys, and the alpine sections from the Selwyn River to the mine site generally does not intersect habitats suitable for the collared pika. As such, the road is unlikely to interact with suitable pika habitat. The mine site is the main Project component to interact with pika habitat, as it is largely located in subalpine and alpine habitats and is in relatively close proximity to known pika ranges (Appendix 12A).

Collared pika habitat is naturally fragmented, occurring in relatively small, discrete patches of talus habitat (Morrison and Hik 2008). A unique suite of habitat features defines suitable pika habitat including presence of boulder (e.g., talus) patches, rock size (medium to large), distance to meadows (usually less than 10 m), aspect (often south-facing), and elevation (generally between 700 and 1,800 m; COSEWIC 2011b). As a result of these specific habitat requirements, collared pikas are vulnerable to habitat changes.

Pikas could be killed by Project activities, such as collisions on the road; however, this is highly unlikely due to the lack of overlap of Project infrastructure with suitable pika habitat. Although the Project could interact with pika mortality, this risk cannot be adequately assessed due to the lack of information regarding current populations and a relatively poor link between Project effects and pika mortality.

12.3.6.3 Effects Assessment Methods for Collared Pika

The assessment of Project effects on collared pika was based on potential Project effects to habitat. The measureable parameter for this effect was area (km²) of suitable habitat. To assess potential Project effects on this parameter, a combination of baseline studies, literature review, and desktop analyses were performed.

Spatial and Temporal Boundaries

The scope of the assessment for collared pika is limited to areas of suitable habitat within the LSA (Figure 12.1-1). The LSA includes the length of the Freegold Road Extension plus a roughly 1 km buffer on either side of the road alignment. The 1 km buffer was used for terrestrial ecosystem mapping and all terrain polygons within the 1 km buffer were mapped and vegetation types assigned to the polygon's extent, often outside of the 1 km buffer. Surrounding the mine site, the LSA encompasses the watersheds of Britannia Creek and its tributary Canadian Creek, as well as upper Dip Creek and its tributary Casino Creek. The Yukon River defines the northern boundary of the LSA. The LSA encompasses an area that is 886.36 km².

Although pikas remain active during winter months, they do not surface above the snow until spring. The Project is most likely to interact with pika during the snow-free months, when they are actively foraging on alpine vegetation.

Criteria for Significance

Habitat availability — There are no prescribed thresholds for evaluating the Project's effects on available collared pika habitat. In the absence of thresholds, the assessment considers the distinct suite of habitat features used by pikas and its inherent vulnerability to habitat alteration, as mentioned above.

For most bird and mammal species, evidence suggests that with less than 10–30% of remaining suitable habitat, habitat fragmentation compounds the effects of habitat loss on population size (Andrén 1994; Swift and Hannon 2010). Similar to the habitat thresholds for caribou, these values largely consider the population viability or persistence of a species, which is not considered to be a conservative approach to effects assessment. Persistence and viability suggests that population decline is acceptable as long as the herd persists. These thresholds can provide a parameter for evaluating the magnitude of the Project's effects to habitat; however, they must be adjusted to reflect a more conservative approach. In consideration of this evidence and to reflect the inherent variability in these values (e.g., differences between species, landscapes, and population status) a difference of 15% from baseline to maximum disturbance (i.e. 85% residual habitat) is considered a high magnitude effect (Table 12.3-24). This threshold reflects a very conservative approach to the assessment. The context for the assessment of Project effects on collared pika is the habitat available within the LSA.

Table 12.3-24 Thresholds for Project Effects to Suitable Collared Pika Habitat

Magnitude of Effect	Total Range Disturbance Threshold
Low	0–10%
Moderate	10–15%
High	>15%

Habitat Effects Methods

To assess potential Project effects on suitable pika habitat, direct habitat loss was quantified by calculating the area of suitable habitat lost to the PDA. Suitable habitat was quantified in Appendix 12A. Habitat suitability indices (HSI) were assigned to habitat variables based on a review of literature and comparing the proportion of pika observations to the proportion of available suitable habitat.

12.3.6.4 Potential Effects and Mitigation Measures for Collared Pika

General Project mitigation measures are described above in Section 12.3.2 (Mitigation Measures). These measures address a number of potential impacts to all wildlife species and habitat. The general mitigation measures will address potential effects to pika, especially measures that aim to reduce the Project footprint and unnecessary sensory disturbances. There are no additional species-specific mitigation measures suggested for collared pika.

12.3.6.5 Potential Residual Effects on Collared Pika

Habitat Residual Effects

There will be a direct, permanent loss of 1.78 km² of suitable collared pika habitat in the LSA (Table 12.3-25). This translates to a total change of 5.73% from baseline conditions and is considered a residual effect because this habitat will not be reclaimed within a generation of pika.

Table 12.3-25 Change in Collared Pika Habitat Quality Due to Project Effects in the LSA

Habitat	Baseline (km²)	Loss to PDA (km²)	Maximum Disturbance (km²)a	% Changeb
Suitable	31.07	1.78	29.29	5.73

Notes:
Maximum disturbance represents remaining habitat once habitat loss to PDA is accounted for.
% change is the difference in habitat conditions at maximum disturbance from baseline conditions.

12.3.6.6 Significance of Residual Effects for Collared Pika

Project-related effects to suitable collared pika habitat will occur; however, the loss to the PDA may be over-estimated because the PDA represents the maximum area of development. By reducing the Project footprint and avoiding known pika habitat where possible, effects to habitat can be minimized.

Residual effects of the Project on collared pika habitat are quantified in Table 12.3-25. The area of suitable habitat within the LSA that will be directly lost totals 1.78 km². The effect of the Project on suitable pika habitat is not significant at the scale of the LSA, as the loss is within the identified low threshold (Table 12.3-24). In consideration of uncertainty due to natural regimes (e.g., climate warming), the confidence in this prediction is moderate.

The significance of residual effects of the Project on collared pika is summarized in Table 12.3-26.

Table 12.3-26 Significance of Residual Effects – Collared Pika

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat availability (loss)	Adverse	Low	Localized	Permanent	Infrequent	Reversible	Low resilience	High	Not significant

12.3.6.7 Follow-up Monitoring for Collared Pika

There are no key data gaps for collared pika. Initial monitoring goals will be to test effects predictions that were made with moderate to weak confidence, and collect information that is relevant to further monitoring triggers. General monitoring initiatives for wildlife and specific initiative for collared pika are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC is committed to supporting any further studies of collared pika in the Project area. CMC will conduct facility-wide monitoring for the presence of collared pika through the life of the Project.

12.3.7 Passerine and Bird Species at Risk Effects Assessment

12.3.7.1 Baseline Summary

The Project area includes a wide variety of habitats ranging from alpine peaks to forested valley bottoms. A diverse assemblage of bird species inhabit the area including raptors, grouse, ptarmigan, shorebirds, kingfisher, woodpeckers, and a variety of passerine (songbird) species such as flycatchers, shrikes and vireos, jays and crows, swallows, chickadees, kinglets, thrushes, waxwings, warblers, sparrows, blackbirds and finches. Baseline surveys for birds were conducted within the LSA in 2010, 2011, and 2013 which documented the presence of 82 bird species within the Project area.

Passerine species comprised the majority (>90%) of the survey observations. The most common passerine species detected during point count surveys included dark-eyed junco, myrtle warbler, American robin, white-crowned sparrow, Lincoln's sparrow, and Swainson's thrush. However, species distributions varied greatly across habitat types and elevation. In general, higher elevation habitats showed lower bird densities and lower species diversity than valley bottom habitats. Forested habitats had some of the highest bird density and diversity, but the richest habitats were usually associated with riparian features (e.g. riparian forest and riparian shrub habitats).

The Project area contains several bird species at risk that have been documented present or are likely to occur based on regional survey data or known distributions within the Yukon. Eight species are listed as at risk, either by COSEWIC or SARA — horned grebe, peregrine falcon, common nighthawk, short-eared owl, olive-sided flycatcher, bank swallow, barn swallow, and rusty blackbird. The Project area also contains several additional species of conservation concern that are listed on the Yukon Conservation Data Centre's track list and/or identified as priority species for conservation under the recent bird conservation strategy for Bird Conservation Region 4.

12.3.7.2 Potential Project Interactions with Passerine Species and Bird Species at Risk

Section 12.3.1 identifies all Project components and activities that interact with wildlife KIs; the current discussion focuses on the key issues related to passerine birds and bird species at risk. Project infrastructure and activities are expected to interact with these species primarily through the loss of available habitats caused by land clearing and sensory disturbance. There is also a potential for increased risks to the health and mortality of birds, but the risk is expected to be limited to particular sites in the PDA.

- The risk of mortality to nesting birds and the destruction of nests as a result of land clearing activities will be addressed through mitigation, specifically, wherever possible, clearing will occur outside of the nesting season; if clearing must occur during the nesting season, pre-clearing nest surveys will be conducted and any active nests located will be protected.
- Bird mortality due to collisions with Project vehicles or Project infrastructure is possible, but is not expected to occur in large enough numbers to significantly affect local populations.

Therefore the effects assessment for passerine species and bird species at risk will focus on effects to habitat.

Habitat loss is the result of areas becoming unavailable for use by birds. It can occur in one of two ways. Direct habitat loss occurs when areas are physically altered by Project activities such that the habitat itself is changed. Indirect habitat loss occurs when Project activities result in sensory disturbance to birds (through noise, visual, or physical disturbances etc.) and result in birds avoiding areas close to the Project footprint. The area within which indirect habitat effects occur is often referred to as the zone of influence (ZOI).

Responses to sensory disturbance vary greatly among various bird species; as a result, effects to the overall bird community can be hard to predict, but may include a decrease in overall bird densities within the ZOI, and/or a shift in the species composition. Research into the ecological effect of exurban development in forested regions within Colorado and New England has found a 180 m and a 200 m ZOI around homes (respectively) within which the bird community has been altered — in general, the occupancy rates of generalist species that adapt well to human presence (human-tolerant or human-adapted species) are higher within the ZOI, while occupancy rates of more sensitive species are lower within the ZOI as compared to the surrounding areas (Odell and Knight 2001, Glennon and Kretser 2013). Studies into the effects of chronic industrial noise resulting from compressor stations in the boreal forests of Alberta have found that songbird densities are significantly lower within 300 m of compressor stations, and that approximately one third of species show reduced abundance out to 700 m from compressor sites (Bayne et al. 2008). Also in Alberta, Habib et al. (2007) found that the chronic industrial noise from compressor stations has a detrimental effect on the pairing success of ovenbirds within 200 m; in addition, they found a higher occurrence of younger first-time breeders, possibly indicating lower habitat quality near compressor stations. The effects of roads and road traffic on bird habitat use adjacent to the roads have primarily been studied on larger, paved roads. In the Netherlands, Reijnen et al. 1997 estimated the maximum size of the ZOI for a road with 10,000 vehicles per day in woodland habitats to be up to 305 m for certain species and 125 m for all species combined, and in open grassland habitats to be 365 m and 190 m for certain species and all species combined respectively.

In a study of nest site selection and nest survival of rusty blackbirds in relation to forest harvesting, Powell et al. (2010) found that rusty blackbird nests within areas not recently harvested were 2.3 times more likely to fledge young than nests in areas that had been harvested within 20 years.

12.3.7.3 Effects Assessment Methods for Passerines and Bird Species at Risk

The assessment of Project effects on passerine species and bird species at risk is based on potential Project effects to habitat. The measureable parameter for this effect was area (km²) of suitable habitat.

Spatial and Temporal Boundaries

The assessment of Project effects on passerine and bird species at risk habitats is focussed on the bird Local Study Area (LSA; Figure 12.1-1). The LSA contains the Project footprint and a buffer around Project facilities. Around the mine site, the LSA encompasses the watersheds of Britannia Creek and its tributary Canadian Creek, as well as upper Dip Creek and its tributary Casino Creek. Along the Freegold Road Extension, the study area includes the proposed road alignment plus a 1 km buffer on either side of the road. In total, the LSA encompasses an area of approximately 886 km².

With a few exceptions (e.g. gray jays, chickadees, some finches, etc.), the passerine and bird species at risk found in the Project area are present only during the summer months. The majority of the passerine migrants arrive in May, breeding occurs during June and July, and fall migration begins in late July or early August and is complete for most species by the end of September. Although there is some potential for Project interaction with migrating birds, the assessment focusses on the effects to breeding habitats during the months of June, July and August.

Criteria for Significance

Habitat availability — There are no prescribed thresholds for evaluating the Project's effects on bird habitats. For most bird and mammal species, evidence suggests that with less than 10–30% of remaining suitable habitat, species population size will be affected (Andrén 1994; Swift and Hannon 2010). In consideration of this evidence and to reflect the inherent variability in these values (e.g. differences between species, landscapes, and population status) a difference of 15% from baseline to maximum disturbance (i.e. 85% residual habitat) is considered a high magnitude effect (Table 12.3-27). This threshold reflects a very conservative approach to the assessment.

Table 12.3-27 Thresholds for Project Effects to Passerine and Bird Species at Risk Habitat

Magnitude of Effect	Habitat Disturbance Threshold
Low	0–10%
Moderate	10–15%
High	>15%

Habitat Effects Methods

The assessment of potential Project effects on passerine and bird species at risk was done in two stages. First, a qualitative assessment was conducted to identify those species at risk which could potentially interact with the Project and for which habitat modelling was possible given the available data. Second, habitat suitability models were developed for passerine birds as a group, and for the selected species at risk. For each species or species group, the available habitat was summarized for each of four ratings classes (High, Medium, Low, and Nil). Habitat suitability modelling methods and results are detailed in Appendix 12B. Direct habitat loss was quantified by calculating the area of available habitat within the PDA. It was assumed that habitats within the PDA will

become completely unavailable to birds (i.e. Nil value). Indirect habitat loss as a result of sensory disturbance was quantified using a ZOI approach. Based on the literature described above, a 300 m ZOI was applied to all Project components; within the ZOI, the habitat ratings were decreased by one class to a minimum of Low (i.e. High becomes Medium, Medium and Low become Low, Nil remains as Nil). The resulting habitat values at maximum disturbance were then summarized and compared to the baseline values.

12.3.7.4 Potential Effects and Mitigation Measures for Passerine Species and Bird Species at Risk

General Project mitigation measures are described Mitigation Measures for Wildlife in Section 12.3.2 (Mitigation Measures) and in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). These include several mitigation measures aimed at addressing potential impacts to all bird species and habitat. These include measures to reduce the Project footprint and unnecessary sensory disturbances; to, whenever possible, conduct land clearing outside of the nesting season; and if clearing must occur during the nesting season, to conduct pre-clearing nest surveys and protect active nests.

To protect nest sites themselves, there is a directive to clear outside of the bird nesting season, and if not possible, to conduct active migratory bird nest surveys and protect nests until fledging.

Specific mitigation measures that address potential effects to habitat availability for passerine species and bird species at risk are described below.

- Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen etc.).
  - In addition to protecting rusty blackbirds, the 100 m buffer will also benefit other species at risk which may be nesting (e.g. horned grebe) or foraging (e.g. bank swallow and common nighthawk (if present)) in these habitats. Furthermore, the 100 m buffer will help maintain riparian shrub and riparian forest communities which were identified as high value habitats for passerine species as a group.
- Dust suppression methods will be employed along roads during dry summer periods to reduce effects on passerine habitat (this is a general mitigation action applicable to habitats of many wildlife Key Indicators).

Mitigation actions specific to reducing effects on passerine and bird species at risk are summarized in Table 12.3-28.

Table 12.3-28 Proposed Mitigation Measures and Residual Effects Specific to Passerine and Bird Species at Risk

Potential Effect	**Project Phase** (C, O, DC, PC)	**Direction** (Adverse/Beneficial)	**Proposed Mitigation Measure** (or Enhancement Measure)	**Predicted Effectiveness** (Low, Moderate, High, Unknown)	**Residual Effect** (Yes/No)
Habitat loss	C	Adverse	Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen etc.).	Moderate	Yes

12.3.7.5 Potential Residual Effects on Passerine Species and Bird Species at Risk

Preliminary Assessment

The preliminary assessment (Table 12.3-29) determined that a habitat assessment was suitable to assess impacts to passerine bird species as a group, and to four of the potential bird species at risk: horned grebe, short-eared owl, olive-sided flycatcher and rusty blackbird. Of the remaining species at risk, the preliminary assessment determined that peregrine falcon was better assessed based on known nest sites since Project interactions are likely to have the highest effect at active nests and because the available topographic data is not detailed enough to pick up many of the habitats that cliff-nesting raptors are nesting on within the LSA. Common nighthawk and barn swallow are considered unlikely to interact with the Project given that the species have not been documented in the LSA, and that the study area is at the northern extent of both of their ranges. Bank swallow have been observed foraging in the Project area, but no nesting colonies have been located within the LSA. There is a possible colony located just outside the LSA; however, the colony is located more than 1 km from Project infrastructure and is unlikely to interact with the Project. Additionally, the available habitat data for the LSA is not detailed enough to delineate suitable nesting habitats for bank swallow (gravel, silt, or clay banks along roadsides, gravel pits, lakes and rivers). Effects on bank swallow are best addressed through site-specific mitigation measures for the protection of any nesting colonies, if any are located within the LSA.

Table 12.3-29 Preliminary Effects Assessment of Bird Species at Risk within the Project Area

Species	Potential for Interaction with the Project?	Carried Forward for Detailed Assessment Y/N
Passerine species	Likely — breeding has been confirmed for various passerine species within the Project area.	Yes — Habitat assessment conducted.
Horned grebe	Possible — Species has been observed in suitable nesting habitat within the LSA during the breeding season.	Yes — Habitat assessment conducted.
Peregrine falcon	Likely — Peregrine falcon was confirmed breeding in the LSA and was noted annually during baseline surveys in the Project area.	Yes — Impacts to known nest sites assessed under cliff-nesting raptors — see Section 12.3.8.
Common nighthawk	Unlikely — Common nighthawk was not observed in the Project area and the LSA is at the northern extent of its breeding range (Sinclair et al. 2003).	No — If present, the species will be protected by general mitigation measures for birds (e.g. avoidance of clearing during the breeding season; if unavoidable, then pre-clearing nest surveys). If nests are found they will be addressed through site-specific management and nest avoidance.
Short-eared owl	Possible — Short-eared owl has been documented foraging near the proposed mine during the breeding season, but nesting has not been confirmed.	Yes — Habitat assessment conducted.
Olive-sided flycatcher	Likely — Species was detected regularly during breeding bird surveys in the Project area.	Yes — Habitat assessment conducted.
Bank swallow	Possible – A possible nesting colony is located just outside the LSA and a few bank swallows have been documented foraging over aquatic habitats in the LSA, but no nesting colonies have been located within the LSA.	No — Possible nesting colony outside the LSA is >1 km from proposed development and shouldn't be affected. If additional colonies are present in the LSA, they will be addressed through site-specific management and nest avoidance.
Barn swallow	Unlikely — Species has not yet been documented in the LSA and is only occasionally found in central Yukon (Sinclair et al. 2003).	No — Project may actually enhance opportunities for barn swallow since the species prefers nesting on buildings and other anthropogenic structures, and will forage in human-modified openings in the landscape (COSEWIC 2011).
Rusty blackbird	Likely nesting habitats in several locations within the LSA.	Yes — Habitat assessment conducted.

Habitat Residual Effects

A quantitative assessment of habitat effects was conducted for passerine species, horned grebe, short-eared owl, olive-sided flycatcher and rusty blackbird (Table 12.3-30). The habitat assessments indicated that the PDA will result in a direct loss of approximately 70 km^2 or 7.9% of the LSA. For the various species and species groups assessed, the PDA will directly affect 6% of the high value passerine habitat in the LSA, 4% of high value horned grebe habitat, 2% of high value short-eared owl habitat, 8% of high value olive-sided flycatcher habitat, and 5% of high value rusty blackbird habitat. This loss is considered to be a residual effect since the habitat will not be reclaimed within a generation of these bird species.

Habitat effectiveness will also be reduced in the areas immediately surrounding the PDA as a result of sensory disturbance. Based on the habitat models, an additional 28% of high value passerine habitats, 37% of high value horned grebe habitats, 7% of high value short-eared owl habitats, 21% of high value olive-sided flycatcher habitats, and 33% of high value rusty blackbird habitats within the LSA may be indirectly affected. This results in a total percent change in high value habitats of 35% for passerine species, 41% for horned grebe, 9% for short-eared owl, 29% for olive-sided flycatcher, and 39% for rusty blackbird as compared to baseline conditions. At first glance, these numbers appear quite high; however, several points need to be kept in mind:

- The majority of the habitat effects occur within the ZOI; habitats within the ZOI are not expected to be completely lost but may experience a variety of indirect effects that will reduce the suitability of the habitats (e.g. high value to medium value).
- The effect of the ZOI is not permanent and indirect effects will cease as soon as operations are complete and sensory disturbances are diminished.
- Habitat loss loss to the PDA may be over-estimated since the PDA represents the maximum area of development and it is likely that some bird habitat will remain intact within this area.
- The assessment compares the affected habitats to available habitats only within the LSA, an 886 km^2 study area including the area around the mine plus a 1 km buffer on the proposed Freegold extension. This is a relatively small area in relation to the larger region — e.g. the Klondike Plateau and the Yukon Plateau-Central Ecoregions within which the LSA is located encompass areas of 38,471 km^2 and 26,803 km^2 respectively (Yukon Ecoregions Working Group 2004). It is assumed that suitable habitats for each of the species/species groups assessed also occur in similar environments throughout the region.

Table 12.3-30 Change in Passerine Species and Bird Species at Risk Habitat Quality Due to Project Effects in the LSA

Habitat Quality	Baseline Conditions	Conditions at Maximum Disturbance			
	Available Habitat (km²)a	**Loss to PDA (km²)**	**Reduced effectiveness in ZOI (km²)**	**Available habitat (km²)b**	**% changec**
Passerines					
Nil	4.72	+69.85	--	74.57	--
Low	14.97	-0.61	+77.65	92.01	+515%
Medium	730.29	-61.05	-49.54	619.70	-15%
High	136.38	-8.19	-28.11	100.08	-27%
Horned Grebe					
Not Suitable	886.02	+0.01	+0.10	886.13	--
Suitable	0.27	-0.01	-0.10	0.16	-41%
Short-eared Owl					
Nil	4.65	+69.85	--	74.50	--
Low	803.06	-65.94	+12.45	749.51	-7%
Medium	57.86	-3.44	-11.09	43.33	-25%
High	20.39	-0.47	-1.37	18.55	-9%
Olive-sided Flycatcher					
Nil	4.72	+69.85	--	74.57	--
Low	340.58	-24.93	+37.66	353.31	+4%
Medium	343.90	-30.25	+1.21	314.86	-8%
High	197.16	-14.68	-38.87	143.61	-27%
Rusty Blackbird					
Nil	826.28	+3.65	--	829.93	--
Low	56.59	-3.47	0	53.12	-6%
Medium	0.00	0.00	+1.15	1.15	+
High	3.45	-0.18	-1.15	2.12	-39%

Notes:
The total area of the LSA is approximately 886 km2
Available habitat at maximum disturbance is a combination of the habitat loss to PDA and reduced effectiveness in the ZOI
% change is the difference in habitat conditions at maximum disturbance from baseline conditions.

12.3.7.6 Significance of Residual Effects for Passerines and Bird Species at Risk

Project-related effects to habitat for passerines and bird species at risk will occur at the level of the LSA; however, these effects are limited to the local study area. Within the LSA, direct habitat loss for all species/species groups assessed is less than 10%, the threshold set for low significance (Table 12.3-27), although the combined habitat effect from direct and indirect loss exceeds these thresholds. The majority of habitat effects within the LSA are indirect effects within 300 m of the PDA as a result of sensory disturbance. To help mitigate some of these effects, a minimum 100 m buffer will be maintained between Project infrastructure and any ponds or open-water wetlands wherever feasible given the terrain and other site-specific features. Ultimately, the identified habitat effects at the level of the LSA are not expected to result in significant effects to regional populations given the small size of the LSA in relation to the local ecoregions. However, due to uncertainty regarding the habitat availability for species at risk within the larger region and in consideration of uncertainty due to natural regimes (e.g. climate warming), the confidence in this prediction is moderate.

The significance of residual effects of the Project on passerine birds and birds species at risk are summarized in Table 12.3-31

Table 12.3-31 Significance of Residual Effects on Passerines and Bird Species at Risk

Residual Effect	Predicted Degree of Effect After Mitigation Measures								Significance of Residual Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat availability (direct loss)	Adverse	Low (less than 10% of high quality habitats lost to PDA)	Localized	Permanent	Infrequent	Reversible	High resilience	Moderate	Not significant
Habitat availability (reduced effectiveness)	Adverse	High within the LSA, but Low within the region	Localized	Long term	Frequent	Reversible	High resilience	Moderate	Not significant

Criteria definitions are detailed in Table 12.1-4

12.3.7.7 Follow-up Monitoring for Passerine Species and Bird Species at Risk

There are some data gaps in regional abundance of passerines and bird species at risk. General monitoring initiatives for wildlife and specific initiatives to protect nests of passerines and bird species at risk outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). There are no Project-specific follow-up monitoring plans targeting passerines or bird species at risk.

12.3.8 Cliff Nesting Raptors Effects Assessment

12.3.8.1 Baseline Summary

Cliff-nesting raptors in the Casino Project area include peregrine falcon, gyrfalcon and golden eagle. Within Canada, peregrine falcon is listed federally as a species of Special Concern (COSEWIC 2012), and is included on Schedule 1 of the *Species at Risk Act* (Environment Canada 2012); in the Yukon, peregrine falcon populations are considered to be Vulnerable (Yukon Conservation Data Centre 2012). Additionally, both peregrine falcon and golden eagle have been identified as priority species for conservation under the bird conservation strategy for Bird Conservation Region (BCR) 4.

All three species typically nest on cliff ledges: golden eagle construct large stick nests, typically on south-facing cliffs, usually associated with tundra areas or river outwash plains. Gyrfalcons are normally found nesting on cliffs above treeline and peregrine falcons usually nest on cliffs overlooking a water body (Sinclair et al. 2003). Both gyrfalcon and peregrine falcon do not build their own nest structures, but instead will nest in a scrape on a cliff ledge or in an abandoned stick nest of species like golden eagle or common raven (Sinclair et al. 2003). Raptors are well-known to reuse nest sites. Nest reuse can either be by the same pair of birds or multiple pairs and can

extend for generations or sometimes even centuries. Studies on gyrfalcons have found cases of nest sites used for over 1,000 years (Burnham et al. 2009).

Within the Casino Project area, the nest sites of cliff-nesting raptors are known from three sources:

- Raptor nest locations identified and monitored during Yukon Environment's raptor surveys conducted during the late 1970s and early 1980s (hereafter referred to as historic sites) — 16 historic nests sites of cliff-nesting raptors are located within 5 km of the proposed Project;
- Project aerial surveys for raptors conducted in May and June 2010 in the proposed mine area and along parts of the Freegold Road Extension — surveys identified 17 nests and possible nests; and
- Project aerial survey for cliff-nesting raptors in June 2013 within 2–3 km of the Freegold Road Extension and the proposed mine infrastructure; the survey revisited all of the nests and potential nest sites identified in 2010 as well as any of the historic nest sites located within 3 km of the proposed Project (excluding those along the existing Freegold Road).

In total, 20 potential nest sites (recent and historical) were located within 5 km of the Project (Appendix 12B); however, the 2013 survey determined that a few of the potential nest sites identified in 2010 were likely just perch sites, and while some of the historic sites could not be located during 2013, several additional sites located in 2010 and 2013 are within a few kilometers of these previous nests. Assuming that the historical nest sites not surveyed during 2013 still exist, surveyors estimate that there are approximately 12 nest sites located within the RSA — six around the proposed mine site and Yukon River access road, and six along the proposed Freegold Road Extension. These nests are located on cliff faces, rocky outcrops and tors in the study area. Nest occupancy during baseline surveys in the Project area was relatively low; of the eight nest sites surveyed in 2013 only two were active or showed evidence of having been active that year.

12.3.8.2 Potential Project Interactions with Cliff-Nesting Raptors

Section 12.3.1 identifies all Project components and activities that interact with wildlife KIs. This discussion focuses on the key issues related to potential Project interactions with cliff-nesting raptors. Potential interactions include the loss of nesting and foraging habitats, and risks to the health and mortality of individual birds; however, foraging habitat is assumed to be abundant, and the risk to the heath and mortality of birds is expected to be limited. Therefore, the primary Project interaction with cliff-nesting raptors is expected to be effects on specific nest sites including potential loss of nest sites and disturbance to nesting birds.

Sensory disturbance to cliff-nesting raptors may result from blasting and mining operations, vehicles, aircraft, and visual disturbance from the presence of humans and human developments. Disturbed birds can react in several different ways, depending on the proximity and magnitude of the disturbance, the species, and the individual pair, but tend to be most sensitive during the breeding season, particularly during the nest initiation and nestling stages (Fyfe and Olendorff 1976, Cade et al. 1996, Environment Canada 2007b). Responses to disturbance include agitation, increased alertness, vocalizing, flushing from a nest resulting in interruptions to incubation and brooding that can cause thermoregulation stresses to eggs or nestlings, and ultimately, nest abandonment. Steidl et al. (1993) found that adult golden eagles spent less time at nests and fed young less frequently when observers camped 400 versus 800 m from nests in Alaska. Birds disturbed by human activity may also be more likely to move to alternate nests or not breed the following year (Fyfe and Olendorff 1976, Platt 1977, Harmata 2002, Environment Canada 2007b).

Protective buffers zones of various sizes have been suggested for cliff-nesting raptor species by various authors. Richardson and Miller (1997) determined mean distances of 500 to 1,000 m for mid to large sized raptors in a

review of recommended buffer zones for nesting raptors including a mean of 800 m for both peregrine falcon and golden eagle. Steidl et al. (1993) also recommended no human activity within 800 m of occupied golden eagle nests. BirdLife International's International Species Action Plan for Gyrfalcon (BirdLife International 1999) recommended a 1 to 3 km buffer on gyrfalcon nests depending on the surrounding terrain. Holthujzen et al. (1990) recommended a buffer distance between prairie falcon nests and mine blast sites of only 125 m, but in the United States, most states have peregrine management plans that prescribe protective buffers ranging between 150–800 m although one recommends 4,800 m (U.S. Fish and Wildlife Service 1982; Ellis 1982; Hayes and Buchanan 2002). Fyfe and Olendorff (1976) suggested that aircraft should not approach closer than 500 m above a nest.

Some raptors have been shown to be relatively tolerant of human disturbance. Peregrine falcons have been seen nesting on artificial structures in high traffic areas, e.g., concrete ledges on city buildings and bridges (Cade and Bird 1990), smokestacks (Cade et al. 1994) and power generating stations (Septon 1994). Breeding falcons have also demonstrated a certain degree of tolerance to mining and blasting activities, as evidenced by the successful nesting of both peregrine falcons and gyrfalcons on the open pit walls at the Ekati diamond mine in the NWT (Independent Environmental Monitoring Agency (IEMA) 2013). Holthuijzen et al. (1990) experimentally examined the influence of blasting noise at mines on the prairie falcon (closely related to the peregrine falcon), and recorded no observable effects to 140 dB blasts occurring 500–1,000 m from nests. Blasts in the range of 250–500 m flushed adults from their nests but the average recorded return time to the nest was only 1.4 min after a blast. Palmer et al. (2003) found that noise disturbance to peregrine falcons from jet aircraft over-flights 150 m above nests affected peregrine activity budgets and nest attendance patterns but did not affect overall food provisioning rates to nestlings. Ellis et al. (1991) found peregrine falcons to be tolerant of aircraft noise levels between 85–140 dB and while low level jet flights (<1,000 m) caused a flight response in some pairs, nest abandonment or reproductive failure did not occur.

Habituation to non-threatening disturbance (e.g., haul trucks regularly passing by a nest site) may occur that will further reduce impacts to raptor behaviour, distribution, and abundance, although it may take several years to occur (Ratcliffe 1962). Remotely located pairs that have little to no experience with disturbance from human activities are most reactive to human intrusions (White et al. 2002).

12.3.8.3 Effects Assessment Methods for Cliff-Nesting Raptors

Spatial and Temporal Boundaries

The assessment of Project effects on cliff-nesting raptors is focussed on the bird regional study area (RSA). The RSA consists of the Project footprint and a minimum of a 5 km buffer around Project facilities. Around the mine site, the RSA encompasses the watersheds of Britannia Creek and its tributary Canadian Creek, as well as upper Dip Creek and its tributary Casino Creek. Along the Freegold Road Extension, the RSA includes the proposed road alignment plus a 5 km buffer on either side of the road. In total, the RSA encompasses an area of approximately 1,712 km².

Cliff-nesting raptors within the Project area include both year-round residents and migratory species: gyrfalcon are potentially found in the region year-round, while golden eagles and peregrine falcon are seasonal inhabitants. The nesting period for each of these species differs slightly: gyrfalcon typically start nesting in early April and have left the nest by about mid-June; golden eagle usually commence nesting activities between late April and early May and are present at the nest through to August; while peregrine falcon don't begin nesting until about late May and leave the nest around mid-August (Sinclair et al. 2003). Combined, the nesting period for cliff-nesting raptors in the Casino Project area runs from April 1 through August 31. Note however, that since gyrfalcons may be present

within the study area year-round, gyrfalcon nest sites may be occupied at all times of the year (Platt 1976 *in* Sinclair et al. 2003).

Nest-Site Effects Methods

The assessment of potential Project effects on known nest sites for cliff-nesting raptors in the RSA was done in two stages. During baseline studies biologists compiled a list of all known cliff-nesting raptor nests in the area based on Project surveys and information from Yukon Environment (Appendix 12B). The location of nests observed during Project surveys were compared to the location of historic nest sites to determine how many nest sites are currently located within the RSA, and GIS was used to assess the distance between the nest sites and proposed Project infrastructure. All known nest sites within the RSA were assigned to one of three risk categories:

- Priority 1 nests are located within 500 m of proposed Project infrastructure and are expected to be most at risk from Project activities;
- Priority 2 nests are located between 500 and 1,000 m from proposed Project infrastructure; and
- Priority 3 nests are located beyond 1,000 m from the proposed Project infrastructure; Project effects on these sites are expected to be limited.

The second stage of the assessment was a site-specific assessment for those nest sites rated as Priority 1 or Priority 2.

12.3.8.4 Potential Effects and Mitigation Measures for Cliff-Nesting Raptors

General Project mitigation measures are described above in Section 12.3.2 (Mitigation Measures) and in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). These include several mitigation measures aimed at addressing potential impacts to all bird species and habitat such as measures to reduce the Project footprint and unnecessary sensory disturbances.

Specific mitigation measures that address potential effects to cliff-nesting raptors are described below.

- Nest-specific management plans will be developed for any cliff nests identified inside the PDA or within 500 m of the PDA.
- Annual occupancy surveys of potentially disturbed cliff nest sites.
- Wherever possible, a site-specific no-disturbance, no-stopping buffer of approximately 500 m will be implemented around active cliff-nesting raptor nests during the nesting period.

Mitigation actions specific to cliff nesting raptors are summarized in Table 12.3-32.

Table 12.3-32 Proposed Mitigation Measures and Residual Effects – Cliff Nesting Raptors

Potential Effect	**Project Phase** (C, O, DC, PC)	**Direction** (Adverse/ Beneficial)	**Proposed Mitigation Measure** (or Enhancement Measure)	**Predicted Effectiveness** (Low, Moderate, High, Unknown)	**Residual Effect** (Yes/No)
Nest-site Effects	C, O	Adverse	Nest-specific management plans within 500 m of PDA, wherever possible, a 500 m no-disturbance buffer around nests, annual occupancy surveys	Moderate	Yes

12.3.8.5 Potential Residual Effects on Cliff-Nesting Raptors

Nest-Site Residual Effects

Project baseline surveys concluded that there are 12 known nest sites located within the RSA — six around the proposed mine site and Yukon River access road, and six along the proposed Freegold Road Extension. Assessment of these sites in relation to the proposed Project infrastructure concluded that two of these nests (Site 1244 and Site 2010-08) are Priority 1 sites located within 500 m of Project infrastructure, and two more nests (Site 2012-01 and Site 2013-11) are Priority 2 sites located between 500 and 1,000 m from Project development (Table 12.3-34). All of the nest sites are expected to remain intact through the operating phase, although sensory disturbance to nesting birds may occur.

Nest Site 1244 is a stick nest located within Wildlife Key Area 1331; the site was originally identified by Yukon Environment as a golden eagle nest (although the original waypoint was located approximately 0.78 km northeast of the identified nest; based on the available habitat and a careful search of the area, surveyors concluded that the identified nest was likely Nest Site 1244). The nest was inactive during Project surveys in both 2010 and 2013, although both surveys noted some recent whitewash at the site. The 2013 survey also noted that the nest was not in ideal shape for occupancy (Photo 12-1). The nest is located on the southwest side of a block of tors within the subalpine adjacent to the proposed mine site. It falls within the mine PDA but is approximately 500 m from proposed infrastructure and is on the opposite side of the tor from the proposed development. Based on the surrounding terrain, birds at the nest are not expected to be able to see any Project infrastructure or activities. Some sensory disturbance, e.g. noise, may carry to the nest site, but effects are expected to be limited.

Nest Site 2010-08 is also found within Wildlife Key Area 1331. The nest was located during Project surveys in 2010 but was inactive in both 2010 and 2013. The site consists of a large stick nest, likely golden eagle in origin, situated on the west side of a tor in the subalpine. As of 2013, the nest was in very poor shape with moss growing over much of it; it likely has not been used in several years (Photo 12-2). The nest site is located within the mine PDA and is approximately 150 m from the Yukon River access road. The tor on which the nest is located is expected to remain intact during mine operation, but the nest directly faces the road and sits less than 100 m above the road surface. If raptors were to attempt nesting at this site again, the proximity to disturbance could result in high levels of sensory disturbance. The proximity to disturbance could also inhibit raptors from attempting to nest at this site during the life of the mine.

Nest Site 2012-01 was discovered incidentally during rare plant surveys in 2012. The site consists of a large stick nest, likely golden eagle in origin, located on a rocky outcrop near the top of a steep south-facing grassy/aspen slope above Big Creek (Photo 12-3). When located on 18 July 2012, the nest was occupied by peregrine falcons — one adult and two chicks were confirmed present. The nest was surveyed during the 2013 raptor nest survey, but was vacant. The nest is located approximately 600 m northeast of the proposed Freegold Road Extension. It

will have a direct view of the road, but sits 150 to 200 m higher than the road in elevation. As a result, sensory disturbance is expected to be limited.

Nest Site 2013-11 was located during the 2013 raptor nest survey. Three large stick nests, likely golden eagle in origin, were found on a rocky outcrop along a steep, south-facing, aspen slope above Big Creek (Photo 12-4). At the time of the survey on 16 June 2013, one adult peregrine falcon and three eggs were present. The nest sits approximately 800 m northeast of the proposed Freegold Road Extension and is estimated to be at least 100 m higher in elevation. Sensory disturbance at the nest is expected to be minimal.

12.3.8.6 Significance of Residual Effects for Cliff-Nesting Raptors

The Project is not expected to have population-level effects on cliff-nesting raptors but could affect a few known nest sites in close proximity to Project infrastructure. All known nest sites and the features they are located on will be kept intact, although sensory disturbance to nesting birds may occur. However, the two nest sites most at risk from potential sensory disturbance were vacant in 2013 and at least one has likely been vacant for the last several years. The 2013 raptor nest survey found relatively low occupancy rates within the Project area which would indicate that alternate nest sites may be available (depending on future occupancy rates). Nest-specific management plans will be developed for all cliff nests identified inside of or within 500 m of the PDA to help minimize effects on these sites.

Residual Project effects on cliff-nesting raptor populations are not expected. In consideration of uncertainty regarding the exact size and state of the raptor population in the Project area, the confidence in this prediction is moderate. The significance of residual effects of the Project on cliff nesting raptors is summarized in Table 12.3-33.

Table 12.3-33 Significance of Residual Effects — Cliff-Nesting Raptors

Residual Effect	**Predicted Degree of Effect After Mitigation Measures**								**Significance of Residual Effect** (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Physical loss of nest sites	Adverse	High to individuals	Localized	Permanent	Infrequent	Reversible	Low Resilience	Low	Not Significant
Sensory disturbance at nest sites	Adverse	High to individuals	Localized	Long term	Frequent	Reversible	Low Resilience	Moderate	Not Significant

Criteria definitions are detailed in Table 12.1-4

12.3.8.7 Follow-up Monitoring for Cliff-Nesting Raptors

There are some data gaps in long-term use of the sites by cliff-nesting raptors. Initial monitoring goals will be to test effects predictions that were made with moderate to weak confidence, and collect information that is relevant to further monitoring triggers. General monitoring initiatives for wildlife and specific initiative for cliff-nesting raptors are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC will conduct annual occupancy

and productivity surveys of known cliff nests within 500 m of the PDA through the life of the Project to facilitate nest site management.

Table 12.3-34 Cliff-nesting raptor nest sites within the Casino bird RSA

ID	Species	Carried forward for assessment (Y/N)	Distance to infrastructure	Priority
1244	Golden eagle	Yes	0.5 km	1
1254	Golden eagle	Yes	4.6 km	3
1257	Golden eagle	Yes	3.9 km	3
2010-08	Golden eagle	Yes	0.1 km	1
2010-21	Unknown raptor	Yes	1.9 km	3
2010-24	Unknown raptor	Yes	2.1 km	3
1243	Gyrfalcon	Yes	3.0 km	3
1294	Gyrfalcon	Yes	4.9 km	3
1295	Gyrfalcon	Yes	3.8 km	3
2012-01	Peregrine falcon\ golden eagle	Yes	0.6 km	2
2013-11	Peregrine falcon\ golden eagle	Yes	0.8 km	2
2013-15	Golden eagle	Yes	1.6 km	3



Photo 12-1 Raptor Nest Site 1244



Photo 12-2 Raptor Nest Site 2010-08



Photo 12-3 Raptor Nest Site 2012-01



Photo 12-4 Raptor Nest Site 2013-11

12.3.9 Waterfowl Effects Assessment

12.3.9.1 Baseline Summary

The LSA contains no lakes. Open-water wetlands and pond habitats are generally infrequent and small. As a result of limited habitat, the study area does not contain a high density or diversity of waterfowl (i.e. ducks, swans, and geese) and other water birds (e.g. loons, grebes, gulls) — herein collectively referred to as waterfowl. Species such as Canada goose, mallard, green-winged teal, bufflehead, and goldeneye are expected to use small wetlands within the LSA, particularly in the Dip Creek drainage to the southwest of the mine site. Harlequin duck and common merganser may also be found along larger streams and rivers within the project area including Big Creek, Hayes Creek, and the Selwyn River. In total, 17 species of waterfowl and other water birds occur, or are expected to occur, within the LSA, seven of which were confirmed present; however, numbers are very low.

12.3.9.2 Potential Project Interactions with Waterfowl

Section 12.3.1 identifies all Project components and activities that interact with wildlife KIs. The key issues related to potential Project interactions with waterfowl are focussed on negative health effects from water within the Tailings Management Facility (TMF) and other mine water bodies such as the Events Pond. Habitat loss and the direct mortality of waterfowl and related species is expected to be minimal since waterfowl habitats are currently limited within the LSA and there is a corresponding relatively low density and diversity of waterfowl and related species. General mitigation measures for passerines and bird species at risk (e.g. pre-clearing nest searches, and a 100 m buffer maintained around ponds and open-water wetlands wherever feasible) should address most potential impacts to waterfowl and related species. However, Environment Canada has raised concerns over the potential interactions between waterfowl and the proposed TMF for the Casino Project, particularly the development of a wetland as part of the TMF Closure and Decommissioning phase.

Use of tailings and other water bodies associated with a mining operation by waterfowl is not uncommon and has been documented at mine sites within the Yukon. At the Faro Mine Complex (a previously active mine in south-central Yukon) monitoring in the fall of 2009 and the summer of 2010 documented waterfowl in groups of one to 24 ducks using several of the pits and ponds irregularly throughout the spring, summer and fall seasons. Details on habitat use, duration of stay and behaviour (i.e. feeding, nesting, etc.) is unknown; however, some of the water bodies that waterfowl were observed using are documented to have relatively low pH (2 to 5) and elevated concentrations of several metals (Ecological Logistics and Research Ltd. 2011). At the Wolverine Mine in southeastern Yukon, weekly monitoring was conducted at the tailings facility during the fall of 2010, and the spring and fall of 2011 and 2012. These surveys documented waterfowl (including mallards, scaup, goldeneye and swans) landing on the tailings pond and occupying areas surrounding the tailings facility (Yukon Zinc Corporation 2011, 2012 and 2013). During Yukon Zinc's monitoring at the Wolverine Mine in 2012, it was noted that the tailings pond was the only available open water body during early spring which is likely why it attracted waterfowl (Yukon Zinc Corporation 2013). Although waterfowl were found to use this tailings facility, the number of individuals and number of species were much less then was observed at reference lakes. Waterfowl observed using the tailings facility at Wolverine Mine were successfully deterred using bear bangers and other deterrent devices (Yukon Zinc Corporation 2011, 2012 and 2013).

Health effects to waterfowl from tailings and/or other mine-associated water bodies can vary widely from no effect to large scale mortality. The magnitude of the effect depends on a variety of factors including the exact water quality characteristics (e.g. pH, the levels of metals and other elements etc.), the timing and duration of the

interaction, the species of waterfowl, and the behaviour of the birds (e.g. whether resting, diving, attempting to feed etc.).

12.3.9.3 Effects Assessment Methods for Waterfowl

Project effects on waterfowl health as a result of interactions with the TMF and other mine water bodies were assessed qualitatively as the likelihood of waterfowl experiencing toxic effects. The assessment looked at the potential for waterfowl to establish residence or spend prolonged periods of time associated with the water body, the predicted water quality, proposed closure plans, and literature on the effects of pH and various contaminants on waterfowl.

Spatial and Temporal Boundaries

Project components assessed for health effects on waterfowl are all located within the PDA (Figure 12.1-1). Interaction between the Project and waterfowl could occur seasonally throughout all phases of the Project (Construction, Operations, Closure and Decommissioning, and Post Closure). The majority of waterfowl arrive in the Yukon in April, and disperse to their nesting grounds by the end of May; breeding occurs from about mid-May through August, and fall migration follows from August through October (Sinclair et al. 2003); therefore the temporal boundaries for this effect are annually between April and October.

Criteria for Significance

The context for the assessment of Project effects on waterfowl health is the Project's potential effects on the sustainability of the Yukon waterfowl population that are likely to use mine water bodies for foraging, nesting and other life requisites.

12.3.9.4 Potential Effects and Mitigation Measures for Waterfowl

Mitigation measures proposed to address potential effects on waterfowl health during the Operation Phase will be triggered by Project monitoring. If water quality parameters exceed acceptable water quality standards, wildlife monitoring will be conducted in the vicinity of the affected water body to determine if waterfowl, or other wildlife, are using that area. If necessary, wildlife deterrence measures may be implemented to minimize interactions (see the Casino Project: Wildlife Mitigation and Monitoring Plan, Appendix 12C).

Water quality modelling predicted that water discharged from the Heap Leach Facility will have elevated levels of selenium, which may have negative effects on waterfowl health. Therefore, water from the Heap Leach Facility will be routed through a bio-reactor designed to remove selenium prior to being pumped into the Pit Lake. As part of the Decommissioning and Closure phase, water quality monitoring will be conducted in the TMF and in the Pit Lake once flooding is initiated. These results will be used to validate the predictions of the water quality modelling and to determine if additional mitigation is necessary to achieve a passive care closure scenario. If water quality results exceed the thresholds, additional mitigation measures may be implemented and could include the construction of additional wetlands or increasing the size of the wetlands, the use of chemical or bio-treatment to remove elements of concern, modification of the decant system, or stratification of the Pit Lake. Mitigation measures for the Operations, Decommissioning and Post-closure phases are summarized in Table 12.3-35.

Table 12.3-35 Proposed Mitigation Measures and Potential Residual Effects Specific to Waterfowl

Potential Effect	Project Phase (C, O, DC, PC)	Direction (Adverse/ Beneficial)	Proposed Mitigation Measure (or Enhancement Measure)	Predicted Effectiveness (Low, Moderate, High, Unknown)	Residual Effect (Yes/No)
Health effects on waterfowl	O, DC, PC	Adverse	Use of bio-reactor to treat waters from Heap Leach Facility; Water quality monitoring in TMF and pit lake; and If necessary, implement mitigations to improve water quality; wildlife monitoring in TMF or pit lake area (during Operations and Closure and Decommissioning); and use of wildlife deterrents (during Operations and Closure and Decommissioning).	Moderate	Yes

12.3.9.5 Potential Residual Effects on Waterfowl

Health Residual Effects

An assessment of the potential effects to waterfowl health due to interactions with Project water bodies (Table 12.3-36) indicates that:

- While some individual waterfowl may be exposed to elevated levels of trace metals and other contaminants in the TMF during Operation and from the Pit Lake during Closure and Decommissioning and Post-closure phases, the potential for health effects is expected to be low when considered at the population level. While similar projects in the Yukon have documented waterfowl use of tailings facilities and other mine water bodies, overall, the habitat in these water bodies is not expected to be very attractive to birds. During Operation, the TMF will have a distinct lack of nesting sites along the shorelines and little to no available food. Interactions are expected to be primarily with non-resident birds and of a temporary nature (i.e. short duration). In consideration of the proposed monitoring and mitigation measures (e.g. deterrence of waterfowl), it is expected that residual effects to waterfowl health from these sources will be minimal.
- The greatest potential for health effects to individual waterfowl is expected to be from the TMF during the Closure and Decommissioning and Post-Closure phases. The closure plan for the TMF includes the development of two wetlands (North and South TMF wetlands) that are connected by the TMF pond. Depending on the exact nature of these wetlands, they could provide foraging and nesting opportunities for waterfowl that may increase the exposure of waterfowl to elevated levels of trace metals and other contaminants.

Water quality modeling for the TMF during the Closure and Decommissioning and Post-Closure phases is predicting elevated levels of several elements including sulphate, cadmium, copper, molybdenum, selenium and uranium (Volume 3, Section 7: Water and Sediment Quality). Elevated levels of trace metals have been shown to cause detrimental effects to waterfowl including reduced reproductive success, physical deformities, impaired biological functions, reduced growth rates and even death. However, effects vary widely depending on the particular element, the level of exposure, interactions with other elements, and in many cases, by species. Of the

elements predicted to be present in elevated levels within the TMF, selenium is of particular concern due to documented toxicological effects to waterfowl at relatively low concentrations and its tendency to bioaccumulate within the environment.

Selenium uptake by birds occurs primarily through diet and is driven by bioaccumulation of selenium within the food chain. Selenium is an essential dietary requirement, but has a very narrow range between beneficial concentrations and toxic levels (Harding 2007). At very high levels, selenium can cause adult mortality; however, it more commonly results in reproductive effects such as reduced hatchability and developmental abnormalities. Several studies have attempted to determine selenium toxicity thresholds for birds based on dissolved concentrations within water, for example, Adams et al (1998) suggested that a threshold of 6.8 µg/L would protect 90% of species and sites from adverse effects, while Skorupa (1998) proposed that selenium concentrations of less than 5 µg/L were necessary to protect birds and fish. However, it is generally accepted that water concentrations are not entirely predictive of selenium toxicity (Luoma and Presser 2009). The bioaccumulation of metals is a complex process and can be influenced by a number of factors. The effect of selenium on birds and on aquatic life has been shown to vary significantly between sites and among species (Adams et al. 1998), and is affected by the form in which selenium is present, interactions with other trace metals, the complexity of the local food web and levels of trophic transfer among other factors (Ohlendorf 2003, Luoma and Presser 2009).

Based on water quality modelling, with the implementation of the bio-reactor, during closure and post-closure selenium levels in the pit discharge are expected to peak at approximately 8.3 µg/L. Within the North TMF Wetland, selenium levels are expected to peak at approximately 7.7 µg/L following pit discharge and will fall below 5 µg/L within about 70 years, while selenium levels in the TMF Pond and the TMF Spillway are predicted to range from approximately 4 to 6 µg/L and within approximately 25 years of closure should be below 5 µg/L (Volume 3, Section 7: Water and Sediment Quality). These levels are well below concentrations that could be expected to cause acute toxicity. They are just above some of the recommended thresholds for aquatic birds, but given differences in site conditions and species, it is unclear whether these concentrations will result in effects to the local bird population. There are instances where levels similar to those predicted within the TMF were shown to cause reproductive effects. The following points highlight some examples from the literature:

- At the Martin Reservoir in Texas, unauthorized discharge from settling ponds associated with a coal-fired electric plant resulted in selenium levels within the reservoir between 1 to 34 µg/L with an overall average of 2.6 µg/L and an average of about 5 µg/L in the primary impact areas; seven to eight years after the discharge, studies found high levels of selenium within red-winged blackbird eggs and an associated depression of more than 50% in hatchability (Skorupa 1998).
- At the Richmond Oil Refinery in Texas, an experimental program was conducted to treat wastewater using constructed wetlands. Selenium concentrations ranged from approximately 20 µg/L at the inflow to 5 µg/L at the outflow. Studies found high levels of selenium within bird tissues and documented a more than 30% increase in the occurrence of deformed embryos in mallard nests and 10% increase in the occurrence of deformed embryos in the nests of American coots (Skorupa 1998).

However, there are also examples within the literature of similar or higher concentrations of selenium having no detrimental effect on birds:

- In the Elk River valley of southeast British Columbia, wetlands downstream of several coal mines were studied for effects on red-winged blackbirds (mean selenium concentrations in the wetlands ranged from <1 to 92 µg/L). The study found a high level of variability among wetlands, but the generalized trends indicated that selenium concentrations in the range expected at Casino (approximately 5 to 10 µg/L) should have no detrimental effect on red-winged blackbirds (Harding 2007).

- In wetlands on the Kennecott Utah Copper mine property in Utah, selenium levels in the diets of various waterfowl and shorebird species exceeded levels reported in other studies as associated with reproductive effects; however, field studies could not detect a difference in the reproductive success of birds using the Kennecott wetlands and reference sites (ep&t and Parametrix 1997 *in* Adams et al 1998).

Ultimately, elevated levels of selenium and other trace metals have the potential to affect the health of individual birds that are exposed to the TMF over an extended period — for example, birds that nest along the TMF or spend substantial amounts of time foraging there. However, the potential for effects will depend on a variety of site conditions and the species of birds that nest there. If effects do occur, they are expected to observed as decreased reproductive output in select species, and effects on adult birds are unlikely. In consideration of potential mitigation measures that can be used to address water quality if Project monitoring indicates that levels of trace metals or other constituents are beyond acceptable levels, the residual effect is expected to be limited.

Table 12.3-36 Sources of Potentially Contaminated Water during all Project Phases

Project Phase	Source	Description	Potential for Interaction with Waterfowl
Construction and Operation	Heap Leach Facility	With the exception of the Events Pond, the Heap Leach Facility will not include open 'ponds' but will be contained within tanks. The Events Pond will not be part of the regular operational functioning but will be used in the case of a storm event that exceeds the capacity of the in-heap storage.	The leaching solution is generally expected to be inaccessible. If storm events require the use of the Events Pond, it will be pumped out within a short time frame.
	Tailings Management Facility (TMF)	During operation, the TMF will consist of a waste storage area and aqueous tailings. For most of the operational period, the tailings waters will cover only the southern sections of the TMF (northern sections will be a waste storage area); it will only be in the last years of operation that the tailings waters will flow over the waste storage area and cover the entire TMF. The supernatant waters of the tailings are expected to have elevated levels of suspended solids and several trace metals including cadmium, copper, molybdenum, selenium and uranium among other elements (Volume 3, Section 7: Water and Sediment Quality).	The habitat of the TMF is not expected to be very attractive to birds during operation — presumed lack of nesting sites along the shorelines and little to no food web in the tailings waters; however, there is potential for temporary interactions with birds, particularly during migration.
	Various other ponds	During operation and construction, several other freshwater ponds will be built within the PDA for water management, processing etc.	Ponds are not expected to present a risk to waterfowl or other wildlife.
Closure and Post-Closure	Pit Lake	During closure, water from the Heap Leach Facility will be treated with a bioreactor to address residual levels of selenium and mercury before being pumped into the Pit Lake. Waters in the Pit Lake may have elevated levels of arsenic, cadmium, copper, mercury, molybdenum, selenium, silver, uranium, and zinc among other elements (Volume 3, Section 7: Water and Sediment Quality).	The Pit Lake is not expected to be very attractive to birds — presumed lack of nesting sites and little to no food web in the waters; however, there is potential for temporary interactions with birds, particularly during migration when birds may land and rest on the Pit Lake.
	Tailings Management Facility (TMF)	Wetland development in the TMF will treat elevated levels of several elements like cadmium, copper and zinc. Contaminants removed by the wetlands will be retained in wetland sediments and will be biologically unavailable. However water quality modeling is predicting elevated levels of several trace metals and other elements within the TMF post-closure including sulphate, cadmium, copper, mercury, molybdenum, selenium and uranium; some of these elements may also be slightly elevated in the discharge from the TMF (Volume 3, Section 7: Water and Sediment Quality).	The closure plan for the TMF involves the development of two wetlands along the tailings pond. Depending on the exact structure of these wetlands, there is potential for these areas to be used by waterfowl from approximately April through October; foraging within the TMF and nesting along the edges of the TMF is considered a possibility.

12.3.9.6 Significance of Residual Effects for Waterfowl

Significance of Effects on Health

Adverse health effects to waterfowl could result from the use of Project water bodies, particularly from waterfowl use of the TMF during the Closure and Decommissioning and Post Closure phases. If they occur, potential effects are expected to be limited to individuals that nest in or near, or otherwise spend an extended period of time associated with the TMF. Additionally, water quality monitoring will document contaminant levels during the Closure and Decommissioning Phase and additional water quality mitigation measures are possible if monitoring indicates that these are required. Residual effects are not expected to be significant at the population level. In consideration of uncertainty due to species-specific effects thresholds for trace metals, potential interactions

between elements, and the potential interaction with natural regimes (e.g., freezing and thawing of the tailings in relation to other water bodies, weather events impacting waterfowl migration etc.), the confidence in this prediction is moderate. The significance of residual effects of the Project on waterfowl is summarized in Table 12.3-37.

Table 12.3-37 Significance of Residual Effects on Waterfowl

Residual Effect	**Predicted Degree of Effect After Mitigation Measures**								**Significance of Residual Effect** (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Health effects	Adverse	Medium	Localized	Permanent	Infrequent	Reversible	High Resilience	Moderate	Not Significant

Criteria definitions are detailed in Table 12.1-4

12.3.9.7 Follow-up Monitoring for Waterfowl

General monitoring initiatives for wildlife and specific initiatives for waterfowl are outlined in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). CMC will monitor wildlife use of the TMF during Operation as part of the regular facility monitoring program. Further actions will be triggered if water quality monitoring results exceed acceptable standards.

12.3.10 Subjects of Note

12.3.10.1 Dall's Sheep

Dall's sheep are common to alpine habitats within the RSA, with known wintering ranges on Apex, Prospector, Klaza, Nansen, and Langham mountains. Dall's sheep inhabit dry mountainous regions where there is access to subalpine meadows, shrublands, and terrain with rocky slopes, ridges, and cliffs to help avoid predation and provide safe lambing grounds (Bowyer and Leslie 1992; Festa-Bianchet 2008). Nearby grasslands and meadows provide habitat for feeding on grasses, sedges, and the leaves and buds of forbs and shrubs (Bowyer and Leslie 1992). In the last ten years, sheep harvest in the Project area has only occurred in GMS 523, primarily by non-residents likely guided by outfitters. During baseline studies sheep were observed on Mount Langham (five groups ranging from 2 to 12 individuals), Prospector Mountain (one group of 11), and near Klaza Mountain (on group of 5).

The PDA does not lie within any known sheep range and the 4 km ZOI used for caribou does not overlap any sheep ranges either. One potential interaction with sheep may be the increase in aircraft flying into the Mine Site. Sheep respond to aircraft noise by being vigilant, resulting in less time spent foraging and resting (Laberge Environmental Services 2002). To mitigate this potential effect, CMC will adopt the guidelines outlined in *Flying in*

sheep country: how to minimize disturbance from aircraft (Laberge Environmental Services 2002). Habitat loss, both direct and indirect, for sheep in the RSA will likely not occur as a result of the Project.

There are no mechanisms for direct Project-related sheep mortality. Concerns have been raised about increased hunter access as a result of the Freegold Road Extension; however, harvester access will be limited by managing the road privately.

If effects to sheep in the region are detected (by way of regional, government-led surveys and/or Project footprint monitoring), Project effects to sheep will be re-evaluated and adaptive management measures may be implemented if deemed necessary.

12.3.10.2 Mineral Licks

During baseline studies, two mineral licks were identified by biologists — one near Dip Creek in the northern part of the RSA (west of the mine site) and one near Hayes Creek. Both licks were monitored during 2013 using remote, motion sensing cameras. Mineral licks not only provide mineral nutrients and water to moose, but also aid in digestion (by consuming soil) and are known as social gathering areas (Rea et al. 2004). Mineral licks were also identified by Pearse (1988) in the Casino Trail Project Phase I Report as areas to avoid when constructing the Casino Trail. Only moose were observed spending time at these licks, while other mammals (grizzly and black bears, wolves, and lynx) were observed passing through, likely following the well-established animal trails near the licks, or following prey species.

Both licks are located outside the PDA — the Dip Creek lick is approximately 130 m from the PDA and the Hayes Creek lick is located across Hayes Creek, approximately 380 m from the PDA. These areas are considered of high importance to all wildlife species and mitigation measures aimed at reducing effects to habitat will apply to these areas. General habitat mitigation measures, as well as mineral-lick-specific mitigation and monitoring plans are detailed in the Wildlife Mitigation and Monitoring Plan (Appendix 12C).

12.4 SUMMARY OF RESIDUAL EFFECTS ON WILDLIFE

The Project will have adverse effects on wildlife habitat availability and effectiveness, adverse effects on wildlife movement, and mortality risk increases. Overall Project effects on terrestrial wildlife are predicted to be not significant with a moderate to high level of confidence in those predictions (

Table 12.4-1). CMC recognizes that Project construction and operation will alter and disturb the landscape and there will be measureable effects to individuals and local wildlife populations. There will be a loss of habitat, reduced habitat effectiveness, an increased risk of mortality, and adverse effects on health. While these effects are not significant, CMC acknowledges the inherent risk that the Project introduces to the environment and the wildlife resources.

Wildlife populations could be at risk if effects predictions are incorrect and mitigation is not successful. Project risk will be managed by implementing the Wildlife Mitigation and Monitoring Plan. CMC is confident that effects predictions have been characterized correctly and mitigation measures will be effective. This is largely based on experience from other mining projects of a similar nature. Monitoring programs will have the capability to detect Project-related effects to wildlife and adaptive management actions will evolve as the Project proceeds. Stakeholder participation in monitoring and adaptive management planning is the key to the success of the Wildlife Mitigation and Monitoring Plan.

Table 12.4-1 Summary of Project-related Residual Effects on Wildlife

Residual Effect	Direction (Adverse/Beneficial)	Significance (significant/not significant)	Level of Confidence (Low, Moderate, High)
Habitat availability (loss) for caribou	Adverse	Not significant	High
Habitat availability (reduced effectiveness) for caribou	Adverse	Not significant	Moderate
Movement of caribou	Adverse	Not significant	Moderate
Mortality risk to caribou	Adverse	Not significant	Moderate
Habitat availability (loss) for moose	Adverse	Not significant	High
Habitat availability (reduced effectiveness) for moose	Adverse	Not significant	Moderate
Movement of moose	Adverse	Not significant	Moderate
Mortality risk to moose	Adverse	Not significant	Moderate
Habitat availability (loss) for grizzly bears	Adverse	Not significant	High
Habitat availability (reduced effectiveness) for grizzly bears	Adverse	Not significant	Moderate
Movement of grizzly bears	Adverse	Not significant	Moderate
Mortality risk to grizzly bears	Adverse	Not significant	Moderate
Habitat loss for collared pika	Adverse	Not significant	High
Habitat availability (direct loss) for passerine species and bird species at risk	Adverse	Not significant	Moderate
Habitat availability (reduced effectiveness) for passerine species and bird species at risk	Adverse	Not significant	Moderate
Physical loss of known nest sites for cliff-nesting raptors	Adverse	Not significant	High
Sensory disturbance at known nest sites for cliff-nesting raptors	Adverse	Not significant	Moderate
Health of waterfowl	Adverse	Not significant	Moderate

12.5 CUMULATIVE EFFECTS ASSESSMENT

The assessment of cumulative effects on wildlife follows the cumulative effects methods outlined in Section 5. Residual effects from the Casino Project and effects from other projects in the area were assessed to determine the overall cumulative effects on wildlife in the region. Residual effects from the Casino Project on wildlife include:

- Habitat loss/reduced habitat effectiveness for caribou, moose, grizzly bear, passerines, bird species at risk and cliff nesting raptors;
- Restrictions to movement for caribou, moose, grizzly bear;
- Increased mortality risk for caribou, moose, grizzly bear; and
- Reduced health of waterfowl using the tailings management facility after closure of the mine.

The residual effects from the Casino Project are expected to be similar to effects from other current and future development activities in the region. Residual effects on habitat loss/reduced habitat effectiveness and increased mortality risk have the potential to overlap in time and space with other projects in the region, therefore these effects have been carried forward for the cumulative effects assessment. Residual effects on restrictions to movement and reduced waterfowl health are not expected to be measurable and are therefore were not considered in this cumulative effects assessment.

In the Casino Project Wildlife Baseline Report (Appendix 12A), the habitat models for grizzly bears included an assessment of the effects from other projects within the grizzly bear study area, so there is nothing to add from further assessment of grizzly bear habitat loss within this cumulative effects assessment. Therefore, for grizzly bear, the only effect assessed in this cumulative effects assessment is increased mortality risk and loss of habitat is not discussed in further detail.

12.5.1 Other Projects and Activities that could lead to a Cumulative Effect on Wildlife

For past, present or likely future projects/activities to be included in the cumulative effects assessment, three conditions were required to warrant further assessment:

- Adequate qualitative and/or quantitative information on a project or activity is publicly available to allow for spatial and temporal characterization;
- The project spatially overlaps with the residual effects of the Casino Project; and
- The project temporally overlaps with the residual effects of the Casino Project.

Mineral exploration and placer mining projects have occurred in, and are likely to continue to occur in, the Project region. There are no known areas that are excluded from mineral exploration, and there are a number of placer claims that will likely exist and be active either continuously or intermittently into the foreseeable future. Although the claim blocks can be very extensive and numerous (e.g., as illustrated in the White Gold Cumulative Effects Report; EDI 2013), actual works are likely to be limited to a few focal areas for either a short period of time, or seasonally for many years, as is the case for several quartz claims in the area. Projects and/or activities that meet the conditions described above are summarized in Table 12.5-1 and illustrated in Figure 12.6-1. Projects/activities in the same category (e.g., placer mining, quartz claims) are assumed to cause similar types of residual effects and are therefore assessed collectively. Based on the characteristics of the timber in the region, it is unlikely that forestry activities will occur at a scale large enough to be considered a cumulative effect. Forest fire was considered in the baseline models for caribou and moose (Appendix 12A).

Table 12.5-1 Residual Effect Information for Other Projects or Activities Considered in the Wildlife Cumulative Effects Assessment

Projects or Activities	Status[1]	Assumed Residual Effect2	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Minto Mine	Present operating mine	Habitat loss for moose. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 12.92 km², including mine site and access road.	Minto mine is expected to operate through the construction and initial operating years of the Casino Project.
Coffee Creek	Present	Late winter habitat loss to moose, no winter activity. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint (approx.): 10 km², including mine site and access road.	Advanced exploration likely to continue intermittently and seasonally. Development or operation period possible over the next few years.
Carmacks Copper (proposed mining project)	Likely future project	Transportation (cumulative increased mortality risk to moose and other wildlife that could be found on road), late winter habitat loss to moose, sensory disturbance year-round. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 1.36 km², and if developed assumed equivalent to disturbance observed at Casino mine site. Current activities are likely very sporadic and site-specific.	Development or operation period possible within the next few years
WS Total	Present	Late winter habitat loss to moose, no winter activity. Increased mortality risk	Current footprint: 0.08 km². Likely includes some	Exploration likely to continue intermittently and

Projects or Activities	Status[1]	Assumed Residual Effect2	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
(exploration project)		or grizzly bear (defense of life and property).	individual seasonal drill locations	seasonally through life of the Casino Project. No indication of development or operation period.
Nucleus/Revenue (exploration project)	Present	Late winter habitat loss to moose, no winter activity. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 0.08 km². Likely includes some individual seasonal drill locations.	Advanced exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Mt. Nansen (reclamation project)	Past mine development, Present care and maintenance, future reclamation activities	Sensory disturbance in late winter habitat to moose. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 1.85 km². Activities likely to be limited to extent of existing disturbance footprint.	Likely to occur over a two to three year period within the next decade.
Prospector Mountain (exploration project)	Present	Late winter habitat loss to moose and caribou (no winter activity known at project). Increased mortality risk or grizzly bear (defense of life and property).	Assumed equivalent to disturbance observed at Casino mine site during exploration phase. Likely includes some individual seasonal drill locations.	Exploration likely to continue intermittently and seasonally through life of the Casino Project. No indication of development or operation period.
Sonora Gulch (exploration project)	Present	Late winter habitat loss for moose and caribou (no winter activity known at project). Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 0.27 km². Activities likely to be limited to extent of existing disturbance footprint.	Exploration likely to continue intermittently through life of the Casino Project. No indication of development or operation period.
Numerous quartz exploration permits	Past, present and future	Assuming typical practices of small camps and individual drill locations or some trenching, limited habitat loss that is indiscernible at the scale of the ranges of moose and caribou. Increased mortality risk or grizzly bear (defense of life and property).	Localized effects, but distributed across the landscape.	Exploration likely to continue intermittently and seasonally through life of the Casino Project.
Numerous placer mining permits	Past, present and future	Seasonal placer mining activities limited to creeks. Low quality caribou habitat, but disturbed areas and resulting forage growth possibly beneficial to moose habitat. Increased mortality risk or grizzly bear (defense of life and property).	Localized effects in areas accessible to heavy equipment.	Placer mining likely to continue intermittently and seasonally through life of the Casino Project.
Canadian Creek, Upper Canadian Creek (Placer mine)	Present	Late winter habitat loss to moose. Increased mortality risk or grizzly bear (defense of life and property).	Current footprint: 0.52 km². Footprint likely increases with successive placer mining operations, but older areas will naturally re-vegetate.	Mining likely to continue intermittently and seasonally through life of the Casino Project. No indication of operation period.
First Nations subsistence harvest	Past, present and future	Cumulative increased mortality risk.	Possible harvest beyond sustainable limits with GMSs that overlap with Project.	Freegold Road Extension Mitigation is possible through multiparty participation in a management plan related to harvest access.
Licenced harvest	Past, present and future	Cumulative increased mortality risk.	Possible harvest beyond sustainable limits with GMSs that overlap with Project.	Harvest is regulated by YG Environment, no residual effect expected.
Outfitter-based camps and harvest	Past, present and future	Cumulative increased mortality risk.	Possible harvest beyond sustainable limits with GMSs that overlap with	Harvest is regulated by YG Environment, no residual

Projects or Activities	Status[1]	Assumed Residual Effect2	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
activities			Project.	effect expected.
Wildlife survey and research activities	Past, present and future	Intermittent disturbance to a substantial proportion of the Klaza caribou or other species of research interest. Intermittent disturbance and handling of animals could affect herd productivity.	GMS-wide, Klaza-caribou range, various depending on study objectives and methods.	Some surveys require low level flights that disturb groups of animals, and some research requires the capture and handling of individual animals.

Note

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for wildlife, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

12.5.2 Residual Effects of Other Projects and Activities and Potential Cumulative Effects

Active or historic quartz mines, such as the Minto Mine and Mt Nansen Mine, are assumed to have residual effects of habitat loss/reduced habitat effectiveness within the project footprint. Quartz exploration projects may or may not have residual effects of habitat loss associated with permanent footprints of unmitigated trenching, camp locations, drilling, and other activities (e.g., grey water disposal areas). Some sites in the past may have left waste rock piles and other features not naturally present in the landscape. Current Mining Land Use Regulations now require these features to be reclaimed. Placer mining projects usually have residual effects of waste rock piles in riparian areas. It is now standard practice for these piles to be reclaimed and natural revegetation tends to occur effectively in these areas, often providing increased habitat for moose. Outfitting concessions will have small camp footprints, and perhaps some minor disturbances associated with trail maintenance. All mining activity has the potential for increased mortality risk to bears as a result of human-bear conflicts. Harvesting activities may result in animal mortality that, if left unmanaged, may exceed sustainable harvest thresholds. Research activities may result in unmitigated disturbances to animals, but the activities are likely to be of too low frequency to have detectable effects at the population level.

A CEA interaction matrix was used to indicate if there is a temporal and spatial overlap between the residual effects of the Casino Project and the assumed residual effects of other projects and activities, as shown in Table 12.5-2. If there is a potential for an interaction spatially and temporally, the cell is marked YES, and the interaction is analyzed. A cell marked YES does not presume there to be cumulative effect; rather, it is an indication that there is a potential for a cumulative effect. More detailed explanation is provided in the text as to how the interactions were derived, by discussing any baseline information, the source of the information, and any underlying assumptions. If the cell is marked as NO, a rationale describing why there is no predicted interaction is provided in the text, and those residual effects are no longer carried forward in the assessment.

Table 12.5-2 Cumulative Effects Assessment Interaction with Wildlife

Casino Project Residual Effect	Potential Spatial and Temporal Overlap			
	Past and ongoing exploration	**Past and ongoing Placer Mining**	**Active/historic quartz mines**	**Past, present and future harvest activities**
	Habitat loss, reduced effectiveness, increased risk of grizzly bear mortality	Habitat loss, increased risk of grizzly bear mortality	Habitat loss, increased mortality risk	Increased mortality risk to wildlife
Late winter habitat loss for caribou	YES	NO, placer mining occurs in low quality late winter habitat for caribou	YES	NO
Late winter habitat loss for moose	YES	YES, placer mining likely occurs in moderate or high quality moose forage habitat	YES	NO
Increased mortality risk to caribou, moose and grizzly bear	YES, but only for grizzly bear problem kills	YES, but only for grizzly bear problem kills	YES, for all wildlife given likely improved access to project area	YES

Note:
YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporally with an assumed residual effects of other projects and activities.

Only the assumed residual effects of other projects and activities that meet all three conditions and overlap spatially and temporally with the Casino Project were carried forward into the CEA as potential cumulative effects and summarized in Table 12.5-3.

Table 12.5-3 Potential Cumulative Effects on Wildlife

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Late winter habitat loss for caribou	Combined quartz exploration, active/historic quartz mines	Cumulative loss of late winter habitat
Late winter habitat loss for moose	Combined quartz exploration, active/historic quartz mines and placer mines	Cumulative loss of late winter habitat
Increased mortality risk to caribou, moose and grizzly bear	Combined placer operations, current and future harvesting activities	Cumulative increasing mortality risk on caribou, moose and grizzly bear

12.5.3 Proposed Mitigation Measures and Residual Cumulative Effects

There are no additional mitigation actions proposed beyond what CMC has already committed to at the Project-specific level, and those mitigations are described in detail in the effects assessment above and in the Wildlife Mitigation and Monitoring Plan (Appendix 12C). Managing the cumulative effect of increased mortality risk to wildlife will need to have a multi-party approach that includes CMC, other stakeholders, communities and First Nation Governments. These mitigation and management activities will occur regardless of the Casino Mine Project, but CMC does recognize the management challenges associated with the perceived access provided by the Freegold Road Extension.

CMC will support YG Environment and affected First Nations wildlife harvest management initiatives in the Project area.

CMC will mitigate the risk of increased mortality from collisions and harvest by managing the Freegold Road Extension as a private industrial road. This will include:

- Restricting access to the road at all times by installing a continuously manned gate at Big Creek; and
- Decommissioning the road during the reclamation and closure phase;

- Developing a road use plan in cooperation with Yukon and First Nation Governments. Key elements of the Road Use Plan for wildlife include the following commitments:
  - "No Hunting" in game management zones along access road (continuation of existing hunting ban in some areas, extended to include entire length of access corridor);
  - Special management provisions for Klaza caribou that include long-term and increased active monitoring (currently underway), and other measures as agreed (Discussed in Section 5); and
  - Identification of 'wildlife crossing' areas along route, that may include active monitoring (discussed in Section 4.1.2), snow clearing berm management in late-winter, travel speed reductions and restrictions as defined and agreed in the management plan.

Other land users, hunters in particular, have the potential to cause significant changes to the abundance and distribution of wildlife in the Project area. CMC does not have the ability to manage the public's ability to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RSA. Furthermore, proponents of other projects in the area may have conditions in their operating permits that are inconsistent with CMC's Project mitigations. To mitigate potential Project effects that are outside of CMC's control and ensure the long-term health of regional wildlife, a landscape level planning process that could include the development of an updated Wildlife Management Plan could be initiated by management authorities. The management plan could be developed through a multi-stakeholder working group that includes those parties that have the responsibility for wildlife and land management. Working group members could include the Yukon Government, Little Salmon Carmacks First Nation, Selkirk First Nation, Selkirk Renewable Resource Council, Carmacks Renewable Resource Council and CMC. While CMC cannot develop or implement the plan independently, it can participate as a stakeholder member of the working group.

Potential cumulative effects on wildlife and some of the mitigation related to cumulative effects management are summarized in Table 12.5-4.

Table 12.5-4 Mitigation Measures for Wildlife and Residual Cumulative Effects

Potential Cumulative Effect	Mitigation Measures for Project-Specific Effects1	Additional Mitigation2 (if possible)	Effectiveness of Additional Mitigation Measure (Low, Moderate, High, Unknown)	Residual Cumulative Effect (Yes/No)
Cumulative loss of late winter habitat	All efforts made to minimize the Project footprint, and closure and reclamation activities to reclaim habitat. Minimizing placement of borrow sources in high quality late winter habitat, etc. as described in sections above.	No additional mitigation is possible	NA	Yes
Cumulative increasing mortality risk on caribou, moose and grizzly bear	Traffic controls and limited to no public use of the road (harvest) Waste management at site to minimize wildlife attraction	A number of multi-party mitigation actions are possible, including changes to management regimes and community participation in wildlife management planning – many of which are described above, and in Appendix 12C.	Moderate to High – multi-party harvest management for species at risk has proven successful in Yukon (e.g., southern lakes caribou)	No

Note
1. Mitigation measures for Project-specific effects include mitigation measures that have been proposed by CMC to eliminate, reduce or control similar adverse environmental or socio-economic effects.
2. Additional mitigations measures may be either Project-specific mitigation for which CMC can implement or recommended mitigation measures for which other parties could implement.

12.5.4 Significance of Residual Cumulative Effects

Habitat

Residual effects include the loss of late winter habitat for Klaza caribou and moose, both as a result of the Casino Project and from other past, present and future projects in the region. There will be a cumulative loss of habitat in areas that cannot be reclaimed entirely to baseline conditions. However, given the scale of the range of moose and Klaza caribou, cumulative loss can be mitigated by the collective actions of individual Project proponents, which could include minimizing/mitigating disturbances to wildlife and reclaiming key habitats if they are disturbed. Also, based on current known past, present or future projects in the area, it is unlikely that there will be enough large-scale anthropogenic disturbances to reduce population viability as a result of habitat loss. Anthropogenic disturbances can act cumulatively with natural disturbances such as fire, but the scale at which fires occur would mask any effect of industrial-related habitat losses. Considering mitigation and the low likelihood of large-scale anthropogenic disturbances in this landscape, the cumulative effect on habitat loss is expected to be not significant (Table 12.5-5).

Mortality

It is expected that the Project`s adverse effects on wildlife mortality risk will be combined with the potential adverse effects of other past, present and future projects and have an overall cumulative effect on regional wildlife mortality. It is unlikely that project-specific mortalities (e.g., road collisions, kills as a result of defence of life or property) will be the cause of a significant effect on populations, and the interaction may be related to unregulated harvest. If unregulated harvest as a result of increased human access is the issue, tools are available to wildlife managers to ensure that human-caused mortality does not exceed sustainable mortality levels. These tools may include comprehensive management planning and enforcement. Given that tools are available to wildlife managers to manage human-related mortality, the cumulative effect on wildlife mortality is expected to be not significant (Table 12.5-5).

Table 12.5-5 Significance of Residual Cumulative Effects on Wildlife

Residual Cumulative Effect	Predicted Degree of Effect After Additional Mitigation Measures								Significance of Residual Cumulative Effect (Significant/Not Significant)
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Habitat loss	Adverse	Medium	Widespread	Permanent	Infrequent	Irreversible	High	High	Not significant
Mortality risk	Adverse	Medium	Widespread	Permanent	Frequent	Reversible	Low	Low	Not significant

Criteria definitions are detailed in Table 12.1-4

12.5.5 Discussion of Significance of Residual Cumulative Effects

Based on the cumulative effects assessment, the Casino Project is not likely to have any significant adverse effects on terrain features after the implementation of mitigation measures. This is summarized in Table 12.5-6. The level of confidence in these predictions is moderate.

Table 12.5-6 Summary of Residual Cumulative Effects – Air Quality

Residual Cumulative Effect	Direction (Adverse/Beneficial)	Significance (Significant/Not Significant)	Level of Confidence (Low, Moderate, High)
Habitat loss	Adverse	Not significant	Moderate
Mortality risk	Adverse	Not significant	Moderate

12.6 SUMMARY AND CONCLUSIONS REGARDING CUMULATIVE EFFECTS ON WILDLIFE

CMC recognizes the concerns regarding the potential cumulative effect on wildlife from the Casino Project, particularly the concern regarding the Freegold Road Extension. The initial construction and operation of the Freegold Road Extension is the largest contribution to regional cumulative effects because the road provides access into what has generally been an area without year-round access (winter access currently exists to some areas). There may be a perception that the road will provide access for increased mineral development, including increased traffic, spur roads, increasing disturbance footprints, and overall increased human access to the area, especially during the snow free season when access into the interior (away from the currently available river access points). However, access to this road will only be permitted once CMC, the Yukon Government, LSCFN and SFN have all agreed to permit that specific user, and if the use is in accordance with a management plan intended to ensure appropriate mitigation to protect wildlife and habitat are in place.

This analysis and the cumulative effect analyses conducted for the White Gold area (that included the Casino Mine site in that analysis; EDI 2013) show that project footprints contribute to a marginal loss of habitat. Linear and non-linear disturbances increase with increasing developments as shown in the White Gold cumulative effects analyses. Although the Freegold Road Extension provides access to a mineralized belt with many exploration interests, there are a limited number of projects that appear to be at any reasonable stage of development to be considered as potential future projects — Carmacks Copper and Northern Freegold`s Nucleus project among the few considered here. The likelihood of these projects occurring consecutively and year-round with the Casino Project is unknown, and based on mining history in Yukon, consecutive operation is unlikely.



1:250,000 Topographic Spatial Data, National Road Network, Ecoregions; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Potential Disturbance Area (PDA) provided by Knight Piesold Ltd. September, 2013.

Klaza caribou herd range provided by YG - Environment (received 2011).

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Projects Considered in the Wildlife Cumulative Effects Assessment

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13 – EMPLOYMENT AND INCOME

13.1 INTRODUCTION

Construction and operations of the Project will create employment and income opportunities for local and regional residents. The assessment of potential effects on the Employment and Income VC examines labour availability in the study communities and their ability to meet potential labour demands during the lifetime of the Project. It also estimates the direct, indirect, and induced local employment and employment income derived from the Project. Potential effects are considered for residents of the local and regional study areas, including First Nations. Economic issues and proposed management measures are also considered and described. Additional detail to supplement this section is available in Appendix 13A.

13.1.1 Regional Setting

The Project is a proposed Open Pit mine located approximately 300 kilometres northwest of Whitehorse, Yukon Territory on Crown land that is administered by Yukon Government. The Project site is located within the Selkirk First Nation traditional territory. The Project will require construction of a road access, including upgrades to the existing Freegold Road and construction of the Freegold Road Extension on land that falls within the Selkirk First Nation and Little Salmon / Carmacks First Nation traditional territories. The Freegold Road Extension and proposed Freegold Road Upgrade will extend for approximately 200 km southeast from the Project to the village of Carmacks.

13.1.2 Rationale for VC Selection

The Employment and Income VC was selected based on consideration of the information and issues communicated by the public, Aboriginal groups, local communities, and government stakeholders engagement process conducted in support of this Proposal. This VC and specific indicators were also selected based on professional judgement and experience in conducting effects assessments for similar projects.

It is important to assess potential effects on Employment and Income as it is a prominent factor in determining community benefits arising from the Project. Changes in employment and income can affect the well-being of individuals, families, and communities in the area. This section of the Proposal assesses labour availability in the study communities and their ability to meet Project labour demands.

13.2 ASSESSMENT BOUNDARIES

13.2.1 Local Study Area (LSA)

The LSA includes those communities adjacent to the Project site and the proposed access route. These communities represent the closest and most accessible potential sources of direct labour, goods, and services needed for the Project and, therefore, are expected to experience direct Project socio-economic effects. The LSA includes the following communities (Figure 13.2-1):

- Settlement of Pelly Crossing (Selkirk First Nation);
- Village of Carmacks and the community of Little Salmon/Carmacks First Nation; and
- City of Whitehorse.

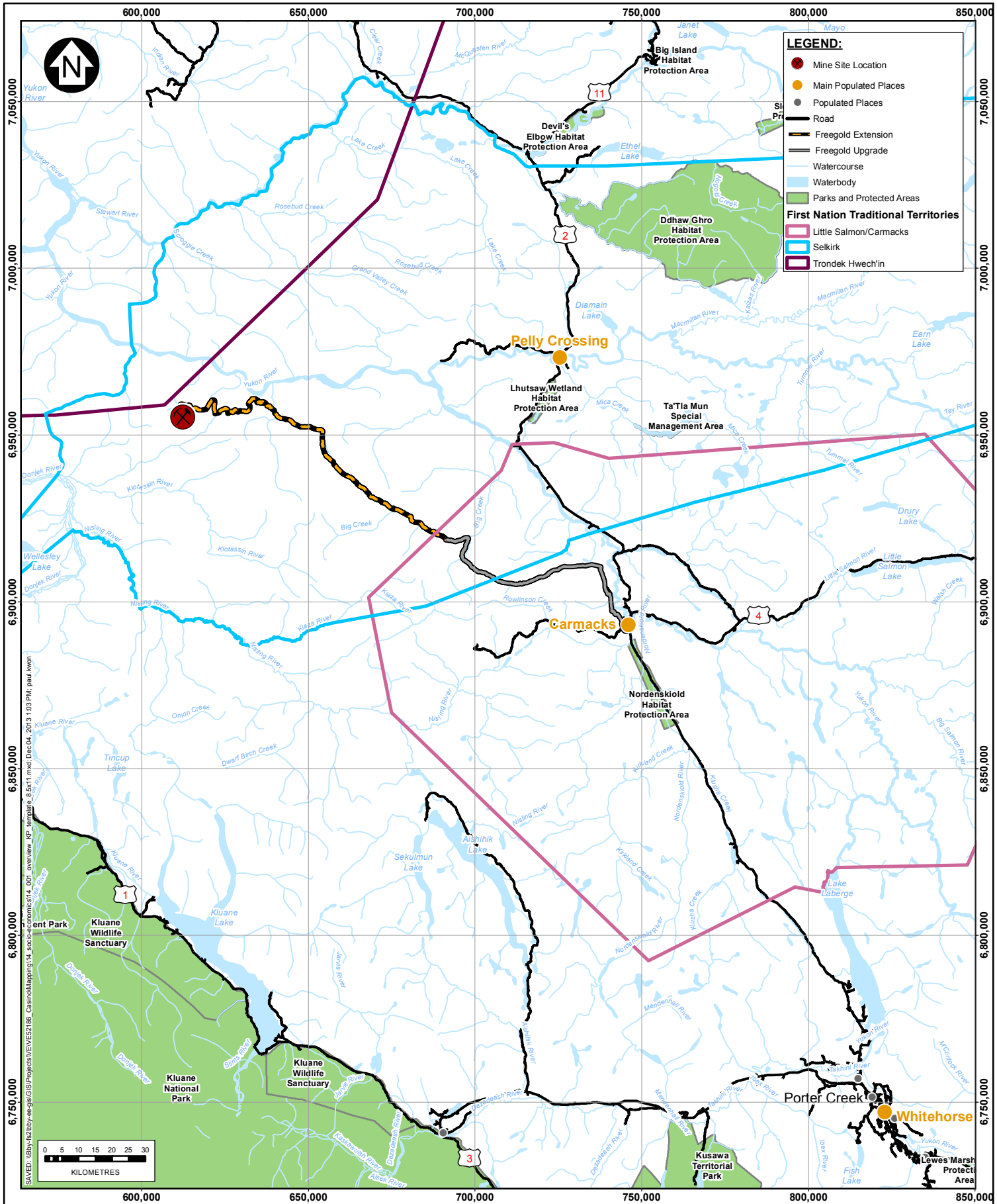
Whitehorse is included in the LSA due to its potential to contribute supplies, services, and labour to the Project. The capital city of the territory is likely to serve as a major supply centre and transportation hub for the Project which has the potential to cause direct socio-economic effects on its residents.

13.2.2 Regional Study Area (RSA)

The RSA comprises the Yukon and provides a broader geographic context for understanding potential Project socio-economic effects. It is expected that some of the Project employment and economic opportunities will be experienced at the territorial level. Particularly, potential effects associated with this Economic Development and Business Sector VC such as changes to economic growth, business opportunities, government revenues, employment and income will be experienced throughout the Yukon.

13.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Project. Details on activities associated with the construction, operation, closure and decommissioning, and post-closure phases of the Project are provided in Section 4.



PREPARED BY:

amec

DESIGNED	PK
DRAWN	PK
CHK'D	MY
APP'D	PMB
REV	-
DATE	03DEC'13

NOTES:
1. BASE MAP: Atlas of Canada 1:1,000,000, Yukon Geomatics
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: Metres

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CASINO PROJECT

Socio-economic Study Area

FIGURE 13.1-1

REF REPORT 1

P/A VA101-325/15

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13.3 BASELINE CONDITIONS

Baseline conditions for this VC vary considerably between the rural communities of Pelly Crossing and Carmacks and the urban community of Whitehorse. Measured by the key indicators of income and employment, the rural communities are characterized by low participation rates (measure of the active component of the labour force), high unemployment rates, and low incomes. Pelly Crossing in 2011 had an unemployment rate of 46%, the highest in Yukon, and the participation rate was 64% compared to a Yukon average of 77%. Data for Carmacks in 2011 is not available from Statistics Canada, but in 2006 the community had an unemployment rate of 19% and a participation rate of 76% compared to a Yukon average of 9% unemployment and 78% participation. Incomes in the rural communities were lower. In Pelly Crossing, 2010 median individual incomes were $18,328 (45% of the Yukon average) and household incomes were $56,345 (74% of the Yukon average). In Carmacks, median individual income in 2005 was $22,912 and median household income was $36,992 (62% of the Yukon average). In Pelly Crossing, government transfers accounted for 21.5% of income compared to a Yukon average of 9.2% (Statistics Canada 2013; Statistics Canada 2006).

Whitehorse, by contrast, is relatively prosperous. Residents of the city have higher participation rates (79.8% in 2011), lower unemployment rates (8.1% in 2011), and higher incomes ($43,111 for individuals in 2010 and $75,944 for households) than in other LSA communities and Yukon as a whole. Whitehorse is home to 97% of the residents of the LSA (27,753 in 2012) and 78% of the residents of Yukon. The city is Yukon's hub for retail, government, business services, and recreation (Yukon Bureau of Statistics 2013; Statistics Canada 2013).

Yukon's mining sector is experiencing a fall in the price of the region's major metals from the highs seen in 2011 (Section 15.2). By September 2013, compared to the average price in 2011, copper prices fell by 19%, gold prices by 14%, and silver prices by 36%. Similar changes have been seen for other metals produced by the mining industry across Canada, noticeably for base metals such as iron ore and nickel. The fall in prices will likely have the largest effect on exploration activities and is expected to lead to reductions in the regional mining workforce. A June 2013 poll reported that 46% of mining companies across Canada are considering layoffs to compensate (Sankey 2013).

Yukon's mining industry employed an estimated 2,675 workers in 2012, most of them (64%) exploration and services workers. The mining labour market in Yukon differs from other parts of Canada in that it has more young and old workers with a gap in the mid-career age group, is highly mobile, employs a greater share of Aboriginal people, and its workers retire later than the national average in mining. The market for skilled workers in the mining industry is tight. In mining production, employers currently rely on a large contingent of workers who live in other provinces, which creates economic, social, and infrastructure challenges and a need to explore ways to encourage these workers and their families to relocate to Yukon. Even though Yukon has seen small increases in the number of students entering mining occupations in the last 5 years, retirements in the rest of Canada are expected to cause shortages in the national market for skilled mine workers, even in an environment of layoffs arising from falling commodity prices (MiHR 2012).

13.4 PROJECT-SPECIFIC EFFECTS

13.4.1 Project Interactions and Potential Effects

Table 13.4-1 presents potential interactions between 44 Project components and activities (see Section 4) and the Employment and Income VC. The identified interactions warrant further analysis because they may result in positive or negative effects on Employment and Income, during the life of the Project. Resulting potential effects are evaluated and described in subsequent sections.

Project components and activities that may cause a direct or indirect effect on employment and income conditions during the Project construction, operations, and closure and decommissioning phases include:

- Contracted Employment; and
- Mine Staffing.

Employment

The Project will result in considerable direct employment as well as contracted employment generated from contracting and procurement associated with Project purchases. The employment effects would depend on whether Project-related jobs are filled by residents or by non-residents; and whether non-residents relocate to the RSA or commute to work. Evaluation of employment effects requires consideration of socio-economic context, since Project demand for labour may be so large as to cause shortages in other sectors and industries.

Labour Income

Increased employment opportunities will positively affect labour incomes of local and regional residents. If the economy is fully employed, rising incomes in one sector can shift workers into higher-paying sectors, shifting the overall industry composition of the labour market.

Table 13.4-1 Potential Interactions between the Project and Employment and Income

Project Components and Activities	**Project Phase**[1] (C, O, DC, PC)	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, DC	No	No specific interaction with this socio-economic VC
Aggregate Sources / Borrow Sites	C	No	No specific interaction with this socio-economic VC
Airstrip and Airstrip Access Road	C, O, DC	No	No specific interaction with this socio-economic VC
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O	No	No specific interaction with this socio-economic VC
Concentrate Transport and Loading	O	No	No specific interaction with this socio-economic VC
Concrete Batch Plant Operation	C, O	No	No specific interaction with this socio-economic VC
Contracted Employment	C, O, DC	Yes	Project purchases would generate employment opportunities for LSA and RSA residents
Contracted Employment	C, O, DC	Yes	Increased employment opportunities would positively affect labour income for LSA and RSA residents
Cyclone Sand Plant	C, O	No	No specific interaction with this socio-economic VC
Dismantling of Facilities	DC	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Diversion of Canadian Creek	C, O	No	No specific interaction with this socio-economic VC
Drilling and Blasting	C, O	No	No specific interaction with this socio-economic VC
Fish Habitat Compensation Construction	C, O	No	No specific interaction with this socio-economic VC
Freegold Road Extension	C, O, DC	No	No specific interaction with this socio-economic VC
Freegold Road Upgrade	C, O, DC	No	No specific interaction with this socio-economic VC
Fuel Storage and Distribution System	C, O	No	No specific interaction with this socio-economic VC
Gold Extraction Plant / Oxide Ore Processing	C, O	No	No specific interaction with this socio-economic VC
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C	No	No specific interaction with this socio-economic VC
Hazardous Materials Storage, Transport, and Disposal	C, O	No	No specific interaction with this socio-economic VC
Heap Leach Facility	C, O	No	No specific interaction with this socio-economic VC
Heap Leach Pad	C, O	No	No specific interaction with this socio-economic VC
Laydown Areas	C, O	No	No specific interaction with this socio-economic VC
LNG Transport to Site	C, O	No	No specific interaction with this socio-economic VC
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O	No	No specific interaction with this socio-economic VC
Maximum Disturbance Area	C, O, DC	No	No specific interaction with this socio-economic VC
Mine Development	C, O, DC	No	No further interaction; already addressed in other Project components
Mine Staffing	C, O, DC	Yes	Project workforce demands would increase local and regional employment
Mine Staffing	C, O, DC	Yes	Project competition for local labour may result in shortages in other sectors and industries
Mine Staffing	C, O, DC	Yes	Increased employment during Construction and Operations would positively affect labour income for LSA and RSA residents
On-site Equipment and Vehicle Use	C, O, DC	No	No specific interaction with this socio-economic VC
Open Pit Mining	C, O	No	No specific interaction with this socio-

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
			economic VC
Ore Conveyors	C, O	No	No specific interaction with this socio-economic VC
Ore Crushing	C, O	No	No specific interaction with this socio-economic VC
Ore Hauling	C, O	No	No specific interaction with this socio-economic VC
Ore Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Processing Facilities for Sulphide Ore	O	No	No specific interaction with this socio-economic VC
Reagent Storage and Distribution	C, O	No	No specific interaction with this socio-economic VC
Site Reclamation / Re-Vegetation	O, DC	No	No specific interaction with this socio-economic VC
Site Security and Fencing	C, O, DC	No	No specific interaction with this socio-economic VC
Surface Water Management (Contact Water)	C, O, DC	No	No specific interaction with this socio-economic VC
Surface Water Management (Non-Contact Water)	C, O, DC	No	No specific interaction with this socio-economic VC
Tailings Management Facility	C, O, DC	No	No specific interaction with this socio-economic VC
Topsoil Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Traffic (Equipment and Materials to Site)	C, O, DC	No	No specific interaction with this socio-economic VC
Waste Management: Garbage and Sewage Waste Facilities	C, O	No	No specific interaction with this socio-economic VC
Wasterock and Overburden Disposal	C, O	No	No specific interaction with this socio-economic VC
Water Supply	C, O, DC, PC	No	No specific interaction with this socio-economic VC

Note:

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

13.4.1.1 Potential Project Effects on Employment and Income

The assessment of economic effects in terms of quantitative estimates of employment and income are based on MNP's Economic Impact Report (MNP, 2013). As discussed in Section 15, MNP's estimates were derived from

Statistics Canada's 2008 Input/Output ("I-O") Model using estimates of future operational and capital spending. The report's assumptions and approaches were selected in cooperation with CMC representatives using expenditure information derived from the Project Feasibility Study.

The Statistics Canada I-O Model has some inherent limitations. For example, changes in industrial structure and linkages since 2008 are not reflected in the modelling results. This also means that changes in the technology of producing goods and services, input patterns, and relative prices since 2008 are not reflected in the estimates. This is a concern in Yukon, where 2008 mining activities did not operate at the scale of the Project and thus may not be representative of its economic effects. As a result, the assessment predicts levels of income below national industry norms and levels of employment above industry norms.

Another limitation is that I-O models are static models in which dynamic changes over time are not explicitly represented. Although I-O models estimate the effects on major economic variables, they do not calculate the amount of time required for the propagation of all effects. Despite these limitations, I-O models are widely used to quantify the potential effects of proposed projects on territorial / provincial and national economic activity and employment.

Construction

Construction of the Project is expected to occur over four years and will be accomplished in the typical EPCM (Engineering, Procurement and Construction Management) format. As such, the construction workers are expected to be employed by contractors engaged to construct specific portions of the project. Employment will be somewhat seasonal given the region's climate. The first phase of construction is projected to take place in 2016 (concurrently with the all-weather Freegold Road Extension and Upgrade to the site). During this period, the peak workforce will be approximately 264 personnel and accommodation will be a combination of owner-furnished and contractor-furnished. The second phase will follow in succeeding years with the peak on-site workforce rising to approximately 1,000 personnel. The owner-furnished construction camp will be used to house construction contractors during this Project phase with only access-road work relying on contractor-furnished accommodation.

Construction of the Project is expected to cost a total of approximately $2.5 billion in capital expenditures, of which approximately 26% would be spent in Yukon. In addition to direct employment effects, indirect and induced employment effects will occur in Yukon from these expenditures. These spin-off effects (Table 13.4-2) are related to the purchase of goods and services needed to construct and operate the Project (indirect effects) and the expenditures of direct and indirect labour income on consumer goods and services (induced effects). Estimates of employment effects include both planned construction workforce and construction contractor support workers.

MNP's analysis estimates that construction of the mine would support 5,091 full-time equivalents (FTEs) of employment in Yukon over 4 years, of which 3,275 FTEs would arise from direct expenditures. It would also bring $195 million in wages and salaries within Yukon, of which $137 million would come from direct expenditures (Table 13.4-2).

Table 13.4-2 Projected Construction Impacts of the Project to Yukon

Total Impacts	Employment (FTEs)	Wages and Salaries (millions)
Direct	3,275	$137
Indirect and Induced	1,817	$58
Total	5,091	$195

Note:
Estimated wage and salary impacts do not include employers' contributions or payments to benefit plans for employees and their families.
Source: MNP, 2013

The income earned through mine staffing and contracted employment will be competitive given the location and the tightness of the market for skilled labour. Wages and salaries for construction personnel will need to be competitive to attract adequate labour of the required skill sets.

It is likely that construction for the Project will be undertaken in competition for resources with other projects. The fall in commodity prices is expected to delay major projects as financing becomes difficult to attain (Northern Miner 2013), but even in this environment, several mines are expected to begin production in Yukon over the medium term. One example of a potential project is Victoria Gold's Eagle Gold Mine near Mayo, which has received permitting approval to begin construction in 2014 on a mine that will move into production in 2016. The Eagle Gold Project would employ 400 construction workers and 200 mining workers over its operations phase; however, the company has not yet acquired the financing to meet this timeline and it could shift into the Casino Project's construction schedule (Ronson 2013). The Yukon Government noted that there are currently five projects (not including the Casino Project) that have gone through permitting or in the process of obtaining the appropriate permits. There are also 10 projects that are conducting advanced exploration or are completing feasibility-related work. A number of the proponents have noted development timelines that could see development and production within five years (Yukon Economic Development 2013).

The combined effect of the simultaneous construction of multiple projects on employment and income would be constrained by the large share of construction workers not resident within the RSA. Yukon residents are expected to account for approximately 26% of the direct construction workforce, and similar or lower shares would be expected for other projects over the period. Income growth would also be constrained by the high share of non-resident workers, since these workers would be drawn from the larger, mobile Canadian labour market. Still, in this scenario, competition for resources would reduce some direct, indirect, and induced effects from the Project on employment and income since these are based on the assumption that the regional economy is not fully employed.

There is considerable uncertainty about the likelihood of any single project moving into production within the time frame of this Project's construction phase. The analysis of economic effects from the Project does not include a quantified estimate of the potential effect during a high growth scenario. Current market sentiment is that financing is difficult for major mining projects and that a high growth scenario is unlikely in the near future (Conference Board of Canada 2013). Construction employment is expected to be short-term and counter-cyclical given the fall in commodity prices.

Operations

Hiring for operations workers will begin during the construction phase, as early as 2017. The Project will require pre-production operations workers in all areas of activity prior to the start of the Operation Phase. These workers will work for CMC and are forecast to rise to as high as 311 workers by 2019. The workforce during the Operation Phase is expected to rise from 638 when production begins in 2020, to 652 in 2024 (Figure 13.4-1).

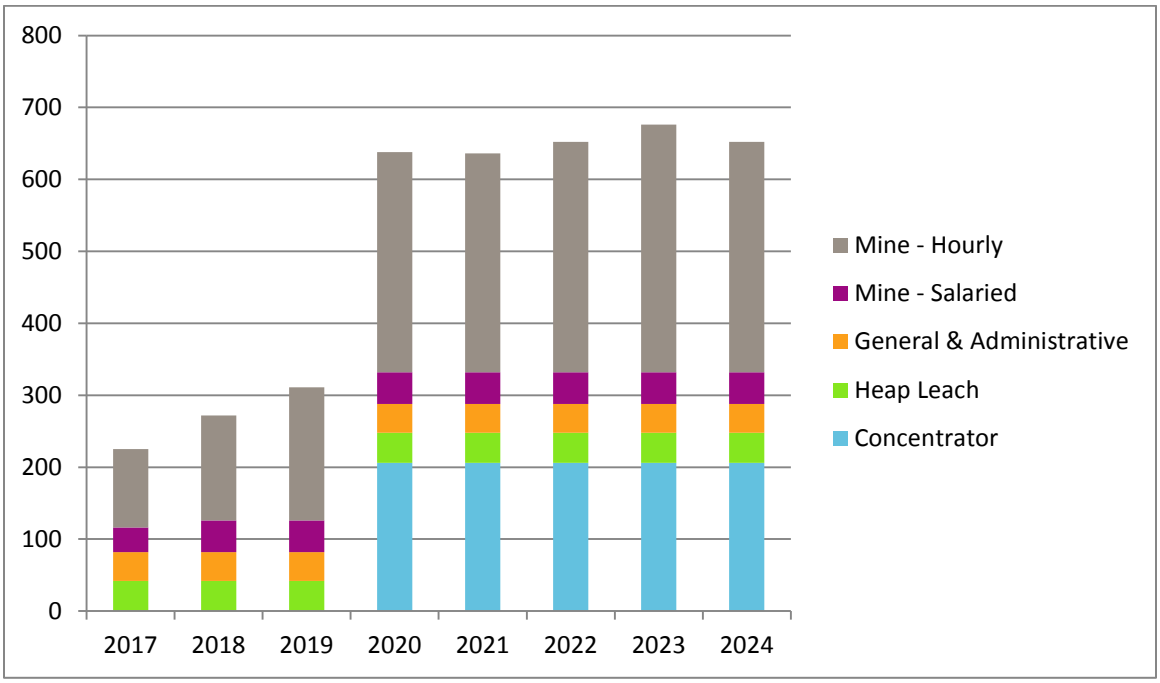


Figure 13.4-1 Estimated Project Pre-operations and Operations Staffing, 2017-2024

CMC intends to employ as many people from Yukon as possible, including from First Nations communities. Additional personnel from outside Yukon may be necessary to fully staff the Project during the operations phase, but CMC plans to develop a rising share of Yukon-based employees as operations move to peak production, as shown in Table 13.4-3. By 2024, this share is forecast to rise to 82% Yukon-based employees compared to a current industry average of 51% (MiHR 2012).

Table 13.4-3 Yukon-based Share of Pre-production and Operations Staffing

Year	Project Phase	Yukon-based Workforce	Total Workforce	Yukon Share
2016	Construction	0	0	N/A
2017		68	143	47.6%
2018		155	272	57.0%
2019		196	311	63.0%
2020	Operations	353	432	81.7%
2021		442	636	69.5%
2022		489	652	75.0%
2023		525	676	77.7%
2024		536	652	82.2%

The size of the workforce is estimated to stabilize at the 2024 peak and then progressively decline as the mine nears the end of its life in 2042. Casino Mining Corporation is committed to the continued recruitment, training, and advancement of Yukon workers and will work to increase the share of Yukon resident workers over the lifetime of the mine; however, to the extent that residency reflects worker preference and given the competitive labour market for skilled workers, it is unlikely that the workforce would become fully resident. Workforce

estimates may change based on changes in productivity, ongoing exploration activity, and changes in commodity prices.

In addition to direct employment opportunities, the operations of the Project are expected to impact Yukon's economy through expenditures on goods and services. CMC estimates that roughly 69% of operational spending will occur in Yukon. With this percentage and with projected annual operational spending data provided by CMC, MNP estimates that the operation of the mine would support an additional 313 FTEs of indirect and induced annual employment. In total, MNP estimates that operations of the mine would create annual employment of 855 FTEs and generate $43 million in annual wages and salaries in Yukon. These results are shown in Table 13.4-4.

Table 13.4-4 Projected Annual Operations Impacts of the Casino project to Yukon

Total Impacts	Employment (FTEs)	Wages and Salaries (millions)
Direct	542	$32
Indirect and Induced	313	$11
Total	855	$43

Note:
Estimated wage and salary impacts do not include employers' contributions or payments to benefit plans for the health and financial well-being of employees and their families.
Source: MNP, 2013

Over the Operation Phase, salaries and hourly wages will be competitive depending on market demand. MNP's economic assessment is based on a conservative estimate of salaries of contractors and mine staff that average roughly $60,000 per year (excluding benefits). Incomes vary between hourly and salaried labour and between operational areas; for example, labour and benefit costs are estimated at around $61,000 for workers at the concentrator while labour and benefit costs for heap leach workers average around $72,700 due to the increased number of higher skilled positions. Labour market pressures may increase salaries and wages beyond these estimates, particularly for skilled workers (Statistics Canada 2013).

As discussed above and shown on Figure 13.4-1, the number of Yukon-resident operations workers is expected to rise over the life of the Project although they will constitute a varying share of the operations workforce (between 70% and 82%, as shown in Table 13.4-3). Most workers are anticipated to be drawn from Whitehorse. Workers will be drawn from Pelly Crossing and Carmacks as much as possible, but (as shown in Table 13.4-5) although rural communities have high unemployment rates, they are too small in size to provide a substantial share of the workforce for skilled positions requiring previous mining experience. However, the Project will also offer employment opportunities for unskilled positions. The Project is forecasted to require 20 general labourers, 12 janitors, and a variety of helpers once the mine moves into production. In addition, there are a large number of trainable positions that will be available for workers with relatively low levels of educational attainment, such as the large (between 50 and 60) team of truck operators.

Table 13.4-5 Labour Force in LSA Communities, 2011

Area	Labour Force Measure			
	Active Labour Force	Unemployed	Construction Labour Force	Mining Labour Force
Pelly Crossing	185	85	21	0
Carmacks*	240	45	14	19
Whitehorse	14895	1130	1341	521
LSA	15320	1260	1376	540

Notes:
*Values for Carmacks are for 2006
Source: Statistics Canada, 2013; Statistics Canada, 2012; Statistics Canada, 2007

While the number of unemployed in the LSA is high relative to Project requirements, the local labour supply lacks the adequate mix of skill levels required to meet Project demands. Labour shortages are common for skilled trades. A 2012 study by MiHR estimated that even under a contracting mining sector, demand for workers in the industry in Yukon was expected to be 2.5 times higher than the number of people currently employed. Employment in mining production was expected to have the largest gains, while employment in exploration was forecasted to shrink slightly as commodity prices experience a partial correction. Employment in support activities was expected to remain steady, with a shift in the types of services offered as more mines become active and exploration shrinks—a trend already starting to happen with the recent developments of new mineral processing and laboratory activities in the territory (MiHR 2012). While the study may have underestimated the extent of the correction in prices, the underlying observation that replacement of retiring workers will tighten the market for skilled workers remains relevant. This is a national trend and one that will likely directly affect Yukon mining wages given the large current role of workers from outside Yukon in the territory's mining labour force.

To some extent, some skilled labour can be provided from existing mines within the RSA. Capstone Mining Corporation's Minto opened in 2007 and is located close to Selkirk First Nation / Pelly Crossing. It now employs a 25% Aboriginal workforce or an estimated 30 individuals based on current workforce requirements (Minto Explorations 2012), with more employment expected for underground production in late 2013. The company has training agreements with Selkirk First Nation and many of these workers are expected to have been drawn from the community, but there is little evidence of this in the 2011 National Household Survey compiled by Statistics Canada, which does not list any of the workforce in Pelly Crossing as working in resource industries and shows the increase in trades, transport, and equipment operators to be only from 17.1% in 2006 to 24.2% in 2011, an increase of about 13 workers (Statistics Canada 2013, Statistics Canada 2007). There are many potential explanations for this, including the possibility that many of the Aboriginal workers at the mine are drawn from members living outside the community and that low response rates among mine employees resulted in workers not being included in the data. Minto mine is scheduled to begin closure and reclamation in mid-2022 and will be decreasing its workforce for years prior to closure. As a result, there is the potential for a supply of skilled local workers from the LSA to transfer to the Project during the time that substantial hiring is expected to occur in advance of production reaching peak output.

Other mine closures outside of the LSA, but within the RSA, may also supply skilled workers. The Wolverine mine, a zinc-silver-copper-lead-gold underground mine operated by Yukon Zinc Corporation located in southeastern Yukon, is scheduled to close in 2021 (Yukon Zinc Corporation 2013). That mine is currently operating at a reduced workforce of 100 people, but typically employs 200 when at full production (Ronson

2013b). Closure for Alexco Resource's Bellekeno mine is currently set for 2016 (Alexco Resources 2013) although weak silver prices have caused the mine to shut down and may not reopen. Bellekeno normally employs 100 people (CBC News 2013).

Despite these closures, it is expected that some new mines will open in Yukon over the next decade and these mines will need workers, which will drive structural changes in labour markets. The transition of employment to the mining sector represents a maturation of the mining industry in Yukon, since it is driven by the shift from relatively small-scale exploration activities to large-scale production activities. This transition is economically efficient in the sense that it allows workers to move to higher value-added positions, which consequently improves incomes. Rises in productivity in the goods-producing sector then translate into the service industry, resulting in higher incomes broadly throughout the economy. This shift can harm low-wage, low-productivity industries, which will have difficulty attracting workers (Bradley and Sharpe 2009).

This is less of a factor in Yukon where the high cost of transportation precludes most low value-added industries. Instead, the pattern seen within the LSA is one of rural communities with high levels of unemployment and local government employment (Section 14.3). Since mining employment occurs in rural areas and a substantive component of its labour demand does not depend on high levels of educational attainment, a large portion of cumulative employment effects are likely to be non-rivalrous as activities pull unemployed and underemployed workers into the formal sector.

Demand for skilled workers, however, is likely to be more problematic. One effect of higher demand for skilled labour would likely be to increase the share of workers drawn from outside Yukon who engage in long-distance commutes across the industry, reducing the share of income generated from the sector retained in Yukon. Another effect would be to increase the rate of migration, as discussed in Section 16. Finally, more students will be drawn to shift careers into the mining sector and some people will pursue re-training into the industry to take advantage of the relatively high incomes offered. An estimate of structural shifts toward the mining sector is presented in Section 14.4.

Closure

Reclamation and closure expenditures are forecast at $125.9 million spread over four years (including the final year of production). These expenditures would include post-closure monitoring, which will continue until results of monitoring demonstrate that closure objectives are achieved and are self-sustaining. Monitoring of various site aspects, such as water quality, is expected to continue at the site over an extended period of time. Data on closure employment are not available, but are expected to be similar to construction employment except distributed over four years and of a much lower magnitude and most work is expected to be contracted with preference given to firms located in the RSA.

Table 13.4-6 summarizes the potential effects of the Project on the Employment and Incomes VC.

Table 13.4-6 Potential Effects on Employment and Incomes

Mechanism of Interaction	Key Indicator(s)[1]	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
Project Purchases	Employment	C, O, DC	Project purchases would generate employment opportunities for LSA and RSA residents	Beneficial
Project Purchases	Labour Income	C, O, DC	Increased employment opportunities in supplier industries would positively affect labour income for LSA and RSA residents	Beneficial
Project workforce demands	Employment	C, O, DC	Project workforce demands would increase local and regional employment	Beneficial
Project workforce demands	Labour Income	C, O, DC	Project competition for local labour may result in shortages in other sectors and industries	Adverse
Project workforce demands	Labour Income	C, O, DC	Increased employment during C and O would positively affect labour income for LSA and RSA residents	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

13.4.2 Identification of Mitigation Measures

Effects on the LSA and RSA employment and income are generally considered to be beneficial and do not require mitigation. Wages in the mining sector are substantially higher than the average area wage and so employment income derived from the mining sector will be a positive effect and no mitigation is required. Mining jobs also generate additional benefits that are not reflected in the immediate wage income; these include pension contributions, dental and medical plans, and other employee benefits not considered in the MNP analysis. While mitigation is not required, there are opportunities for enhancement of local and regional benefits. CMC will enhance these positive effects by:

- Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA;
- Implementing a procurement process that, where economically feasible, gives preferences to suppliers from the RSA and in particular from rural communities within the LSA;
- Requiring cultural awareness training for employees and contractors;
- Monitoring Project socio-economic effects and adapting management measures where required;
- Providing on-the-job training to assist local and regional workers to develop mining-specific skills;
- Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA (Section 16);
- Partnering with First Nation communities to access additional funding for training;

- Supporting non-mining training and entrepreneurial initiatives; and
- Implementing career training and development opportunities for employees once hired.

The mining sector is expected to be an increasingly important employer in Yukon but this has implications for other sectors that may have difficulty keeping workers in an environment where mining companies are working to recruit away their employees. CMC is committed to reduce these effects by wherever possible drawing from the existing mining workforce when recruiting. The Wolverine, Bellekeno, and Minto mines are scheduled to close in the period when the Project would be actively recruiting operations workers (Minto Explorations 2012; Alexco Resources 2013; Yukon Zinc Corporation 2013). CMC would work with mining companies within the RSA to attract local workers set to be laid-off as these mines reach their end-of-life. CMC will use reasonable best efforts to draw workers from the existing unemployed or underemployed regional labour pool and from residents from outside Yukon.

At closure, the loss of operational employment would result in a large net decrease in local and regional employment. The overall effect of closure will be negative and unavoidable. Given that mine closure will occur some 30 years in the future, it is not possible to establish a list of specific mitigation actions at this time that will ultimately prove to be effective. CMC is committed, however, to ongoing investment in workers to enhance employability and to help workers find new employment in the mining industry after production ends.

Given the potential significance of mine closure, CMC will commit to working with the affected communities and government agencies to develop a mine closure plan that includes a strategy for buffering the effects of eventually losing up to 500 mining jobs. Elements of the plan could include such things as continuing to offer skills upgrading to workers to provide them with the capacity to find other non-mining jobs after mine closure, assisting in the development of new economic development opportunities, and working with other regional employers to find new jobs for mine employees. However, given the dynamic nature of the regional economy and that mine closure would occur 30 years from now, it is premature to commit to more specific mitigation actions at this time.

Employment in the post-closure phase will be limited to monitoring and not be of a magnitude noticeable outside of the rural communities within the LSA. Table 13.4-7 summarizes the potential Project effects and proposed mitigation measures.

Table 13.4-7 Potential Residual Effects and Identification of Mitigation Measures

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (*or Enhancement*) Measure[2]	Predicted Effectiveness	Residual Effect
Project purchases would generate employment opportunities and increase labour income for LSA and RSA residents	C, O, DC	Beneficial	Implementing a procurement process that gives preferences to suppliers from the RSA and in particular rural communities within the LSA; requiring cultural awareness training for employees and contractors.	High	Yes
Project workforce demands would increase local and regional employment	C, O, DC	Beneficial	Encouraging training and education so that workers can maximize incomes through: providing on-the-job training to assist local	High	Yes

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (*or Enhancement*) Measure[2]	Predicted Effectiveness	Residual Effect
			and regional workers to develop mining-specific skills; providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; partnering with First Nation communities to access additional funding for training; implementing career training and development opportunities for employees once hired; and providing continuous, on the job safety training.		
Project competition for local labour may result in shortages in other sectors and industries	C, O, DC	Adverse	Work with closing mines to transfer workers; target unemployed for trainable positions	Moderate	No
Increased employment during C and O would positively affect labour income for LSA and RSA residents	C, O	Beneficial	Encouraging training and education so that workers can maximize incomes through: providing on-the-job training to assist local and regional workers to develop mining-specific skills; providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; partnering with First Nation communities to access additional funding for training; implementing career training and development opportunities for employees once hired; and providing continuous, on the job safety training.	High	Yes

Notes

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio economic benefits are included as proposed enhancement measures.

13.4.3 Significance of Residual Effects

The criteria used to discuss residual effects are discussed in detail in Section 5, Assessment Methods and Frameworks. Table 13.4-8 outlines the seven criteria used to assess significance for the Employment and Income VC.

Table 13.4-8 Determining Significance of Residual Effects for Employment and Income

Criteria	Rating	VC Specific Definitions
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	Effect that occurs might or might not be detectable, but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge
Geographical Extent	Localized	Within the identified Local Study Area
	Widespread	Outside the identified Local Study Area
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, decommissioning and closures
	Permanent	Effects measureable Post-Closure
Frequency	Infrequent	Effects occur occasionally
	Frequent	Effects are continuous and consistently applied over the period
Reversibility	Reversible	Effect will return to baseline condition after operations, decommissioning and closure
	Irreversible	Effect is persistent after operations, decommissioning and closure
Context	Low Resilience	Effects operate outside of regional experience and represent a challenge to local socio-economic management institutions
	High Resilience	Effects are familiar to local socio-economic management institutions
Probability of Occurrence	Low	Effects are unusual under similar circumstances and are not expected to occur with this Project
	Moderate	Effects has a reasonable risk of occurring under similar circumstances or there is not currently sufficient information to assess probability
	High	Effects have consistently occurred under similar circumstances and are expected to occur with this Project

The Project will alter labour conditions during construction and operations, by increasing demand for labour and thereby lowering unemployment and raising incomes. Total employment effects from the Project annually amount to 11.1% of the total LSA labour force during the construction phase and 5.6% during the average operating year. Labour demand would be met by a combination of a falling unemployment rate, higher productivity for existing workers, rising participation rates, and increased migration (Prachowny 1993). The average annual incomes of operations workers will be 1.46 times the average RSA personal income and 3.22 times the average personal income of residents of Pelly Crossing. In combination with increased incomes flowing from indirect and induced

employment gains, the average annual income in the LSA over the operations phase will be increased over the 2010 average by about 6.9%. The effects on unemployment and income will be most noticeable in rural LSA communities for which low-skilled, unemployed workers make up a large share of the population. Labour that is not available from the local labour market would be drawn from migrants outside Yukon and from the training of non-mining workers for skilled worker positions. Given the size and nature of the labour market, and CMC's intention to implement a suite of enhancement measures, these effects are considered to be positive and significant in relation to both the RSA and LSA.

Mining activities within the RSA are expected to impose increasing pressure on the labour market for skilled mine workers, raising wages, and accelerating the structural shift in Yukon's labour market. The Project's contribution to these effects, however, will be limited in a labour market in which operates on a national scale with almost half of mine workers living outside Yukon (MiHR 2012). Thus, while the Project is expected to be noticeable within the context of Yukon's mining workforce, with the peak on-site workforce expected to increase mining employment in Yukon by 92% over its size in 2010 (Yukon Bureau of Statistics 2013), it is not noticeable within the context of Canada's mining workforce (accounting for 0.25% of the 2011 mining labour force) that because of high labour mobility will effectively set the wages of skilled mine workers. As a result, the magnitude of employment and income effects on wage inflation for skilled workers from the Project is not considered to be of significance. The Project will have noticeable effects on regional labour markets in that it will encourage a structural change towards the mining industry given the large magnitude of overall employment effects, but this process would be voluntary and efficient, and consequently not harmful to the livelihoods of existing Yukon workers.

The frequency of income effects is low as there will be two income expansion and contraction events, once around the short construction phase and then again during the longer operating phase. The duration coincides with the construction (4 years) and operating (22 years) phases. Direct income earned during the Project will also contribute to the retirement income of the workforce during operations and extend benefits beyond the operational phase of the Project.

Employment and income effects are reversible and are expected to return to baseline conditions during the closure and post-closure phases. However, as discussed in Section 16, substantial investments in training and capacity-development will improve the employability of workers and thus their capacity to maintain incomes within the mining industry. The duration of employment and income are expected to be long-term and sustained.

Table 13.4-9 Significance of Residual Effects for Employment and Income

Residual Effect	Predicted Degree of Effect After Mitigation (*or Enhancement*) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Project purchases and Project workforce demands would generate employment opportunities for LSA and RSA residents	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Increased employment opportunities would positively affect labour income for LSA and RSA residents	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Project competition for local labour may result in shortages in other sectors and industries	Adverse	Low	Localized	Long Term	Continuous	Reversible	High resilience	Moderate	Not Significant

Note:

For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

13.4.4 Discussion of Significance

The employment effects of the Project are significant and largely beneficial, having the potential to produce employment effects amounting to 5.6% of Yukon's workforce and raising incomes by an average of 6.9%. These effects would be expected to reduce the RSA's unemployment rate, increase participation, and increase the rate of migration into Yukon. Local effects in rural LSA communities would be particularly significant, given the very high baseline rates of unemployment, low overall populations, and the commitment of CMC to work with First Nation leaders to maximize local recruitment, training, and advancement within the Project workforce.

By the end of operations, local and regional employment supported by the Project will be largely eliminated. CMC is committed to improving the employability of workers through investments in training and education. CMC will commit to working with the local municipalities, First Nations, and the Yukon Government to help those who worked on the Project continue to work within the region.

Predictions of economic effects in terms of local and regional employment and on labour income were based on the financial model in the Project's Feasibility Study which is estimated to have a margin of error within the range of plus 15% to minus 10% (M3 2013). The Project's economic effects are estimated by MNP using the 2009 input/output economic multipliers for the Yukon as provided by the Industry Accounts Division of Statistics Canada. These multipliers describe how a change in final demand for the output of one particular industry would affect economic activity in the entire territory. The structure of the mining industry in 2009 in the Yukon may not be representative over the life of the Project, especially given its unique scale compared to other mining activities in the region. In addition, smaller regions increase the possibility of data errors within the tables which can increase the margin of error to the predictions. The combined effect of these sources of error are likely to increase the margin of error above plus or minus 15%.and thus require a moderate level of confidence. The moderate level of confidence with respect to local labour shortages reflect both the uncertainty with respect to the prediction of economic effects and uncertainty with respect to the distribution of employment effects between existing residents and new migrants to the Yukon.

Table 13.4-10 Summary of Residual Effects for Employment and Income

Potential Residual Effect	Direction	Significance	Level of Confidence (Low, Moderate, High)
Project purchases and workforce demands would increase local and regional employment during C and O	Beneficial	Significant	Moderate
Increased employment opportunities would positively affect labour income for LSA and RSA residents	Beneficial	Significant	Moderate
Project competition for local labour may result in shortages in other sectors and industries	Adverse	Not Significant	Moderate

13.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

13.5.1 Introduction

The assessment of potential Project effects on employment and income was conducted in the context of all past and existing economic activity, as well as forecasts industry employment that take into consideration other proposed and anticipated development projects and activities. Consequently, the effects assessment of the proposed Project is inherently cumulative and therefore no further assessment of cumulative effects is practical or required.

13.5.2 Identification of other Activities Potentially Affecting the VC

Identification of cumulative effects of the Project in terms of employment and income are addressed in Section 13.4.

13.5.3 Interactions and Potential Cumulative Effects

Interaction and potential cumulative effects of the Project in terms of employment and income are addressed in Section 13.4.

13.5.4 Proposed Mitigation Measures

Proposed mitigation measures for cumulative effects are discussed in Section 13.4.

13.5.5 Evaluation of Significance of Residual Cumulative Effect

Residual cumulative effects are evaluated in Section 13.4 and are included in consideration of direct residual effects.

13.6 SUMMARY AND CONCLUSIONS

Beneficial employment and income effects from the Project would be significant, amounting to 5.6% of Yukon's workforce and raising incomes by an average of 6.9%. These effects would be expected to reduce the RSA's unemployment rate, increase participation, and increase the rate of migration into Yukon. Local effects in rural LSA communities would be particularly significant, given the very high baseline rates of unemployment, low overall populations, and the commitment of CMC to work with First Nation leaders to maximize local recruitment, training, and advancement within the Project workforce.

Labour market forecasts for the mining industry predict that other mines will move into production in Yukon in the next decade. These actions are expected to accelerate a trend towards a rising share of the mining industry in employment and income effects. The Project would contribute to this trend, but is likely to enhance the beneficial effects of employment among low-skilled workers in rural communities and to have little noticeable effect on the harmful shortage of skilled workers in the mining sector.

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14 – EMPLOYABILITY

14.1 INTRODUCTION

The Employability VC concerns the economic effects of the Project on human capital formation, indicated by formal education and work experience attained by workers at the local and regional levels. The Project will require substantial amounts of labour with different skill levels during the construction and Operation Phases. Meeting labour demand is expected to require substantial investments in training and capacity-development. Effects are considered for all residents of the LSA and RSA, including First Nations. Economic issues and proposed management measures are also considered. Additional information to supplement this section is available in Appendix 13A.

14.1.1 Regional Setting

The Project is a proposed Open Pit mine located approximately 300 kilometres (km) northwest of Whitehorse, Yukon Territory on Crown land that is administered by Government of Yukon. The Project site is located within the Selkirk First Nation traditional territory. The Project will require construction of a road access, including upgrades to the existing Freegold Road and construction of the Freegold Road Extension on land that falls within the Selkirk First Nation and Little Salmon/Carmacks First Nation traditional territories. The Freegold Road Extension and proposed Freegold Road Upgrade will extend for approximately 200 km southeast from the Project to the village of Carmacks.

14.1.2 Rationale for VC Selection

The Employability VC was identified based in consideration of the information and issues communicated by the public, Aboriginal groups, local communities and government stakeholders during the engagement process conducted in support of this Proposal. This VC and specific indicators were also selected based on professional judgement and experience in conducting effects assessments.

Employability is important to consider because it is a prominent factor in determining long-term benefits for RSA residents arising from the Project. Changes in employability can affect the well-being of individual, families and communities in the area but are not attached to the Project itself, so that they can outlast the Project and can be transferred to other activities or areas. This section of the Proposal assesses the potential effects of the Project on these conditions that could affect the employability of residents of the local communities.

14.2 ASSESSMENT BOUNDARIES

14.2.1 Local Study Area (LSA)

The LSA for socio-economic VCs, which includes Employability, is defined in Section 13.2.1.

14.2.2 Regional Study Area (RSA)

The RSA for socio-economic VCs, which includes Employability, is defined in Section 13.2.2.

14.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Project. Details on activities associated with the construction, operation, closure and decommissioning, and post-closure phases of the Project are provided in Section 4.

14.3 BASELINE CONDITIONS

There are considerable differences between baseline conditions for Employability measured by educational attainment between the rural communities of Pelly Crossing and Carmacks compared to the urban community of Whitehorse. A greater proportion of residents of rural communities have lower levels of educational attainment. In 2011, 56.1% of adults in Pelly Crossing did not have any kind of educational certificate, diploma, or degree compared to 15.4% of adults in Whitehorse. 2011 data for Carmacks is not available, but in 2006 the share of adults without a certificate, diploma, or degree was 42.6% (Statistics Canada 2013; Statistics Canada 2007).

Low levels of educational attainment are correlated with lower levels of workplace training and skills; it is not clear whether this reflects the preferences of employers or workers, or a combination of both. Workers with low levels of educational attainment tend to be less comfortable with classroom learning environments and can be intimidated by complex, document-based procedures. At the same time, academic credentials can be regarded by employers as a proxy for ability and the lack of credentials may discourage them from investing in those employees without them. The end result is that, even when those with low educational attainment can find suitable employers, they often are not directed in a path that develops their capacity and employability over the long term. As a consequence, low educational attainment can indicate that a broader set of capacities learned through work experience that are useful to formal employers are under-developed (European Centre for the Development of Vocational Training 2011).

Census data for the rural communities indicate that labour forces in these regions are largely not oriented toward mining positions. In 2011 the National Household Survey reported no workers from Pelly Crossing with experience in resource industries and 11.5% of the workforce (21 people) with experience in the construction industry, whereas public administration employed 73.1% of the workforce (135 people). However, 24.2% of the labour force worked in trades, transport, and equipment operation, 6.1% in natural and applied sciences, and 6.1% in primary industries, which indicates that a sizable share of the labour force may be gaining experience in areas relevant to the needs of the mining sector even though they may be employed by local government. In addition, more recent sources show that a number of Pelly Crossing residents work at Minto mine that began operations in late 2007. According to a presentation made by Capstone Mining Corporation, the Minto mine currently employs 22 people from Selkirk First Nation (Capstone Mining Corp. 2012).

Data for Carmacks are only available for 2006, which indicate that 7.8% of the workforce (19 people) had experience in resource industries and 5.9% (14 people) had experience in construction. However, the same data indicate that 27.7% of the labour force worked in trades, transport, and equipment operation and 6.4% in primary industries. Those with experience in public administration make up 52.9% of the population (127 people) (Statistics Canada 2013; Statistics Canada 2007). Employment by local government rather than industry can restrict employability of workers, since it does not allow workers to carry over the reputation benefits of the firms they work for when they are looking for jobs even if their work experience is of relevance to private sector employers.

Detailed data from the 2011 National Household Survey concerning employment are not available for rural communities, but are available for Whitehorse. The data show that the city has a diversified industrial workforce. In the 2011 Census, 3.5% of the labour force had experience in resource-based industries (521 people) and 9% had experience in the construction industry (1,340 people). In terms of total available workers, Whitehorse likely captures most of the LSA workforce; in 2006, Whitehorse accounted for 93% of workers in the LSA with experience in the mining industry and 97% of those with experience in the construction industry (Statistics Canada 2013; Statistics Canada 2007).

In Whitehorse, trades, transport, equipment operators, and workers in primary industry accounted for a combined 17.2% of the workforce (2,560 people). Of these, 1,015 were in industrial, electrical, and construction trades; 425 in maintenance and equipment operation; 640 in transport, heavy equipment operation, and related maintenance; and 225 were trades helpers and construction labourers. In Yukon as a whole, trades, transport, equipment operators and workers in primary industry accounted for a combined 19.5% of the workforce (4,143 people). Of these, 1,275 were in industrial, electrical, and construction trades; 535 in maintenance and equipment operation; 980 in transport, heavy equipment operation, and related maintenance; and 335 were trades helpers and construction labourers (Statistics Canada 2013).

14.4 PROJECT-SPECIFIC EFFECTS

14.4.1 Project Interactions and Potential Effects

Table 14.4-1 identifies potential interactions between specific Project components and activities and the Employability VC. The identified interactions warrant further analyses because they may result in substantive socio-economic effects on Employability, either positive or negative. The specific nature of the impacts is evaluated and discussed in subsequent sections. The list of Project components and activities included in this table was derived from the Project Description as described in Section 4.

Project components that may affect directly or indirectly the Employability conditions during the mine construction, operations, and closure and decommissioning phases include:

- Contracted Employment; and
- Mine Staffing.

These two Project activities are identified as having potential effects on Employability through their effects on the employment and income of residents of the LSA and RSA.

Contracted Employment

The Project will result in considerable direct employment as well as contracted employment generated from contracting and procurement associated with Project expenditures. Procurement and contracting in particular were identified since purchases associated with the Project will require and thus incentivize education requirements from contractors as well as provide a valuable opportunity for contractors to build capacity and "learn by doing" over the life of their contracts. Moreover, some aspects of training programs (in particular, those relating to workplace safety) will be provided to both Project staff and contractors.

Mine Staffing

Project workforce demand was identified because hiring requirements would increase incentives for educational attainment and training among local residents; moreover, those hired would benefit from industry experience as long as they work at the Project. Employee training programs would directly enhance the skill and employment levels of residents of the LSA and RSA. The proposed Project employability effects would depend on whether Project-related jobs are filled by residents or by non-residents; and on whether non-residents relocate to the RSA or commute to work. Potential Project effects are outlined in Table 14.4-1.

Table 14.4-1 Potential Interactions between the Project and Employability

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, DC	No	No specific interaction with this socio-economic VC
Aggregate Sources / Borrow Sites	C	No	No specific interaction with this socio-economic VC
Airstrip and Airstrip Access Road	C, O, DC	No	No specific interaction with this socio-economic VC
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O	No	No specific interaction with this socio-economic VC
Concentrate Transport and Loading	O	No	No specific interaction with this socio-economic VC
Concrete Batch Plant Operation	C, O	No	No specific interaction with this socio-economic VC
Contracted Employment	C, O, DC	Yes	Contracting experience improves capacity and industry experience of contractors
Contracted Employment	C, O, DC	Yes	Potential for employment with contractors will increase incentive for educational attainment and training of local residents
Cyclone Sand Plant	C, O	No	No specific interaction with this socio-economic VC
Dismantling of Facilities	DC	No	No specific interaction with this socio-economic VC
Diversion of Canadian Creek	C, O	No	No specific interaction with this socio-economic VC
Drilling and Blasting	C, O	No	No specific interaction with this socio-economic VC
Fish Habitat Compensation Construction	C, O	No	No specific interaction with this socio-economic VC
Freegold Road Extension	C, O, DC	No	No specific interaction with this socio-economic VC
Freegold Road Upgrade	C, O, DC	No	No specific interaction with this socio-economic VC
Fuel Storage and Distribution System	C, O	No	No specific interaction with this socio-economic VC
Gold Extraction Plant / Oxide Ore Processing	C, O	No	No specific interaction with this socio-economic VC
Ground Preparation Activities (e.g., cut, fill, grub, etc.)	C	No	No specific interaction with this socio-economic VC
Hazardous Materials Storage, Transport, and Disposal	C, O	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Heap Leach Facility	C, O	No	No specific interaction with this socio-economic VC
Heap Leach Pad	C, O	No	No specific interaction with this socio-economic VC
Laydown Areas	C, O	No	No specific interaction with this socio-economic VC
LNG Transport to Site	C, O	No	No specific interaction with this socio-economic VC
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O	No	No specific interaction with this socio-economic VC
Maximum Disturbance Area	C, O, DC	No	No specific interaction with this socio-economic VC
Mine Development	C, O, DC	No	No further interaction; already addressed in other Project components
Mine Staffing	C, O, DC	Yes	Training programs for staff enhance the local and regional skills and education profile
Mine Staffing	C, O, DC	Yes	Employment opportunities will increase incentive for educational attainment and training of local residents
Mine Staffing	C, O, DC	Yes	Work experience will improve capacity and industry experience of workers
On-site Equipment and Vehicle Use	C, O, DC	No	No specific interaction with this socio-economic VC
Open Pit Mining	C, O	No	No specific interaction with this socio-economic VC
Ore Conveyors	C, O	No	No specific interaction with this socio-economic VC
Ore Crushing	C, O	No	No specific interaction with this socio-economic VC
Ore Hauling	C, O	No	No specific interaction with this socio-economic VC
Ore Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Processing Facilities for Sulphide Ore	O	No	No specific interaction with this socio-economic VC
Reagent Storage and Distribution	C, O	No	No specific interaction with this socio-economic VC
Site Reclamation / Re-Vegetation	O, DC	No	No specific interaction with this socio-economic VC
Site Security and Fencing	C, O, DC	No	No specific interaction with this socio-economic VC
Surface Water Management (Contact	C, O, DC	No	No specific interaction with this socio-

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Water)			economic VC
Surface Water Management (Non-Contact Water)	C, O, DC	No	No specific interaction with this socio-economic VC
Tailings Management Facility	C, O, DC	No	No specific interaction with this socio-economic VC
Topsoil Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Traffic (Equipment and Materials to Site)	C, O, DC	No	No specific interaction with this socio-economic VC
Waste Management: Garbage and Sewage Waste Facilities	C, O	No	No specific interaction with this socio-economic VC
Wasterock and Overburden Disposal	C, O	No	No specific interaction with this socio-economic VC
Water Supply	C, O, DC, PC	No	No specific interaction with this socio-economic VC

Note:

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

14.4.1.1 Potential Project Effects on Employability

During the approximate 4 year construction phase, the Project is expected to require a large workforce of contracted and employed personnel. Construction workers will be contracted, but the Project will require pre-production operations workers in all areas of activity prior to the start of the Operation Phase (Figure 13.3-1). Employment will be somewhat seasonal given the region's climate. The first phase of construction is scheduled to start in early 2016 (concurrently with the all-weather road to the site) and continue to throughout 2016. In this period the peak workforce will be approximately 264 personnel. The second phase will follow thereafter with the peak on-site workforce rising to approximately 1,000 personnel. The owner-furnished construction camp will be used by all construction contractors.

The size of the pre-production operations workforce resident in the LSA is expected to increase in this time from 68 personnel in 2017 to 196 personnel in 2019 and the share of LSA residents in the total workforce is expected to increase from approximately 45% to 65% over the same period. Unlike construction employment, in which the workforce is contracted and seasonal, operations workers are employed directly by CMC for extended periods of time. This allows these employees to develop new skills and capabilities as they advance within the company over many years. These effects are expected to increase as the LSA-resident workforce rises over the operations phase from approximately 353 personnel when production begins in 2020 to approximately 536 personnel in 2024 (Table 14.4-3). Over this period, the share of workers resident in Yukon is expected to vary from 70% to 85% of the total workforce and include a mix of high- and low-skilled workers. Over both the construction and Operation Phase, the demand for contracted services as part of Project expenditures will support employment in a range of supplier industries, which is expected to further increase demand for skilled labour.

Staffing requirements over the construction and Operation Phase will require a mixture of high- and low-skilled employees resident in the RSA. Some of these workers are expected to be people in senior positions who will migrate into the RSA (Section 16). Some of these workers will be existing residents who are either unemployed or underemployed in their current positions. A large share of these workers, however, will be workers who will need to be trained by CMC. The extent and type of training will be driven by developments in the RSA labour market over the construction and Operation Phase.

The market for skilled employees is expected to be tight over the next decade, particularly with respect to workers with mining-specific skills. A Mining Industry Human Resources Council (MiHR) study of Yukon's labour market predicts that the expectation of rapid expansion in the mining workforce, driven by a switch from what is currently an exploration-based industry to an increasingly production-based industry, will create demands for new skills that Yukon has not attracted or trained over the past decade. In particular, demand for underground miners will increase as will demands for several categories of technologist and technician in geosciences and mineral processing. It can take 4 or more years to acquire the basic skills and knowledge required for many of the mining occupations facing supply constraints, and nearly a decade or more to acquire important industry experience to replace retiring workers, a major component of labour demand in the mining sector across the country (MiHR 2012).

As discussed in Section 15.3, MiHR predicts that a gap will emerge between the amount of new labour supplied to mining occupations and the demand for new labour and replacements of workers leaving the mining industry. Using its labour market forecasting models to project the industry's needs over the next 10 years, their analysis shows that this gap will widen rapidly over the next 4 years, and remain for the next decade. Labour demand in the industry will be nearly 150% higher in 2023 compared to the demand in 2012; meanwhile, labour supply could be approximately 12% lower in 2023 than in 2012, assuming nothing is done to address the skills and labour shortages and fill the projected gaps (MiHR 2012). Table 14.4-3 compares MiHR estimates of the 2012 mining labour force and forecasted labour force growth in the mining industry in Yukon up to 2023 with MiHR's forecasts of cumulative hiring requirements for Yukon's mining industry and the projected Project's hiring requirements for Yukon-based workers in 2023. Assuming that workers for the Project are drawn from both talent growth and the existing workforce produces an estimate for the Project's share of new workers. These new workers can be drawn from skilled workers migrating to Yukon, from workers trained by CMC for their positions, from workers drawn from other parts of the mining industry (support services or exploration), or from new talent drawn to mining from other industries. The results are approximated by National Occupation Code (NOC). This analysis estimates that by 2023, 207 regional workers, or 31% of the overall Project workforce, will need to be trained for positions or recruited from other industries.

Migrants are assumed to make up an average of 25% of Yukon-based labour force, although this share is expected to change over time (Section 16). This is based on a 2013 survey of current long distance commuters in Yukon's mining industry; that survey found that between 35% to 45% of those surveyed could be incentivized to move to Yukon by measures an employer could offer (e.g., housing and travel allowances, education funding for children). It also found that no incentive could convince 35% of commuters to relocate (Herkes, Mooney and Smith 2013). This implies that in order to meet CMC's hiring targets of employing an average of 78% resident workers, at most 20% of the workforce could be composed of workers from outside Yukon enticed to migrate and the remaining 58% would be composed of local workers already resident in Yukon. Migrants are assumed to be hired only when there is a shortage of skilled regional workers available. This analysis estimates that by 2023, 134 workers would migrate into the region.

Table 14.4-2 Potential Effects of the Project on Employability

Mechanism of Interaction	Key Indicator(s)[1]	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
Project purchases	Experience	C, O, DC	Improved capacity and industry experience of contractors	Beneficial
Project purchases	Educational level	C, O, DC	Employment opportunities will increase incentive for educational attainment and training of local residents	Beneficial
Training programs	Educational level	C, O	Training programs during operations would enhance the local and regional skills profile and employment levels	Beneficial
Project workforce demands	Educational level	C, O	Employment opportunities will increase incentive for educational attainment and training of local residents	Beneficial
Project workforce demands	Experience	C, O	Project employment will improve capacity and industry experience of workers	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

Table 14.4-3 Mining Employment, Training, and Recruitment in Yukon to 2023

NOCS Code	Description	2012 Mining Labour Force	Forecasted 2023 Mining Labour Force	Forecasted 2023 Mining Production Labour Force	Estimated 2023 Yukon-based Project Workforce (A)	Estimated 2023 Mining Industry Cumulative Hiring Requirements (B)	Total 2023 Yukon Hiring Requirement (A+B)	New Workers Share of Projected Workforce	Project New Workers	Migrants	Training and Recruitment
6733	Janitors	365	NA	NA	12	NA	NA	NA	NA	NA	NA
A111	Financial managers	41	41	14	1	10	11	0%	0	0	0
A381	Primary production managers (except agriculture)	3	13	5	1	10	11	59%	1	0	0
B011	Financial auditors and accountants	2	2	1	3	5	8	91%	3	1	2
B021	Specialists in human resources	8	8	3	8	25	33	92%	7	3	4
B541	Administrative clerks	26	26	9	7	80	87	90%	6	2	4
B573	Production clerks	3	3	1	8	10	18	94%	8	3	5
C013	Geologists, geochemists and geophysicists	358	378	132	2	100	102	0%	0	0	0
C032	Mechanical engineers	30	30	11	1	30	31	66%	1	0	0
C042	Metallurgical and materials engineers	13	13	5	2	40	42	89%	2	1	1
C043	Mining engineers	12	42	15	2	35	37	60%	1	0	1
C044	Geological engineers	364	394	138	12	40	52	0%	0	0	0

NOCS Code	Description	2012 Mining Labour Force	Forecasted 2023 Mining Labour Force	Forecasted 2023 Mining Production Labour Force	Estimated 2023 Yukon-based Project Workforce (A)	Estimated 2023 Mining Industry Cumulative Hiring Requirements (B)	Total 2023 Yukon Hiring Requirement (A+B)	New Workers Share of Projected Workforce	Project New Workers	Migrants	Training and Recruitment
C048	Other professional engineers.	179	179	63	1	10	11	0%	0	0	0
C132	Mechanical engineering technologists and technicians	3	3	1	8	10	18	94%	8	3	5
C141	Electrical and electronics engineering technologists and technicians	5	5	2	0	15	15	88%	0	0	0
C155	Mapping and related technologists and technicians	54	54	19	8	10	18	0%	0	0	0
H212	Industrial electricians	34	34	12	26	100	126	91%	24	9	14
H411	Construction millwrights and industrial mechanics (except textile)	39	39	14	0	120	120	89%	0	0	0
H412	Heavy-duty equipment mechanics	108	118	41	26	85	111	63%	16	6	10
H611	Heavy equipment operators (except crane)	182	222	78	80	370	450	83%	66	26	40

NOCS Code	Description	2012 Mining Labour Force	Forecasted 2023 Mining Labour Force	Forecasted 2023 Mining Production Labour Force	Estimated 2023 Yukon-based Project Workforce (A)	Estimated 2023 Mining Industry Cumulative Hiring Requirements (B)	Total 2023 Yukon Hiring Requirement (A+B)	New Workers Share of Projected Workforce	Project New Workers	Migrants	Training and Recruitment
H622	Drillers and blasters - Surface mining, quarrying and construction	239	239	84	8	25	33	0%	0	0	0
H711	Truck drivers	270	NA	NA	60	NA	NA	NA	NA	NA	NA
H812	Material handlers	60	60	21	4	0	4	0%	0	0	0
I121	Supervisors, mining and quarrying	31	31	11	14	95	109	90%	13	5	8
I214	Mine workers (welders, mechanics and helpers)	53	53	21	50	160	210	90%	45	18	27
J011	Supervisors, mineral and metal processing	47	47	16	15	140	155	89%	13	5	8
J121	Machine operators, mineral and metal processing	125	125	44	70	375	445	90%	63	25	38
J311	Workers in mineral and metal processing	217	217	76	96	140	236	68%	65	25	40
Total		2871	3011	1054	525	2040	2565	-	341	134	207

Note:

Statistics Canada estimate of total labour force in occupation. NA - not applicable

Source: MiHR, 2012.Statistics Canada, 2013.

The largest areas of training and recruitment of new workers are low-skilled support positions (40 people), heavy equipment operators (40 people), machine operators (38 people), generalized mine workers (e.g., welders, mechanics, helpers) (27 people), industrial electricians (14 people), and heavy-duty equipment mechanics (10 people). Most of these roles require specialized training and certification. Active recruitment of labour force entrants may draw new talent away from other industries (particularly construction), notably with respect to welders, mechanics, and heavy equipment operators. Two occupations, truck drivers and janitors, were not included in the MiHR analysis and consequently are left out of the analysis. Both are expected to be recruited entirely from within the RSA labour force.

The Project would also encourage secondary effects in employability. As discussed in Section 13.4.1, expenditures from the construction and Operation Phase of the Project would encourage demand for labour through the direct, indirect, and induced economic activity in the region. As shown in Section 15.4.1, economic activity will create potential business opportunities for a range of regional businesses that will in turn require workers with a variety of skill levels. Although some of that skilled labour would be met by the migration of workers to Yukon (Section 16), most of it would need to be met by private (corporate and individual) investment in capacity development, training, and education. Also in Section 15.4.1, noticeable effects on government revenue from the Project will expand public resources available for training and education. As these effects are dependent on the responses by agencies, individuals, and companies independent of CMC, estimates can be made of their direction but not of their magnitude.

Reclamation and closure expenditures are spread over 4 years (including the final year of production). These expenditures would include post-closure monitoring, which will continue until results of monitoring demonstrate that closure objectives are achieved and self-sustaining. Monitoring of various site aspects, such as water quality, is expected to continue at the site over an extended period of time. Closure activities would largely be contracted and work is expected to be seasonal and short-term, similar to construction employment. As such, little investment in training motivated by the Project is expected during this period. Monitoring work may present some opportunities for LSA residents but on a small scale.

14.4.2 Identification of Mitigation Measures

The effect of the Project on the LSA and RSA employability is considered to be positive. CMC intends to provide substantial investments in human capital for RSA residents and will employ residents for long periods well-suited for professional capacity development. CMC will enhance these positive effects by:

- Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA;
- Implementing a procurement process that, where economically feasible, gives preference to suppliers from the RSA and LSA;
- Providing incentives for workers hired from outside Yukon to re-locate;
- Requiring cultural awareness training for employees and contractors;
- Monitoring Project socio-economic effects and adapting management measures where required;
- Providing on-the-job training to assist local and regional workers to develop mining-specific skills;
- Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA;

- Partnering with First Nation communities to access additional funding for training;
- Supporting non-mining training and entrepreneurial initiatives;
- Implementing career training and development opportunities for employees once hired; and
- Providing continuous, on the job safety training.
- After Project production ends CMC will, for a reasonable amount of time, assist Project-related employees to enhance their employability and find new employment in the mining industry

These mitigation measures are summarized and paired to Project effects in Table 14.4-4.

Table 14.4-4 Proposed Mitigation Measures and Potential Residual Effects for Employability

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (*or Enhancement*) Measure[2]	Predicted Effectiveness	Residual Effect
Training programs during operations would enhance the local and regional skills profile and employment levels	O	Beneficial	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	High	Yes
Employment opportunities will increase incentive for educational attainment and training of local residents	C, O, DC	Beneficial	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	Medium	Yes
Project employment will improve capacity and industry experience of workers	C, O, DC	Beneficial	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	High	Yes
Improved capacity and industry experience of contractors	C, O DC	Beneficial	CMC will implement a procurement process that, where feasible, gives preference to suppliers from the RSA and LSA; Contractors would be encouraged to hire local/regional/territorial residents to the extent practical	Medium	Yes

Notes
1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

14.4.3 Significance of Residual Effects

The criteria used to discuss residual effects are discussed in detail in Section 5, Assessment Methods and Frameworks.

Table 14.4-5 outlines the seven criteria used to assess significance for the Employability VC.

Table 14.4-5 Determining Significance of Residual Effects for Employability

Criteria	Rating	VC Specific Definitions
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	Effect that occurs might or might not be detectable, but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge
Geographical Extent	Localized	Within the identified Local Study Area
	Widespread	Outside the identified Local Study Area
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, decommissioning and closures
	Permanent	Effects measureable Post-Closure
Frequency	Infrequent	Effects occur occasionally
	Frequent	Effects occur often or are continuous
Reversibility	Reversible	Effect will return to baseline condition after operations, decommissioning, and closure
	Irreversible	Effect is persistent after operations, decommissioning, and closure
Context	Low Resilience	Effects operate outside of regional experience and represent a challenge to local socio-economic management institutions
	High Resilience	Effects are familiar to local socio-economic management institutions
Probability of Occurrence	Low	Effects are unusual under similar circumstances and are not expected to occur with the Project
	Moderate	Effects has a reasonable risk of occurring under similar circumstances or there is not currently sufficient information to assess probability
	High	Effects have consistently occurred under similar circumstances and are expected to occur with this Project

Residual effects for employability are assessed by these criteria in Table 14.4-6.

Table 14.4-6 Significance of Residual Effects for Employment

Residual Effect	Predicted Degree of Effect After Mitigation (*or Enhancement*) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Training programs during operations would enhance the local and regional skills profile and employment levels	Beneficial	High	Localized	Long Term	Continuous	Irreversible	High resilience	High	Significant
Employment opportunities will increase incentive for educational attainment and training of local residents	Beneficial	Medium	Localized	Long Term	Continuous	Irreversible	High resilience	Moderate	Not Significant
Project employment will improve capacity and industry experience of workers	Beneficial	High	Localized	Long Term	Continuous	Irreversible	High resilience	High	Significant
Improved capacity and industry experience of contractors	Beneficial	Medium	Localized	Long Term	Continuous	Irreversible	High resilience	Moderate	Not Significant

Note:

For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

14.4.4 Discussion of Significance

The direction of employability effects is considered to be beneficial for two reasons: first, because they represent investments in human capital, which improve the ability of regional residents to earn higher incomes, and second because these investments in human capital are sustainable given that mining-related skills are expected to be in high demand within the region over at least the next decade. As such, investments in training and education are expected to be “good” in that they will likely earn a positive rate of return for the recipients in terms of higher incomes and reduced risk of unemployment.

The re-applicability of human capital investments mean that they are not expected to depreciate except in those cases where workers choose to leave the industries for which they have been trained, and thus residual effects are considered to be irreversible.

The number of workers receiving direct training from the Project to the year 2023 is estimated at 208 or 1.0% of the current labour force for Yukon, a high magnitude. This includes worker funding training either directly through CMC or independently in order to take advantage of the opportunities the Project offers. It also includes worker training in order to advance in positions or to gain an initial position in the Project workforce. The magnitude of direct training effects (training and capacity development of Project staff) are considered to be higher than indirect training effects (contractor training and capacity development or individual pursuit of education) because the latter are dependent on investment decisions made by other parties and are thus more uncertain given the varying levels of commitment, effectiveness, and results that may be expected from partner companies, governments, and organizations. Until more is known about those commitments, the magnitude of effects is assessed to be medium and their likelihood to be only moderate.

Employability effects are concentrated in the operations phase, although the substantive number of pre-production operations staff and the necessary preparatory investments in training required to meet regional staffing objectives will see considerable employability effects in the construction phase. No noticeable effects are seen in the closure and post-closure phases. These effects are thus sustained continuously over 25 years (22 years in production and roughly 3 years of the 4-year construction phase), which is considered to be long term.

Predictions of direct employability effects (training programs offered by CMC, experience earned by employees and capacity developed by contractors) are based on three key factors: workforce requirements, which have a low margin of error; project expenditures, which have a margin of error within a range of plus 15% to minus 10% (M3 2013); the distribution of the workforce between migrants to the region and local hires, which are more uncertain. Internal training programs are under the direct control of CMC, however, which allow dynamic strategies discussed with respect to effects enhancement which help reduce uncertainties regarding these effects. As a result, direct effects are considered to have a high level of confidence. For indirect effects (the increase in incentives for educational attainment) the analysis is based on the prediction of economic effects and consequently shares the uncertainty of those underlying forecasts. As a consequence, these effects are considered to have a moderate level of confidence.

As shown in Table 14.4-7, direct training effects (Project staff) are thus considered to be beneficial and significant, and indirect effects (contractor and regional residents) are considered to be beneficial but not significant.

Table 14.4-7 Summary of Residual Effects for Employability

Potential Residual Effect	Direction (Adverse/Beneficial)	Significance (Significant/Not Significant)	Level of Confidence (Low, Moderate, High)
Training programs during operations would enhance the local and regional skills profile and employment levels	Beneficial	Significant	High
Employment opportunities will increase incentive for educational attainment and training of local residents	Beneficial	Not Significant	Moderate
Project employment will improve capacity and industry experience of workers	Beneficial	Significant	High
Improved capacity and industry experience of contractors	Beneficial	Not Significant	High

14.5 CUMULATIVE EFFECTS ASSESSMENT

14.5.1 Introduction

The effects assessment of the Project on employability takes into consideration past and existing projects and activities and is based on cumulative labour market forecast for Yukon's mining industry. Consequently, the assessment is already cumulative in nature. Further, the effects of construction and operations on employability are considered to be beneficial and thus are not required to be carried forward.

14.5.2 Identification of other Activities Potentially Affecting the VC

Training programs and capacity development associated with mine staffing, contracted employment, and procurement are estimated to have a beneficial effect on employability of workers in the region. The forecasted tightness in the labour market (Section 14.4.1.1) for skilled mining workers may enhance these effects by increasing turnover and thus incentivizing further investments in training for the purposes of both recruitment and retention. Estimates of training requirements are based on forecasted data, which already include consideration of these cumulative effects. As a consequence, no new identification of activities is necessary.

14.5.3 Interactions and Potential Cumulative Effects

Residual effects on employability are based on labour market forecasts and thus already include cumulative effects in their analysis. As a consequence, residual effects are already a CEA and no further assessment of cumulative effects is required. In addition, the effects of construction and operations on employability are beneficial and are not required to be carried forward.

14.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

As the effects assessment of the Project has already been conducted in the context of other proposed projects and their effects on employability, no additional mitigation measures are required.

14.5.5 Significance of Residual Cumulative Effects

The residual cumulative Project effects on employability are the same as the effects specific to the Project provided in Table 14.4-6.

14.5.6 Discussion of Significance of Residual Cumulative Effects

Training programs and capacity development associated with mine staffing, contracted employment, and procurement are estimated to have a beneficial effect on employability of workers in the region. The forecasted tightness in the labour market (Section 14.4.1.1) for skilled mining workers may enhance these effects by increasing turnover and thus incentivizing further investments in training for the purposes of both recruitment and retention. Estimates of training requirements are based on forecasted data, which already include consideration of these cumulative effects.

14.6 SUMMARY AND CONCLUSIONS

The market for skilled employees is expected to be tight over the next decade, particularly with respect to workers with mining-specific skills. These skill shortages are expected to worsen across Canada, driven by retirements, and are expected to exceed the effect of slumping commodity prices. Existing mines in Yukon depend on a high percentage of non-resident workers, amounting to roughly half of workers, but CMC plans to use a higher share of regional workers among their production workforce, rising above 80% by 2024. In order to achieve this objective, the company plans to work cooperatively with Yukon College's Centre for Northern Innovation in Mining in developing and delivering training programs that would serve the needs of Casino as well as other mining operations in Yukon. Work will also be required with other government departments and the communities towards ensuring appropriate services are in place to attract and retain Yukon-based employees. Skill attainment and upgrading in the RSA would represent a sustained and substantial benefit for the employability of the region's workers. The effects would be particularly important for low-skilled workers in rural communities within the LSA that face high levels of unemployment and poverty.

The construction and operation of the Casino mine is part of a maturation of the mining industry in Yukon that is underway. Casino is expected to take place in the context of a broad and diverse industry that produces a variety of commodities at a number of different operations. This creates a stabilizing effect on the resource economy as well as employment opportunities which are transferable as job opportunities shift through the life-cycle of different mines. The long life at Casino contributes to this stability and a shift to understanding these opportunities as careers, and not just temporary jobs.

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15 – ECONOMIC DEVELOPMENT AND BUSINESS SECTOR

15.1 INTRODUCTION

The Economic Development and Business Sector VC concerns the potential effects of the Project on economic development, indicated by growth in Gross Domestic Product (GDP), opportunities for regional businesses and by government revenues. The Project will require substantial amounts of staff, contracted employment, and procured goods and services in order to meet the demands of construction, operations, decommissioning, and closure. Effects are considered for all residents of the Local Study Area and Regional Study Area, including First Nations. Economic issues and proposed management measures are also considered. Supplementary information to support this section is provided in Appendix 13A.

15.1.1 Regional Setting

The Project is a proposed Open Pit mine located approximately 300 kilometres (km) northwest of Whitehorse, Yukon Territory on Crown land that is administered by the Government of Yukon. The Project site is located within the Selkirk First Nation traditional territory. The Project will require construction of a road access, including upgrades to the existing Freegold Road and construction of the Freegold Road Extension: sections of the Freegold Road Extension will be on land that falls within the Selkirk First Nation and Little Salmon/Carmacks First Nation traditional territories. The Freegold Road Extension and proposed Freegold Road Upgrade will extend for approximately 200 km southeast from the Project to the village of Carmacks.

15.1.2 Rationale for VC Selection

The Economic Development and Business Sector VC was selected after consideration of the information and issues communicated by the public, Aboriginal groups, local communities, and government stakeholders during the engagement process conducted in support of this Proposal. This VC and specific indicators were also selected based on professional judgement and experience in conducting environmental effects assessments for similar projects.

Economic Development is important to consider. It represents a means to raise the livelihood of residents of the region and it has the capacity to fund public services associated with human development and social progress. The effect on the Business Sector is highlighted because it represents a direct and tangible form of regional participation in the long-term benefits arising from the Project. This section of the Proposal assesses the potential effects of the Project on these conditions that could affect the economic development of the local communities and Yukon as a whole. The key indicators selected for this assessment are: Economic Growth; Business Opportunities; and Government Revenues.

15.2 ASSESSMENT BOUNDARIES

15.2.1 Local Study Area (LSA)

The LSA for socio-economic VCs, which includes Economic Development, is defined in Section 13.2.1 (Figure 13.2-1).

15.2.2 Regional Study Area (RSA)

The RSA for socio-economic VCs, which includes Economic Development, is defined in Section 13.2.2 (Figure 13.2-1).

15.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Project. Details on activities associated with the construction, operation, closure and decommissioning, and post-closure phases of the Project are provided in Section 4.

15.3 BASELINE CONDITIONS

Yukon's economy has consistently grown over the past nine years, with a peak growth of 8.7% in 2008. In 2011 the economy reported a growth of 5.6% over the previous year, more than double the national growth rate of 2.6%, but fell to less than 1% for 2013. The forecast for 2014 is for a return to rapid expansion, with Yukon economy growing at a rate of 8.8% due to increased mineral production, mining development expenditures, and large capital projects planned for the year. The recent temporary closure of some Yukon mining operations and the delay of construction of one mine due to softening commodity prices have tempered this outlook in the short-term. This section focuses on growth sectors for the economy; traditional industries such as trapping and outfitting, small in GDP effects but of great social importance to Yukon, are discussed in Sections 18 (Cultural Continuity) and 19 (Land Use).

Yukon's mineral sector is forecasted to continue to be a primary economic contributor (in 2012, mining accounted for 23% of Yukon's GDP) despite softening mid-year mineral prices that resulted in lower exploration and development expenditures and production values. The major metals produced by the mining industry in Yukon include lead, gold, silver, copper, and zinc. All of these metals have seen declines in prices since historic highs in 2011 (Table 15.3-1) ranging from approximately -13% for lead to -36% for silver. This fall in prices can be re-framed, however, as a re-adjustment to long-term trends and that current prices are similar or higher to those seen in 2010, at least for precious metals. Annual mineral production is forecasted for 2013 at $450 million to $500 million, down slightly from the $510 million posted in 2012 (Government of Yukon 2013a).

Table 15.3-1 Commodity Prices for Major Yukon Mining Metals

Metal	2010 Average Price ($USD)	2011 Average Price ($USD)	September 2013 Average Price ($USD)	% Change (2011-2013)	% Change (2010-2013)
Copper (mt)	7534.80	8,828.20	7,159.30	-18.9	-5.0
Lead (mt)	21.48	24.01	20.85	-13.2	-2.9
Zinc (mt)	21.61	21.94	18.47	-15.8	-14.5
Silver (toz)	20.15	35.22	22.56	-35.9	12.0
Gold (toz)	1,224.70	1,569.20	1,348.60	-14.1	10.1

Source: World Bank, 2013.

The volatility of the mining industry has had implications for Yukon based on its significant contribution to the economy. When the mining industry is experiencing a decline, the whole economy tends to suffer, with increased unemployment and some population loss. The future of the mining industry in Yukon will continue to be uncertain and will depend upon metal values, domestic and international demand, and on the corporate decisions of mining companies. A considerable amount of time and money has been invested in infrastructure and exploration in Yukon, which should assist in attracting future mining activity to Yukon, and this will have an effect on Whitehorse's economy.

Many of the businesses that provide services to the mining industry are headquartered in Whitehorse. Whitehorse-based businesses and services related to the mining industry include a number of contracting

companies, heavy equipment sales and rentals, and transportation and logistics services (Whitehorse Chamber of Commerce 2013). Some services and organizations related to the mining industry are described in the annual Yukon Mining and Exploration Directory (Yukon Chamber of Mines 2013). Services offered include the following:

- Communications, catering, and camp services;
- Reconnaissance, surveying, and mapping;
- Drilling and heavy equipment operations;
- Engineering, environmental, and geological consulting;
- Construction and contracting;
- Trucking and hauling;
- Mine development contracting;
- Aboriginal and community engagement consulting;
- Expediting, logistics, and transportation; and
- Mining inspections.

In 2010, the Yukon Bureau of Statistics surveyed over 3,000 Yukon businesses that operated in Yukon and compiled information about their industry, employees, revenue level, and other relevant information. Out of the approximately 3,000 businesses surveyed, 173 (6%) worked in the mining and oil and gas extraction industries, while 454 (15%) worked in the construction industry. The construction industry had the second greatest number of businesses after the Professional, Scientifics, and Technical Services industry. This category includes businesses such as legal, accounting, engineering, and consulting services.

The vast majority of the businesses that conducted business in Yukon were located within Yukon (92% or 2,792 businesses), while the remaining 8% (247 businesses and 919 employees) had main offices located outside Yukon. Within Yukon, most of the businesses and employees were located in Whitehorse. Whitehorse businesses accounted for 72% (2,182) of all businesses surveyed and 80% (10,259) of all employees. Carmacks and Pelly Crossing reported fewer businesses; Carmacks reported 18 businesses and 65 employees, while Pelly Crossing reported only 8 businesses and 13 employees (Yukon Bureau of Statistics 2011).

The Government of Yukon estimates its 2013-14 budget expenditures at $1.1 billion, less than projected revenues of $1.2 billion, for a surplus of $73 million. Taxes and general revenue raised by the Government of Yukon will only account for $151 million, or 12.6% of revenue. Most revenue ($979 million, or 81%) will come from transfers from the Government of Canada. Of the revenue that was raised by the territorial government, most (61%) came from individual and corporate income taxes. The size of the Yukon budget has doubled over the last decade in order to fund rapid growth in services and infrastructure. The largest budget item is health and social services at $348 million (31% of expenditures), followed by community and transportation at $252 million (22% of expenditures), and education at $188 million (17% of expenditures) (Government of Yukon 2013b).

The fiscal relationship between the Government of Yukon and the Government of Canada with regard to resource revenue sharing is changing, with more revenue being retained by the federal government. Prior to August 2012, Yukon's grant from the federal government was reduced by a dollar for each extra dollar received in mining revenue over $3 million annually; currently fees from lands, mines, and forestry are forecasted to exceed this amount by about $30,000 in the 2013 to 2014 period. Since August 2012, however, the cap has been raised to $6 million and Yukon has a future option to keep 50% of all resource revenues, which the Government of Yukon

calculates to be to the territory's fiscal advantage once resource revenues exceed $12 million annually (Government of Yukon 2012).

15.4 PROJECT-SPECIFIC EFFECTS

15.4.1 Project Interactions and Potential Effects

Table 15.4-1 identifies potential interactions between specific Project components and activities (see Section 4) and the Economic Development and Business Sector VC. The identified interactions warrant further analysis because they may result in positive or negative effects on the economic development and business sector during the Project life. Resulting potential effects are evaluated and described in subsequent sections.

Project components that may directly or indirectly affect the Economic Development and Business Sector VC during the mine construction, operations, and closure and decommissioning phases include:

- Contracted Employment;
- Mine Staffing;
- The Freegold Road Upgrade; and
- Mine Development.

These four Project components and activities are identified as having potential effects on economic development through their effects on economic growth, business opportunities, and government revenue within the LSA and RSA.

Contracted Employment

There will be considerable business opportunities for regional firms providing goods and services to the Project, particularly during the construction and Operation Phases. Expenditures on supplies and services will result in indirect employment and earned income, and the spending of earned income will lead to additional induced economic growth, income, and government revenue. These indirect and induced effects are caused by the direct effects and affect the same economic indicators, thus are analyzed together in this section.

Mine Staffing

Mine staffing was identified because the income earned by Project workers will contribute directly and indirectly to Yukon's GDP, employment levels, and taxes paid to all levels of government. The Project economic growth effects will depend on whether Project-related jobs are filled by residents or non-residents, and on whether non-residents relocate to the RSA or commute to work.

Freegold Road Extension and Upgrade

The Project includes upgrading the existing 83 km Freegold Road and construction of the Freegold Road Extension for approximately 120 km southeast from the Project to the existing Freegold Road, which extends to the village of Carmacks. This component was identified because the upgrade and creation of infrastructure has the potential to reduce the capital costs associated with the development of the numerous mineral claim blocks staked proximate to the extension. The extension will be a private road, in which use is carefully controlled by the responsible party. Any other use of the road will require permission of the company, as well as Yukon Government and the two First Nation governments whose territory through which the road extends. Some projects may have right of access that pre-dates this road.

Mine Development

The Project is forecasted to pay royalties and production-related taxes to the federal and territorial governments as a cost of production.

Potential Project effects are outlined in Table 15.4-1.

Table 15.4-1 Potential Interactions between the Project and Economic Development and the Business Sector

Project Components and Activities	**Project Phase**[1] (C, O, DC, PC)	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, DC	No	No specific interaction with this socio-economic VC
Aggregate Sources / Borrow Sites	C	No	No specific interaction with this socio-economic VC
Airstrip and Airstrip Access Road	C, O, DC	No	No specific interaction with this socio-economic VC
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop, etc.)	C, O	No	No specific interaction with this socio-economic VC
Concentrate Transport and Loading	O	No	No specific interaction with this socio-economic VC
Concrete Batch Plant Operation	C, O	No	No specific interaction with this socio-economic VC
Contracted Employment	C, O, DC	Yes	Project purchases of goods and services would contribute to the Yukon economy in terms of increasing its GDP and territorial employment
Contracted Employment	C, O, DC	Yes	Project purchases of goods and services will create contract and business opportunities across Yukon
Contracted Employment	C, O, DC	Yes	Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues
Cyclone Sand Plant	C, O	No	No specific interaction with this socio-economic VC
Dismantling of Facilities	DC	No	No specific interaction with this socio-economic VC
Diversion of Canadian Creek	C, O	No	No specific interaction with this socio-economic VC
Drilling and Blasting	C, O	No	No specific interaction with this socio-economic VC
Fish Habitat Compensation Construction	C, O	No	No specific interaction with this socio-economic VC
Freegold Road Extension	C, O, DC	No	No specific interaction with this socio-economic VC, as it will be private and access controlled; potential industrial users will be restricted

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Freegold Road Upgrade	C, O, DC	Yes	Improved access may increase use for a range of local use. The road already services exploration and placer mining activities. Increases in these activities may occur, but are not expected to be significant. Additional business opportunities related to exploration activities and potential for development of other major Projects
Fuel Storage and Distribution System	C, O	No	No specific interaction with this socio-economic VC
Gold Extraction Plant / Oxide Ore Processing	C	No	No specific interaction with this socio-economic VC
Ground Preparation Activities (e.g., cut, fill, grub, etc.)	C, O	No	No specific interaction with this socio-economic VC
Hazardous Materials Storage, Transport, and Disposal	C, O	No	No specific interaction with this socio-economic VC
Heap Leach Facility	C, O	No	No specific interaction with this socio-economic VC
Heap Leach Pad	C, O	No	No specific interaction with this socio-economic VC
Laydown Areas	C, O	No	No specific interaction with this socio-economic VC
LNG Transport to Site	C, O	No	No specific interaction with this socio-economic VC
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O	No	No specific interaction with this socio-economic VC
Maximum Disturbance Area	C, O, DC	No	No specific interaction with this socio-economic VC
Mine Development	C, O, DC	Yes	During operations Project will pay royalties and corporate taxes to the Government of Yukon
Mine Staffing	C, O, DC	Yes	Project workforce demands would contribute to the Yukon economy in terms of increasing its GDP and employment
Mine Staffing	C, O, DC	Yes	Re-spending by households of additional income derived directly or indirectly from mine employment will increase economic activity and businesses
Mine Staffing	C, O, DC	Yes	Additional direct and indirect taxes paid by Project employees will increase government revenues
On-site Equipment and Vehicle Use	C, O, DC	No	No specific interaction with this socio-economic VC
Open Pit Mining	C, O	No	No specific interaction with this socio-economic VC
Ore Conveyors	C, O	No	No specific interaction with this socio-economic VC
Ore Crushing	C, O	No	No specific interaction with this socio-economic VC
Ore Hauling	C, O	No	No specific interaction with this socio-economic VC
Ore Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Processing Facilities for Sulphide Ore	O	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Reagent Storage and Distribution	C, O	No	No specific interaction with this socio-economic VC
Site Reclamation / Re-Vegetation	O, DC	No	No specific interaction with this socio-economic VC
Site Security and Fencing	C, O, DC	No	No specific interaction with this socio-economic VC
Surface Water Management (Contact Water)	C, O, DC	No	No specific interaction with this socio-economic VC
Surface Water Management (Non-Contact Water)	C, O, DC	No	No specific interaction with this socio-economic VC
Tailings Management Facility	C, O, DC	No	No specific interaction with this socio-economic VC
Topsoil Stockpiles	C, O	No	No specific interaction with this socio-economic VC
Traffic (Equipment and Materials to Site)	C, O, DC	No	No specific interaction with this socio-economic VC
Waste Management: Garbage and Sewage Waste Facilities	C, O	No	No specific interaction with this socio-economic VC
Wasterock and Overburden Disposal	C, O	No	No specific interaction with this socio-economic VC
Water Supply	C, O, DC, PC	No	No specific interaction with this socio-economic VC

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

15.4.1.1 Potential Project Effects on Economic Development and Business Sector

Project interactions concerning income and employment arising from the Project are evaluated in Section 13.3.1. Changes to economic growth, business opportunities and government revenues resulting from anticipated interactions as described above in Table 15.4-1 are evaluated and described in this section of the Proposal.

The assessment of economic effects, in terms of quantitative estimates of economic growth and some elements of government revenue, is based on MNP's Economic Impact Report (MNP LLP 2013). Estimates of economic impacts in this report were derived from Statistics Canada's 2008 Input/Output (I-O) Model using estimates of future operational and capital spending. The Casino Project economic impact report assumptions and approaches were selected in cooperation with CMC representatives using expenditure information provided by CMC.

The Statistics Canada I-O Model has some inherent limitations. One of these is that changes in industrial structure and linkages since 2008 are not reflected in the modelling results. This also means that any changes in the technology of producing goods and services, input patterns, and relative prices since 2008 are not reflected in the impact estimates. This is of particular concern in Yukon, where 2008 mining activities did not operate at the scale of the Project and thus may not be representative of its effects.

Another limitation is that I-O models are static models in which dynamic changes over time are not explicitly represented. Although I-O models estimate the effects on major economic variables, they do not calculate the amount of time required for the propagation of all effects. Despite these limitations, I-O models are widely used to quantify the potential effects of proposed projects on provincial and national economic activity and employment.

Potential Effects on Economic Growth

The quantitative measure used to assess economic growth is growth in GDP. During the approximate 4-year construction phase, the Project is expected to require a total of $2.5 billion in capital expenditures, including $332 million in infrastructure costs (power plant, access road, and airstrip) and $1,566 million in direct costs. Included in these infrastructure costs is the cost of extending the Freegold Road, estimated at $99 million. Over the 22-year LOM, sustaining capital expenditures of $361.7 million are anticipated. The operations of the Project are expected to affect Yukon's economy through expenditures on goods and services and the creation of employment opportunities. Revenue from the sale of minerals from the Project is forecasted at $25.1 billion over 22 years at a cash production cost of $11.4 billion (M3, 2013).

The construction of the Project is expected to require capital expenditures that will affect the regional economy, not only directly but through indirect and induced effects. These spin-off effects (Table 15.4-2) are related to the purchase of goods and services needed to construct and operate the Project (indirect effects) and the expenditures of direct and indirect labour income on consumer goods and services (induced effects). MNP's analysis of the economic impact of the Project estimates that construction of the mine would lead to a $363 million increase in Yukon's GDP over a 4-year period, of which $261 million would arise from direct expenditures. Effects on employment and income are described in Section 13.4.

Table 15.4-2 Projected Construction Effects of the Project to Yukon

Total Impacts	Output[1] ($ millions)	GDP[2] ($ millions)
Direct	576	261
Indirect and Induced	204	102
Total	779	363

Notes:

[1]Total gross value of goods and services measured by the price paid to the producer. This is the broadest measure of economic activity.

[2]Additional value of a good or service over the cost of inputs used to produce it from the previous stage of production. Also refers as value-added or net output.

Totals may not add up due to rounding.

Source: MNP, 2013

Project operations are expected to affect Yukon's economy through expenditures on goods and services, the creation of employment opportunities, and the generation of tax revenues for local, territorial, and federal governments. Casino Mining Corporation estimates that approximately 69% of operational spending will occur in Yukon. Using that percentage, together with projected annual operational spending data provided by CMC, MNP (2013) estimates annual GDP generated in Yukon by the operation of the Project at $274 million, equivalent to 10.3% of Yukon's 2011 nominal GDP of $2.7 billion. These results are summarized in Table 15.4-3.

Table 15.4-3 Projected Annual Operations Effects of the Project to Yukon

Total Impacts	Output[1] ($ millions)	GDP[2] ($ millions)
Direct	307	232
Indirect and Induced	36	42
Total	342	274

Notes:
[1]Total gross value of goods and services measured by the price paid to the producer. This is the broadest measure of economic activity
[2]Additional value of a good or service over the cost of inputs used to produce it from the previous stage of production. Also refers as value-added or net output.
Totals may not add up due to rounding.
Source: MNP, 2013

As mentioned above, the Project includes upgrading the existing Freegold Road (83 km) and construction of the Freegold Road Extension (120 km) for a total of approximately 200 km southeast from the Project to the village of Carmacks. This infrastructure has the potential to reduce the capital costs associated with the development of the numerous mineral claim blocks staked proximate to the existing road and the extension. The relationship between the Freegold Road to existing claims is addressed in the Land Use Baseline (Appendix 19A). Even with reduced exploration budgets, activities in advanced exploration (defined as having more than $1 million in expenditures) in the 2012 season, within 100 km of the road extension included the Boulevard, Coffee, Mariposa, and Betty gold projects. In addition, several early stage exploration projects were carried out and many claims exist that were explored in the region in 2011 (Yukon Geological Survey 2013). Future developers of these properties could reduce the necessary capital costs of construction by some proportion of the $99 million expenditure already made as part of the Project. The spin-off effects of infrastructure investment are uncertain and depend on many other factors outside this analysis, but it is reasonable to expect that the infrastructure investments associated with the Project have the potential to facilitate future projects with noticeable effects on the regional economy

Potential Effects on Business Opportunities

As mentioned above, during the approximate 4-year construction phase, the Project is expected to require a total of $2.5 billion in capital expenditures, including $332 million in infrastructure costs and $1,566 million in direct costs. Over the 22-year LOM, sustaining capital expenditures of $361.7 million are anticipated. The operations of the Project are expected to affect Yukon's economy through expenditures on goods and services, helping to diversify the economic base of the LSA and RSA during the construction and Operation Phases. It will strengthen economic development performance by creating new opportunities for contractors and companies supplying goods and services to construction contractors and the mine when it is in operation. In absolute terms, Whitehorse will be the largest beneficiary because it is the service centre for the RSA, and its supplier and contractor base is best equipped to serve the mine. Companies in rural communities within the RSA do not have the capacity to bid for major service contracts with the Project but, with support in the structure of procurement processes and policies, could service size-appropriate contracts that, given the small populations of these communities, would have a larger relative impact for local residents.

The extent to which business opportunities translates into economic development benefits depends on general economic conditions, the investment climate, and the competitiveness of local suppliers. The estimated capital cost expenditures in the RSA are shown in Table 15.4-4. Where possible these expenditures will be met by local purchasing going to local businesses by the Project. Companies in the RSA are expected to supply $565.9 million in goods and supplies over the 4-year period. This spending will be distributed between numerous construction,

contracting, supply, and service companies, mostly from Whitehorse and among First Nations. Employment effects of these expenditures are detailed in Section 13.

Table 15.4-4 Estimated Capital Cost Disbursements in Yukon

Disbursement	Expenditures in Yukon ($ millions)
Direct	
Plant Equipment	12.6
Material	45.9
Labour	99.7
Subcontract	32.0
Construction Equipment	14.4
Total Indirect Costs	1.0
Camp Operating Cost	27.2
Construction Power	2.7
EPCM	
Management and Accounting	0.8
Engineering	6.3
Project Services	2.6
Project Controls	2.0
Construction Management	57.8
Fixed Fee	0.0
Vendor Commissioning and Other	0.0
Construction Start-up spares	0.1
Power Plant	41.8
Main Access Road	88.9
Airstrip	21.5
Freight	13.9
Mining Equipment Cost	29.5
Mine Development	46.7
Construction Camp Purchase	14.0
Total Contracted Cost	**561.3**

Source: M3, 2013

During the Operation Phase, total operating expenditures spent in the RSA are estimated to be $306.6 million annually. Expenditures by category are shown in Table 15.4-5.

Table 15.4-5 Estimated Annual Operating Cost Expended in Yukon, Typical Year

	Expended in Yukon (Typical Year) ($ millions)
Mining Operations	
Drilling	7.9
Blasting	14.9
Loading	8.7
Hauling	61.2
Roads and Dumps	22.1
Mining Services	9.4
Mining Administration	4.6
Subtotal Mining	128.7
Concentrator	
Primary Crushing and Stockpile Feed	10.6
Grinding, Classification and Pebble Crushing	65.3
Flotation and Regrind	41.5
Concentrate Thickening and Filtration	5.5
Tailings, Dewatering and Disposal	14.0
Fresh Water/Plant Water	-1.8
Flotation Reagents	0.7
Ancillary Services	2.6
Subtotal Concentrator	138.4
Heap Leach and CIL	25.7
Supporting Facilities	13.7
Annual Mine and Plant Operating Expenditures	**306.6**

Source: M3, 2013

In total, 68.6% of operating expenditures are expected to be made within the RSA.

During operations, procurement, and contracting will follow a transparent process that requires reporting of local content both by CMC and its contractors. The most likely candidates for local content include:

- Trucking and other transportation;
- Air transportation;
- Consulting services;
- Hospitality and travel services;
- Medical services;
- Services to employees;
- Road and tire services;
- Equipment supplies and maintenance;

- Communications; and
- Human resource and employment services.

Potential Project effects on business opportunities in the LSA can result from the expansion of existing businesses, the creation of new businesses or the attraction of outside businesses into the region.

Potential Effects on Government Revenue

Revenue from the sale of minerals from the Project are forecasted at $25.1 billion over 22 years at a cash production cost of $11.4 billion. The Feasibility Study for the Project forecasts tax payments arising from the mine over the construction and Operation Phases. Annual results detailed in the study are shown in Table 15.4-6. Over the construction phase, total government revenue paid by CMC averages $7.0 million annually (not including 2016), from Yukon mining royalties (on pre-production revenue). Over the Operation Phase, total government revenue from the project averages $219.1 million annually, mostly through corporate taxes ($130.8 million annually) and Yukon royalties (averaging $88.2 million annually). Taxes raised by the Yukon government average $153.6 million annually while taxes raised by the Federal government average $65.4 million. These figures do not reflect the amounts ultimately retained by the respective governments, since these amounts are adjusted in accordance with agreements between the Federal and Yukon governments (e.g., through the Territorial Formula Funding and Resources Revenue Sharing agreements).

Table 15.4-6 Forecasted Government Revenue from Project, 2017-2041

Phase	Year	Project Revenue (000's)	Government Revenue ($ 000's)					
			Yukon Gold Royalty	Yukon Mining Royalty	Yukon Corporate Tax (15%)	Total Yukon Revenue	Federal Corporate Tax	Total Government Revenue
Construction	2017	24,843	680	0	0	680	0	680
	2018	134,361	3,484	6,993	0	10,477	0	10,477
	2019	129,442	3,364	6,395	0	9,759	0	9,759
	Average	96,215	2,509	4,463	0	6,972	0	6,972
Operations	2020	1,301,711	31,771	54,341	0	86,112	0	86,112
	2021	1,782,639	42,490	98,135	66,485	207,110	66,485	273,594
	2022	1,691,881	40,684	87,904	115,933	244,521	115,933	360,453
	2023	1,449,556	35,182	60,185	91,368	186,735	91,368	278,102
	2024	1,236,406	30,446	38,707	98,116	167,269	98,116	265,384
	2025	1,279,213	31,527	44,484	98,894	174,905	98,894	273,799
	2026	1,314,348	31,997	61,008	97,535	190,540	97,535	288,074
	2027	1,334,014	31,723	90,383	97,164	219,270	97,164	316,433
	2028	1,338,572	31,852	90,939	84,042	206,833	84,042	290,875
	2029	1,240,554	29,363	79,084	84,139	192,586	84,139	276,724
	2030	1,255,087	29,699	78,744	78,988	187,431	78,988	266,418
	2031	1,183,392	28,306	73,693	77,676	179,675	77,676	257,350
	2032	1,168,891	27,954	72,267	71,620	171,841	71,620	243,460
	2033	1,135,909	27,084	67,413	63,994	158,491	63,994	222,485
	2034	1,039,724	24,918	59,210	41,475	125,603	41,475	167,078
	2035	799,289	19,290	38,367	52,503	110,160	52,503	162,662
	2036	858,258	20,634	48,497	76,061	145,192	76,061	221,253
	2037	1,023,065	24,375	70,617	47,233	142,225	47,233	189,457
	2038	757,845	18,193	42,899	37,259	98,351	37,259	135,609
	2039	637,959	15,352	33,704	39,699	88,755	39,699	128,454
	2040	660,991	15,792	36,715	18,901	71,408	18,901	90,308
	2041	353,057	8,400	17,034	0	25,434	0	25,434
	Average	1,129,198	27,138	61,106	65,413	153,656	65,413	219,069

Source: M3, 2013

Taxes and royalties based on income depend on the price of the underlying resource. This is the case with both the Yukon Mining Royalty and Corporate Taxes. Fluctuations in commodity prices can have noticeable effects on government revenue. Moreover, effective corporate tax rates may be lower than statutory rates (CMC 2013). The Project will also generate Government revenues from the taxation of direct, indirect, and induced economic activity supported by the mine expenditures. Using the projected construction costs and the related assumptions, MNP (2013) estimates that construction will generate $22 million in revenues to the Government of Yukon, of which $16 million will be derived from direct expenditures (mainly through Personal Income Tax and Corporate Income Tax) (Table 15.4-7).

Table 15.4-7 Projected Construction Effects of the Project on Taxes on Economic Activity

Phase	Output ($ millions)	Federal Tax ($ millions)	Yukon Territorial and Provincial Tax ($ millions)	Other Tax ($ millions)
Direct	576	24	16	5
Indirect and Induced	204	10	6	2
Total	779	33	22	7

Source: MNP, 2013

The operations of the Project also affect Yukon's economy through the generation of tax revenues from direct, indirect, and induced economic activity. Using estimated operational spending data provided by CMC (and assuming 69% of this spending occurs in Yukon), the economic impact report estimates that the Project would generate $25 million in annual tax revenues to the Government of Yukon (Table 15.4-8).

Table 15.4-8 Projected Annual Operations Effects of the Project on Taxes on Economic Activity

Phase	Output ($ millions)	Federal Tax ($ millions)	Yukon Territorial and Provincial Tax ($ millions)	Other Tax ($ millions)
Direct	307	16	22	1
Indirect and Induced	36	3	3	0.20
Total	342	20	25	1

Source: MNP, 2013

The economic impact model of projected tax revenues does not consider whether revenue raised by the Government of Yukon will be retained or reduced by offsets with the federal government. For the purpose of this assessment it is assumed that off-set calculations will not change as a result of Project revenue.

The total impact on government revenue estimated for the Project is shown in Table 15.4-9. Potential effects of the Project on the VC are summarized in Table 15.4-10.

Table 15.4-9 Projected Total Effects of the Project on Government Revenue

		Government Revenue (Average Annual Revenue, $ Millions)							
		Yukon Royalty	**Yukon CMC Corporate Tax**	**Yukon Direct and Indirect Taxes**	**Total Yukon Government Revenue**	**Federal CMC Corporate Tax**	**Other Federal Taxes**	**Total Federal Revenue**	**Total Government Revenue**
Construction	2017-2019	7.0	0.0	7.3	14.3	0.0	11.0	11.0	25.3
Operations	2020-2041	88.2	65.4	25.0	178.7	65.4	20.0	85.4	264.1

Table 15.4-10 Potential Effects of the Project

Mechanism of Interaction	**Key Indicator(s)[1]**	**Project Phase[2]** (C, O, DC, PC)	**Potential Effect**	**Direction** (Adverse/Beneficial)
Project purchases of goods and services	Economic Growth	C, O, DC	Project purchases of goods and services would increase Yukon GDP and employment	Beneficial
Project workforce demands	Economic Growth	C, O, DC	Project workforce demands would increase Yukon GDP and employment	Beneficial
Improved access along Freegold Road.	Economic Growth	C, O, DC	Increased use of the Freegold Road may occur, particularly for recreational purposes, as the improved alignment will make travel on this public portion of the road easier and safer.	Beneficial
Re-spending by households of additional income derived directly or indirectly from the mine employment	Economic Growth; Business Opportunities	C, O, DC	Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses	Beneficial
Project purchases of goods and	Business Opportunities	C, O, DC	Proposed Project purchases will create contract and business opportunities across Yukon	Beneficial

Mechanism of Interaction	Key Indicator(s)[1]	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction (Adverse/Beneficial)
Direct and indirect taxes by Project, contractors and	Government Revenues	C, O, DC	Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues	Beneficial
Project will pay royalties and corporate taxes to the Government of Yukon	Government Revenues	O	During operations Project will pay royalties / Yukon Mining Tax to Yukon, resulting in increased Government revenue	Beneficial
Additional direct and indirect taxes paid by Project	Government Revenues	C, O, DC	Additional direct and indirect taxes paid by Project employees will increase government revenues	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

15.4.2 Identification of Mitigation Measures and Potential Residual Effects

Effects on the LSA and RSA Economic Development and Business Sector VC are considered to be beneficial. Expenditures on Project construction and operations will require labour, goods, and services, much of which will be procured from Yukon sources and will have a positive effect on territorial GDP, government revenues, and regional businesses.

Substantive business opportunities will be available for businesses based in the LSA. Project infrastructure investments will provide the basis for future developments, which will bolster economic growth. Casino Mining Corporation will enhance these beneficial effects by:

- Implementing a procurement process that gives priority to suppliers from the RSA, where economically practical, and in particular rural communities within the LSA;
- Implementing a procurement process that gives priority to contractors who hire local/regional residents to the greatest extent practical;
- Implementing a procurement process that manages contract components to meet the capabilities of LSA entrepreneurs;
- Encouraging joint ventures between Aboriginal businesses and other regional businesses in the procurement process;
- Requiring cultural awareness training for employees and contractors;
- Monitoring Project socio-economic effects and adapting management measures where required;
- Partnering with First Nation communities and their development corporations to access additional funding for training;
- Support for non-mining training and entrepreneurial initiatives; and

- Coordinating use of transportation infrastructure with exploration companies and other tenure holders.

Given their already beneficial effects, direct enhancement measures on government revenue-related effects are not contemplated. However, efforts to maximize regional involvement in contracting and procurement as well as efforts to maximize the workforce resident in the RSA will all have indirect effects of increasing government revenue.

Mitigation measures are summarized and paired to Project effects in Table 15.4-11. Effects are sorted into the three categories of economic growth, business opportunities, and government revenue.

Table 15.4-11 Proposed Mitigation Measures and Potential Residual Effects for the Economic Development and Business Sector VC

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[2]	Predicted Effectiveness	Residual Effect
Economic Growth					
Project purchases of goods and services would increase Yukon GDP and employment	C, O, DC	Beneficial	Contractors would be encouraged to hire local/regional residents to the extent practical.	High	Yes
Project workforce demands would increase Yukon GDP and employment	C, O, DC	Beneficial	CMC would seek to recruit local/regional/territorial residents to the extent practical (Section 14 Employment and Income).	High	Yes
Increased use of the Freegold Road may occur, particularly for recreational purposes, as the improved alignment will make travel on this public portion of the road easier and safer.	C, O, DC	Beneficial	Local community members may enjoy enhanced access to recreational opportunities along this section of the road.	Medium	Yes

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[2]	Predicted Effectiveness	Residual Effect
Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses	C, O, DC	Beneficial	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes. The proponent would seek to recruit local/regional/territorial residents to the extent practical.	High	Yes
Business Opportunities					
Proposed Project purchases will create contract and business opportunities across Yukon	C, O, DC	Beneficial	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.	Medium	Yes
Government Revenue					
Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues	C, O, DC	Beneficial	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes. The proponent would seek to recruit local/regional/territorial residents to the extent practical.	Medium	Yes
During operations Project will pay royalties / Yukon Mining Tax to Yukon resulting in increased Government revenue	O	Beneficial	None	N/A	Yes

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[2]	Predicted Effectiveness	Residual Effect
Additional direct and indirect taxes paid by Project employees will increase government revenues	C, O, DC	Beneficial	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes; the proponent would seek to recruit local and/or regional/territorial residents to the extent practical.	High	Yes

Notes

1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

15.4.3 Significance of Residual Effects

The criteria used to discuss residual effects are discussed in detail in Section 5, Assessment Methods and Frameworks. Table 15.4-12 outlines the seven criteria used to assess significance for the Economic Development and Business Sector VC.

Table 15.4-12 Determining Significance of Residual Effects for the Economic Development and Business Sector VC

Criteria	Rating	VC Specific Definitions
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	Effect that occurs might or might not be detectable, but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge
Geographical Extent	Localized	Within the identified Regional Study Area
	Widespread	Outside the identified Regional Study Area
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, decommissioning and closures
	Permanent	Effects measureable Post-Closure
Frequency	Infrequent	Effects occur occasionally
	Frequent	Effects occur often or continuously
Reversibility	Reversible	Effect will return to baseline condition after operations, decommissioning and closure
	Irreversible	Effect is persistent after operations, decommissioning and closure
Context	Low Resilience	Effects operate outside of regional experience and represent a challenge to local socio-economic management institutions
	High Resilience	Effects are familiar to local socio-economic management institutions
Probability of Occurrence	Low	Effects are unusual under similar circumstances and are not expected to occur with this Project
	Moderate	Effects have a reasonable risk of occurring under similar circumstances or there is not currently sufficient information to assess probability
	High	Effects have consistently occurred under similar circumstances and are expected to occur with this Project

The significance of potential residual effects from the Project on the Economic Development and Business Sector VC are summarized in Table 15.4-13.

Table 15.4-13 Significance of Residual Effects for the Economic Development and Business Sector VC

Residual Effect	Predicted Degree of Effect After Mitigation (*or Enhancement*) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Economic Growth									
Project purchases would increase Yukon GDP and employment	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Project workforce demands would increase Yukon GDP and employment	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Increased access from Freegold Road Upgrade may provide opportunities for more exploration activities, which in turn will increase Yukon's GDP and employment	Beneficial	Medium	Localized	Long Term	Continuous	Reversible	High resilience	Moderate	Not Significant
Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant

Business Opportunities									
Proposed Project purchases will create contract and business opportunities across Yukon	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Government Revenue									
Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
During operations Project will pay royalties/Yukon Mining Tax to Yukon	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Additional direct and indirect taxes paid by Project employees will increase government revenues	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant

Note:

For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

15.4.4 Discussion of Significance

The significance of these effects is discussed by the three categories of effects (economic growth, business opportunities, and government revenue) in the following sections and summarized in Table 15.4-14. The direct effects of the Project on the Economic Development and Business Sector VC are significant, particularly relative to the size of the RSA's economy. Effects of new infrastructure, in particular the Freegold Road Upgrade and Extension, are not deemed to be significant given the uncertainty of the marginal effect of this infrastructure on other Actions.

Predictions of economic effects in terms of economic growth, business opportunities and government revenue were based on the financial model in the Project's Feasibility Study which is estimated to have a margin of error within the range of plus 15% to minus 10% (M3, 2013). Estimates directly based on feasibility data such as Project purchases of goods and services and payments of royalties to the Yukon government are thus given a high level of confidence. The Project's economic effects are estimated by MNP using the 2009 I-O economic

multipliers for the Yukon as provided by the Industry Accounts Division of Statistics Canada. These multipliers describe how a change in final demand for the output of one particular industry would affect economic activity in the entire territory. The structure of the mining industry in 2009 in Yukon may not be representative over the life of the Project, especially given its unique scale compared to other mining activities in the region. In addition, smaller regions increase the possibility of data errors within the tables which can increase the margin of error to the predictions. The combined effect of these sources of error is likely to increase the margin of error above plus or minus 15% and thus require a moderate level of confidence. The effect of the Freegold Road Upgrade is considered to have a moderate level of confidence because of the lack of data on the cost-benefit considerations of contingent exploration activities.

Table 15.4-14 Summary of Residual Effects for the Economic Development and Business Sector VC

Potential Residual Effect	Direction	Significance	Level of Confidence (Low, Moderate, High)
Economic Growth			
Project purchases of goods and services would increase the Yukon GDP and employment	Beneficial	Significant	High
Project workforce demands would increase Yukon GDP and employment	Beneficial	Significant	Moderate
Increased access from Freegold Road Upgrade may provide opportunities for more exploration activities, which in turn will increase Yukon's GDP and employment	Beneficial	Not Significant	High
Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses	Beneficial	Significant	Moderate
Project purchases (contracting opportunities) would contribute to the Yukon economy in terms of increasing its GDP and employment	Beneficial	Significant	High
Business Opportunities			
Proposed Project purchases will create contract and business opportunities across the Yukon	Beneficial	Significant	Moderate
Improved access from Freegold Road Upgrade may provide additional business opportunities related to exploration activities and potential for development of other major Actions	Beneficial	Not Significant	Moderate
Government Revenue			
Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues	Beneficial	Significant	Moderate
During operations Project will pay royalties/Yukon Mining Tax to the Yukon	Beneficial	Significant	High
Additional direct and indirect taxes paid by Project employees will increase government revenues	Beneficial	Significant	Moderate

15.4.4.1 Discussion of Significance on Economic Growth

The magnitude of the Project's potential residual effect on economic growth is high. The 2012 estimate for mineral production across the RSA is $600 million; average annual revenue for the Project is forecasted to be $1.1 billion, providing what would amount to a 188% increase in Yukon's mineral production. The Project would create $232 million in GDP from direct expenditures and $274 million from total expenditures (including induced and indirect activities) on average annually over the Operation Phase. Yukon's 2011 GDP is estimated at $2.4 billion; this would amount to a 9.7% increase from direct expenditures and an 11.4% increase from total expenditures (Yukon Economic Development 2013).

Potential residual effects on economic growth are expected to be localized to Yukon. Although economic benefits will spill over into other jurisdictions, these effects are not likely to be noticeable within the context of the larger economies of British Columbia and Alberta. They are expected to be continuous over both the construction and Operation Phases given the stability of pre-production operations activities. Effects are considered reversible since they depend on expenditures that will substantively end with the closure and decommissioning of the Project.

Yukon residents are familiar with the cyclical nature of the mining industry and these effects are expected to be manageable within the region's socio-economic context. In general, the effects on economic growth of the Project are expected to be significant.

The magnitudes of effects from the Freegold Road Upgrade are uncertain since they depend on the marginal impact of reduced infrastructure costs on activities for which little information on economic viability is available. If the road made the difference in the decision of whether a specific Action moved into production the effect could be of a high magnitude but even this is uncertain given the varying quality of mineral claims - the reduction in cost from the road is less likely to be the decisive factor for a major resource. The effect of improved transportation infrastructure is considered to be irreversible to the extent that the Freegold Road Upgrade is expected to persist. Overall, the effects of the road expansion and upgrade are not expected to be significant.

15.4.4.2 Discussion of Significance on Business Opportunities

The Project will present major opportunities for businesses and encourage the development of Whitehorse as an exploration and production mining hub in the region. This will result in a high magnitude of new opportunities for Yukon's business sector. In a typical year, the Project is expected to spend $307 million in operating expenditures in the region. This is the same as the combined expenditures in 2011 of all of the exploration companies operating in Yukon. Exposure to the changing demands of mine production would let companies build new capabilities and expand into new areas, which in turn would help them service other activities in the mining sector (Yukon Economic Development 2013).

Effects on business opportunities are expected to be localized to Yukon. Although procurement and contracting will out of necessity spill over into other jurisdictions, these effects are not likely to be noticeable within the context of the larger economies of British Columbia and Alberta.

Effects on business opportunities will be continuous over both the construction and Operation Phases given the stability of pre-production operations activities. Effects are considered reversible since they depend on expenditures that will substantively end with the closure and decommissioning of the Project.

Yukon businesses are familiar with the cyclical nature of the mining industry and these effects are expected to be manageable within the region's socio-economic context.

In general, the effects on business opportunities of the Project are expected to be significant.

The magnitudes of effects from the Freegold Road Upgrade are uncertain since they depend on the marginal impact of reduced infrastructure costs on activities for which little information on economic viability is available. If the road made the difference in the decision of whether a specific Action moved into production the effect could be of a high magnitude but even this is uncertain given the varying quality of mineral claims - the reduction in cost from the road upgrade is less likely to be the decisive factor for a major resource. However, since many businesses service exploration companies, there is a variety of smaller scale uses for which they are likely to see some benefit. The effect of improved transportation infrastructure is considered to be irreversible to the extent that the road is expected to persist after closure. Overall effects from the road upgrade are not deemed to be significant.

15.4.4.3 Discussion of Significance on Government Revenue

The magnitude of the Project's effect on government revenue is very high. The Government of Yukon levies a net profit royalty on mineral production up to a maximum rate of 12% on output greater than $35 million. To place the revenue generated by the Project into perspective, Table 15.4-15 shows the amount of Yukon mining royalties paid by other mines in the RSA over the period from 2007 to 2012. Revenue from the royalty peaked in 2009 at $5.9 million solely from payments by the Minto Mine. In 2011, revenue was $2.0 million, reflecting a reduction in the level of the tax. M3 estimates the annual amount of Yukon mining royalties paid by the Project over the Operation Phase to be $88.2 million sustained over 22 years, roughly 7.4% of Yukon's total revenue in 2012. The Government of Yukon estimates that $12 million in resource revenue would be enough to justify triggering their agreement with the federal government to retain 50% of resource revenues. As a consequence, the Project will generate government revenues sufficient to change the rate of return in terms of government revenue for resource activities across Yukon (Government of Yukon 2012; Government of Yukon 2013b). It should be noted, that because Minto is located on Selkirk First Nation settlement land, all of the royalties payable from the project flow directly to Selkirk.

Table 15.4-15 Yukon Mining Royalty Paid by Other RSA Activities, 2007-2012

Project	Owner	Annual Royalties ($)					
		2007	2008	2009	2010	2011	2012
Minto Mine	Capstone Mining Corp.	0	1,503,491	5,917,904	3,806,550	1,680,398	391,661
Bellekeno Mine	Alexco Resources	N/A	N/A	N/A	0	351,525	372,588
Total		0	1,503,491	5,917,904	3,806,550	2,031,923	764,249

Source: Yukon Government – Energy, Mines and Resources, 2013

Casino Mining Corporation is estimated to pay $65.4 million annually in corporate taxes to Yukon over the operational phase. In addition, it is estimated that the Government of Yukon would raise $25 million annually from direct income taxation (personal income tax and corporate income tax on supplier industries) during the Operation Phase. Overall, Government of Yukon revenue from the Project is estimated at $178.7 million annually over the Operation Phase, or 14.8% of Yukon's total revenue in 2012

Effects on government revenue are expected to be localized. Although the federal government will see an increase in government revenues, estimated at $85.4 million annually over the operational life of the Project (not

including reduced federal offsets from mining revenue), these effects are not likely to be noticeable within the context of overall federal revenues of $8.1 billion (MNP 2013; Department of Finance 2012).

Effects on government revenue will be continuous over the Operation Phase. Effects are considered reversible since they depend on expenditures that will substantively end with the closure and decommissioning of the Project. Although the magnitude of the effects are large, the Government of Yukon is familiar with managing high rates of economic growth and the cyclical nature of the mining industry, and these effects are expected to be manageable within the region's socio-economic context.

The effects on government revenue of the Project are expected to be significant.

15.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

15.5.1 Introduction

The assessment of potential effects of the Project on Economic Development and Business Sector VC in terms of economic growth, business opportunities, and government revenues found effects of construction and operations to be beneficial and thus these effects are not required to be carried forward into a CEA. Furthermore, the assessment of potential Project effects on this VC was conducted in the context of all past and existing economic activity, as well as forecasts of economic growth that take into consideration other proposed and anticipated development projects and activities. Consequently, the effects assessment of the proposed Project is inherently cumulative and therefore no further assessment of cumulative effects is practical or required.

15.5.2 Identification of other Activities Potentially Affecting the VC

The effects of the Project in terms of economic growth, business opportunities, and government revenues would be beneficial and thus these effects are not required to be carried forward into a CEA.

15.5.3 Interactions and Potential Cumulative Effects

The effects of the Project in terms of economic growth, business opportunities, and government revenues would be beneficial and thus these effects are not required to be carried forward into a CEA.

15.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

As the effects of the Project in terms of economic growth, business opportunities, and government revenues would be beneficial and thus these effects are not carried forward into a CEA, no additional mitigation measures are required.

15.5.5 Significance of Residual Cumulative Effect

The residual cumulative effects of the Project on the economy, business opportunities, and government revenues are the same as the effects specific to the Project as stated in Section 17.3.

15.5.6 Discussion of Significance of Residual Cumulative Effects

The residual cumulative effects of the Project on the economy, business opportunities, and government revenues are the same as the effects specific to the Project as stated in Section 17.3 and their significance is discussed in Section 17.3.4.

15.6 SUMMARY AND CONCLUSIONS

The construction of the Project is expected to occur over four years and cost a total of $2.5 billion in capital expenditures, increasing Yukon's GDP over that period by $363 million. During the Operation Phase, the Project is expected to increase GDP by $274 million, equivalent to 11.4% of Yukon's 2011 GDP of $2.4 billion. Government revenues from the Project is forecasted to amount to $219 million annually over the Operation Phase, of which $61.1 million annually is expected to be raised through the Yukon Mining Tax. Revenues for the Government of Yukon are estimated to amount to 7.4% of Yukon's 2012 overall revenue. The magnitude of this increase in resource revenue would be sufficient to change the nature of the funding arrangement between the federal and territorial governments, allowing a greater share of resource revenues to be retained by the Government of Yukon. Residual effects on the economy post-operations would be limited to closure expenditures, which are of a relatively low magnitude and not expected to be noticeable, as well as ongoing economic returns from infrastructure investments made by CMC (notably the Freegold Road upgrade), human capital investments retained by workers (training and education), and returns from public investments funded by increased government revenue.

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16 – COMMUNITY VITALITY

16.1 INTRODUCTION

The Community Vitality VC assesses the potential effects of the Project on demographic conditions and well-being of the communities located in the Project's LSA. The potential effects of the Project on community vitality will ultimately depend on the extent to which Project employment results in people moving into the area, either permanently or temporarily. Typically, the temporary population increase would occur during the construction phase, and workers would be housed in a construction camp at the mine site. During the operations phase, a site camp would continue to be provided, but some workers could decide to move to the LSA. This could lead to an increase in population and possibly change the demographic composition of the LSA. In addition, the potential change in community demographics, and new Project-related income and work schedules could affect social and behavioural conditions in the communities and therefore affect the well-being of individuals, families, and communities in the LSA. The key indicators selected to assess community vitality are: Population and Demographics, and Community Well-being. Supplemental information to complement this section is provided in Appendix 13A.

16.1.1 Regional Setting

The Project is a proposed Open Pit mine located approximately 300 kilometres (km) northwest of Whitehorse, Yukon Territory on Crown land that is administered by Yukon Government. The Project site is located within the Selkirk First Nation traditional territory. The Project will require construction of a road access, including upgrades to the existing Freegold Road and construction of the Freegold Road Extension on land that partially falls within the Selkirk First Nation and Little Salmon/Carmacks First Nation traditional territories. The Freegold Road Extension and proposed Freegold Road Upgrade will extend for approximately 200 km southeast from the Project to the village of Carmacks.

16.1.2 Rationale for VC Selection

The Community Vitality VC was identified based in consideration of the information and issues communicated by the public, Aboriginal groups, local communities, and government stakeholders during the engagement process conducted in support of this Proposal. This VC and specific indicators were also selected based on professional judgement and experience in conducting socioeconomic effects assessments.

Potential population changes are important to consider because it is a prominent factor in determining community character and demands on infrastructure and services. It is a common practice to evaluate population changes because population directly affects the quality of life in a region, and assists public and private agencies in planning for future capacity requirements for various services. Population changes and new Project-related income could also affect the well-being of individual, families, and communities in the area. This section of the Proposal assesses the potential effects of the Project on these conditions that could affect the vitality of the local communities.

16.2 ASSESSMENT BOUNDARIES

16.2.1 Local Study Area (LSA)

The LSA for socio-economic VCs, which includes Community Vitality, is defined in Section 13.2.1 and shown on Figure 13.1-1.

16.2.2 Regional Study Area (RSA)

The RSA for socio-economic VCs, which includes Community Vitality, is defined in Section 13.2.2 and shown on Figure 13.1-1.

16.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Project. Details on activities associated with the construction, operation, closure and decommissioning, and post-closure phases of the Project is provided in Section 4.0.

16.3 BASELINE CONDITIONS

This section provides an overview of relevant baseline conditions for each of the key indicators chosen to assess the potential effects of the Project on Community Vitality. The key indicators used to assess Project effects on this VC include: Population and Demographics, and Community Well-being. A detailed baseline for these indicators is available in Appendix 13A: Socioeconomic Baseline of this Proposal.

16.3.1 Population and Demographics

16.3.1.1 Selkirk First Nation / Pelly Crossing

Selkirk First Nation (SFN) has a registered membership of approximately 500 people according to the community website (SFN 2012) although Aboriginal Affairs and Northern Development Canada (AANDC) reports the figure at 614 as of September 2013 (AANDC 2013). The SFN website estimates that only 40% of membership reside in Pelly Crossing (SFN 2012) and AANDC estimates that 47% of the population live off-reserve (e.g., not in Pelly Crossing) (AANDC 2013). Of those, approximately 75 SFN members reside in Whitehorse (Fred 2008a).

Pelly Crossing's population grew by 24% from 281 to 348, between 2005 and 2010. Net migration into the community accounted for 66% of this growth (Yukon Bureau of Statistics 2011a). Selkirk First Nation comprises the majority of the population, making up approximately 80% of residents (Fred 2008a). The 2011 National Household Survey (NHS) indicates that approximately 91% (305) of Pelly Crossing residents are Aboriginal (Statistics Canada 2013c). This is the highest percentage among the LSA communities. Unlike Yukon, where the proportion of males and females was balanced, Pelly Crossing had a higher proportion of males to females at 55% to 45%, respectively (Statistics Canada 2012).

16.3.1.2 Little Salmon/Carmacks and Carmacks

According to the Little Salmon/Carmacks First Nation (LSCFN) website, LSCFN has a total reported membership of approximately 630 people including status and non-status beneficiaries (LSCFN 2012). Aboriginal Affairs and Northern Development Canada estimates the membership at 640 as of September 2013, of which 52% live outside of the home community of Carmacks (AANDC 2013). The 2006 Census estimates that about half (47.8%) of membership reside within the home community of Carmacks (Fred 2008b). Another, 28.3% reside outside of the home community but within Yukon, while an additional 23.9% live outside of Yukon. According to 2006 Census, approximately 130 members (21%) reside in Whitehorse (Fred 2008b).

Based on Yukon Health Care Registration data, the total population in the Village of Carmacks as of 2012 is 513 people. The population has increased steadily since 2006, growing from 405 in 2006 to 513 in 2012 (Yukon Bureau of Statistics 2013). Net in-migration accounted for 77% of the community's population growth between 2005 and 2010 (Yukon Bureau of Statistics 2011). LSCFN members comprise the majority of the population,

making up approximately 76% of residents (Fred 2008b). This is consistent with census information that reported 76.5% of Carmacks residents in 2006 were of Aboriginal identity (Statistics Canada 2007).

Population growth is identified as a key long-term goal in the Carmacks Integrated Community Sustainability Plan (Village of Carmacks 2006). The report suggests that population growth is needed to increase the ability of local governments to finance community services and infrastructure and would aid development of a thriving business environment.

16.3.1.3 Whitehorse

Whitehorse is the largest community in Yukon with a population of 27,753 in 2012; this equates to 78% of the population of Yukon (35,621) (Yukon Bureau of Statistics 2013). The City of Whitehorse grew by approximately 13.8% between 2006 and 2011, which is about twice the national growth rate of 5.9% for the same period and accounted for most (85%) of the 11.6% growth that occurred in Yukon between 2006 and 2011 (Statistics Canada 2013a). Across the territory, populations in some smaller communities have declined over the past few years (Yukon Economic Development 2010). The majority of the population growth is a result of net migration to the city, but the birth rate also exceeded the death rate, which is not the case for Canada as a whole (CMHC 2012). The 2011 NHS indicates that approximately 17% (3,770) of Whitehorse residents are Aboriginal, higher than the Canadian average of 4% but lower than Yukon's average of 23% (Statistics Canada 2013c).

16.3.1.4 Yukon

Yukon has seen rapid population growth (11.6%) over the period 2006 to 2011, the highest rate of all the provinces and territories. This development is welcomed by the Yukon Government, which seeks to present Yukon as a "world-class destination in which to live, work and invest" (Yukon Economic Development 2011). During the period 2007 to 2012, the number of births (1,885) exceeded the number of deaths (1000) by 89%. At the same time, the number of (1,109) immigrants to Yukon exceeded emigrants (115) by 864% (Statistics Canada 2013b).

16.3.2 Community Well-being

The AANDC has developed a Community Well-being Index (CWBI) based on four primary indicators: education, labour force activity, income, and housing conditions. CWBI scores range from 0 (lowest/worst) to 100 (highest/best) and are constructed from Census 2006 data, which are the most comprehensive data currently available.

There are considerable differences between well-being conditions in the rural communities of Pelly Crossing and Carmacks compared to the urban community of Whitehorse. The rural communities of Pelly Crossing and Carmacks had CWBI scores of 71 and 70, respectively, which is below the overall Yukon score of 78. The education category had the lowest scores for both communities, with average scores of only 43 and 44, respectively, which were the third and fourth lowest in Yukon (AANDC 2006). The small population size, particularly in Pelly, means these results need to be considered as a general indicators, rather than accurate reflections of the situation.

Whitehorse, by contrast, had a CWBI score of 85, which is the highest in Yukon and 7 points above Yukon average. The categories with the highest scores were housing and income (93 and 92, respectively) and the category with the lowest score was education (64 points).

Similarly, there is a considerable difference in crime rates among the study communities. According to the Yukon Bureau of Statistics (2013), Pelly Crossing has the highest crime rates in the LSA (110 crimes per 100 residents),

representing almost six times the crime rate in Whitehorse (20 crimes per 100 residents) and two and a half times the crime rate of Carmacks (42 crimes per 100 residents). Property crime was the most prevalent at Pelly Crossing and Whitehorse at rates of 48.2 and 8 per 100 residents, respectively. The most prevalent crime at Carmacks was “other” crime at a rate of 15.7 per 100 residents, followed by property crime at a rate of 12.2 per 100 residents. Pelly Crossing reported the highest rate of violent crime among the LSA communities at 20.1 per 100 residents, followed by Carmacks at 8.6 per 100 residents and Whitehorse at 3.2 per 100 residents.

There are no data for each community regarding drug and alcohol consumption, but there are data for the entire Yukon. Yukon residents were more likely to be frequent, heavy drinkers when compared with the national estimates. In Yukon, 19% of the population age 12 and older drank heavily more than once a month, compared to 12% for the entire Canada. There is some variation by gender, with a larger estimated proportion of Yukon males (24%) being frequent, heavy drinkers than females (15%) (Yukon Bureau of Statistics 2010).

The emergency room at Whitehorse General Hospital treats many patients for alcohol or illicit drug-related health emergencies. In 2005, visits to the Whitehorse General Hospital emergency room for which alcohol was the reason for the visit (most responsible diagnosis) made up 2.8% of all emergency room visits (698 visits by 279 individuals, 61% of whom were male). In 2009, this rose to 4.1% of all emergency room visits (1,050 visits by 307 individuals, of whom 60% were male).

In contrast to alcohol, there was a decline in drug-related emergency room visits between 2005 and 2009. In 2005, visits to the emergency room for which illicit drugs were the reason for the visit (most responsible diagnosis) made up 0.8% of all emergency room visits (196 visits by 129 individuals, 51% of whom were male). In 2009, this had dropped slightly to 0.6% of all emergency room visits (149 visits by 114 individuals, of whom 45%were male) (Yukon Bureau of Statistics 2010).

16.4 PROJECT-SPECIFIC EFFECTS

16.4.1 Project Interactions and Potential Effects

Table 16.4-1 identifies potential interactions between specific Project components and activities and the Community Vitality VC. The identified interactions warrant further analysis because they may result in substantive socio-economic effects on community vitality, either positive or negative. The specific nature of the effects is evaluated and discussed in subsequent sections. The list of Project components and activities included in this table were derived from the Project Description as described in Section 4.

Project components that may affect directly or indirectly the community vitality conditions during the mine construction, operations, and closure and decommissioning phases include:

- Contracted Employment;
- Mine Staffing; and
- Accommodations (Construction and Mine Staffing).

These Project components are expected to interact with the Community Vitality VC through three mechanisms: population changes, employment income and work schedules, and camp accommodation.

Contracted Employment and Mine Staffing

Population Changes

The Project will result in considerable direct employment as well as contracted employment, which could cause population changes on the local communities (e.g., encourage an influx of new residents into local communities).

The Project population effects would depend on whether Project-related jobs are filled by residents or by non-residents, and on whether non-residents relocate to the area or commute to work. Some potential out-migration is also anticipated following a decline in employment opportunities, specifically towards the end of operations and during decommissioning and closure.

Employment Income

Direct Project employment and contracted employment would also result in increases to personal income for workers and contractors. The increase in employment and income will decrease dependencies on government transfers (i.e., social assistance), but also could lead to poor personal choices for spending disposable income, which could affect workers' family well-being.

Accommodations

Work Schedules and Camp Accommodation

The Project will provide construction and operations camps for employees and contractors. Workers will live away from their families and dependents during working shifts. Project work schedules and separation from family for extended periods of time have the potential to affect family relationships and community well-being.

Table 16.4-1 Potential Interactions between the Project and Community Vitality

Project Components and Activities	**Project Phase**[1] (C, O, DC, PC)	Potential Interaction (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	Yes	Work schedule and fly in/fly out camps
Aggregate Sources / Borrow Sites	C,	No	No specific interaction with this socio-economic VC
Airstrip and Airstrip Access Road	C, O, CD,	No	No specific interaction with this socio-economic VC
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O,	No	No specific interaction with this socio-economic VC
Concentrate Transport and Loading	O,	No	No specific interaction with this socio-economic VC
Concrete Batch Plant Operation	C, O,	No	No specific interaction with this socio-economic VC
Contracted Employment	C, O, CD,	Yes	Direct and indirect population changes from Project employment and income
Contracted Employment	C, O, CD,	Yes	Increase disposable income
Cyclone Sand Plant	C, O,	No	No specific interaction with this socio-economic VC
Dismantling of Facilities	CD,	No	No specific interaction with this socio-economic VC
Diversion of Canadian Creek	C, O,	No	No specific interaction with this socio-economic VC
Drilling and Blasting	C, O,	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Fish Habitat Compensation Construction	C, O,	No	No specific interaction with this socio-economic VC
Freegold Road Extension	C, O, CD,	No	No specific interaction with this socio-economic VC
Freegold Road Upgrade	C, O, CD,	No	No specific interaction with this socio-economic VC
Fuel Storage and Distribution System	C, O,	No	No specific interaction with this socio-economic VC
Gold Extraction Plant / Oxide Ore Processing	C, O,	No	No specific interaction with this socio-economic VC
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C,	No	No specific interaction with this socio-economic VC
Hazardous Materials Storage, Transport, and Disposal	C, O,	No	No specific interaction with this socio-economic VC
Heap Leach Facility	C, O,	No	No specific interaction with this socio-economic VC
Heap Leach Pad	C, O,	No	No specific interaction with this socio-economic VC
Laydown Areas	C, O,	No	No specific interaction with this socio-economic VC
LNG Transport to Site	C, O,	No	No specific interaction with this socio-economic VC
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O,	No	No specific interaction with this socio-economic VC
Maximum Disturbance Area	C, O, CD,	No	No specific interaction with this socio-economic VC
Mine Development	C, O, CD,	No	No further interaction; already addressed in other Project components
Mine Staffing	C, O, CD,	Yes	Direct and indirect population changes from Project employment and income
Mine Staffing	C, O, CD,	Yes	Increase disposable income
On-site Equipment and Vehicle Use	C, O, CD,	No	No specific interaction with this socio-economic VC
Open Pit Mining	C, O,	No	No specific interaction with this socio-economic VC
Ore Conveyors	C, O,	No	No specific interaction with this socio-economic VC
Ore Crushing	C, O,	No	No specific interaction with this socio-economic VC
Ore Hauling	C, O,	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Ore Stockpiles	C, O,	No	No specific interaction with this socio-economic VC
Processing Facilities for Sulphide Ore	O,	No	No specific interaction with this socio-economic VC
Reagent Storage and Distribution	C, O,	No	No specific interaction with this socio-economic VC
Site Reclamation / Re-Vegetation	O, CD,	No	No specific interaction with this socio-economic VC
Site Security and Fencing	C, O, CD,	No	No specific interaction with this socio-economic VC
Surface Water Management (Contact Water)	C, O, CD,	No	No specific interaction with this socio-economic VC
Surface Water Management (Non-Contact Water)	C, O, CD,	No	No specific interaction with this socio-economic VC
Tailings Management Facility	C, O, CD,	No	No specific interaction with this socio-economic VC
Topsoil Stockpiles	C, O,	No	No specific interaction with this socio-economic VC
Traffic (Equipment and Materials to Site)	C, O, CD,	No	No specific interaction with this socio-economic VC
Waste Management: Garbage and Sewage Waste Facilities	C, O,	No	No specific interaction with this socio-economic VC
Wasterock and Overburden Disposal	C, O,	No	No specific interaction with this socio-economic VC
Water Supply	C, O, CD, PC	No	No specific interaction with this socio-economic VC

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

16.4.1.1 Potential Project Effects on Community Vitality

This section evaluates changes to population and community wellbeing resulting from anticipated Project interactions as described above in Table 16.4-1.

Changes in size and characteristics of the local population affect a range of community and regional services that are driven by use levels. Therefore, the assessment of this indicator is linked to the assessment of other socio-economic VCs defined in this Proposal (e.g., Infrastructure and Services).

16.4.1.2 Potential Effects on Population and Demographics

The Project has the potential to change population and demographics in the RSA and LSA through direct Project staffing demands or through indirect changes in employment rates and household incomes. Quantitative assessments are made of these effects for the transitional period (from 2016 to 2024) over which staffing and expenditures peak. Qualitative assessments are made for the later portions of the operations phase, as well as the closure and post-closure phases. This is due to rising uncertainty on staffing and expenditures that would make a quantitative forecast unreliable. The scale of other demographic changes (e.g., ethnicity, age/gender, etc.) is directly dependent on the magnitude of the population change, so the assessment of potential Project effects would focus on population change.

16.4.1.3 Direct Migration (Project Staffing)

As discussed in Section 13 Employment and Income, the Project has substantive staffing requirements over its construction and operations phases. At its peak, the size of the mine construction labour force is estimated at 1,000 workers, of which 26% are expected to be drawn from the RSA. Not included in that share is the pre-production operations workforce, which will begin to be hired in 2017 and is expected to grow until 2024. The size of the mine operations workforce is estimated to be 652 workers by 2024, of which 536 are expected to reside in the RSA (including existing residents and migrants). The decommissioning and closure workforce will be contracted and no staffing estimate is provided, as will also be the case in the post-closure phase.

Casino Mining Corporation (CMC) anticipates three potential sources for the Project workforce: the LSA; RSA; and elsewhere, including other areas in Canada. Some long-term employees hired from outside of the RSA will choose to migrate to Yukon, for example to reduce their commuting time. The share of migrants in the overall workforce is estimated at 20% based on the scarcity of local skilled labour and surveys of existing commuting workers receptivity to incentives. Only incentives that could reasonably be offered by CMC are considered in this analysis, notably travel and housing allowances, as well as training (both external and on the job). Assuming that the average household size of workers is 2.6 (reflecting the Canadian average) the estimated net migration from Project staffing is shown in Table 16.4-2 (MiHR 2012, Herkes, Mooney and Smith 2013, Statistics Canada 2013c). It sees migration from staffing reaching 335 in 2024. These effects are expected to be sustained during operations and then gradually decline in the period leading up to closure as the size of the overall workforce declines.

Table 16.4-2 Estimated population change in RSA from Project Staffing, 2016-2024

Phase	Year	Total Yukon-Resident Staff	Share of Migrants in Resident Staff	Annual Net Migration From Staffing (Annual Individuals)	Total Net Migration From Staffing (Total Individuals)
Construction	2016	0	0	0	0
	2017	68	28	73	73
	2018	155	54	66	140
	2019	196	61	20	160
Operations	2020	353	85	62	222
	2021	442	126	105	327
	2022	489	129	8	335
	2023	525	134	12	335
	2024	536	129	-12	335

16.4.1.4 Indirect Migration

In addition to direct staffing effects, the Project will affect regional labour market conditions (e.g., increase employment rates and household income) and incentivize additional indirect migration, by making the region more attractive to potential migrants. The Project is expected to encourage indirect migration into the region through two mechanisms: employment effects and income effects.

16.4.1.5 Employment Effects

As addressed in Section 13 (Employment and Income), direct, indirect, and induced employment effects will occur in Yukon from Project expenditures. These 'spin-off' effects are related to the purchase of goods and services needed to construct and operate the Project (indirect effects) and the expenditures of direct and indirect labour income on consumer goods and services (induced effects). MNP estimates that construction of the Project would support 5,091 full-time equivalents (FTEs) of direct, indirect, and induced employment. Over the operations phase, MNP estimates the Project will support 855 FTEs annually on average (MNP 2013).

Changes in the regional employment rate resulting from this demand are expected to encourage migration into the region. Amirault et al. (2012) estimate that a 5-percentage point increase in the gap in employment rates between Canadian regions will increase net in-migration to the region, with the higher employment rate by 12% over a 5-year period. This effect includes people coming into the region and the retention of those who would otherwise have left the region (Amirault et al. 2012). Table 16.4-3 uses these results to estimate the effect of the Project on migration from 2016 to 2024. This analysis assumes that migrants will either participate in employment opportunities supported by the Project or replace existing workers drawn to Project-related work. This reduces the change in the migration rate from employment effects as labour markets adjust to incorporate new job opportunities. The analysis predicts that the rise in annual migration peaks during the construction period in 2017 at 77 people falls to 9 in 2020 and then turns mildly negative from 2022 onward. Negative effects arise from fully adjusted labour markets incorporating migrants drawn to the region, which then place downward pressure on the employment rate. Expenditures on services and procurement are expected to decline close to closure and this would be expected to have a negative effect on the migration rate as employment returns to baseline conditions.

Table 16.4-3 Estimated Population Change in RSA from Employment Effects, 2016-2024

Phase	Year	Employment Effects (non-staff) (FTEs)	Change in Employment Rate (non-staff) (Percentage Point)	Change in Migration Rate (%)	Annual Net Migration From Employment Effects (Annual individuals)	Total Net Migration From Employment Effects (Total individuals)
Construction	2016	0	0.0	0.0	0	0
	2017	1,629	5.0	12.3	77	77
	2018	1,542	4.3	10.5	67	144
	2019	1,501	3.8	9.2	59	204
Operations	2020	502	0.5	1.3	9	212
	2021	413	0.1	0.3	2	215
	2022	366	-0.2	-0.5	-3	211
	2023	330	-0.3	-0.8	-5	206
	2024	319	-0.4	-0.9	-6	200

16.4.1.6 Income Effects

As addressed in Section 13 (Employment and Income), employment from the Project (either through direct staffing or from direct, indirect, and induced economic effects) will be tied to increased incomes in the region. It is estimated that the Project would provide $195 million in wages and salaries in Yukon over the construction phase and $43 million annually over the operations phase (MNP 2013). This increase in income is expected to encourage migration into the region. Amirault et al. (2012) estimate that a 10% increase in the difference in median household income between two typical Canadian regions would cause an approximately 6% increase in net migration to the region with higher income. This effect includes both people coming into the region and the retention of those who would otherwise have left the region. It is assumed for the purpose of this analysis that income effects are distributed equitably and consequently a change in mean income would translate fully into a change in median income, which may overstate these effects (MNP 2013, Amirault et al. 2012).

Table 16.4-4 shows the population effects arising from the increase in incomes associated with the Project over the period 2016 to 2024. This analysis assumes that migrants will either earn income derived from employment opportunities supported by the Project or from replacing existing workers drawn to Project-related work. This reduces the change in the migration rate from income effects as labour markets adjust to higher incomes. Changes in migration from income effects are expected to be most pronounced in the construction phase, increasing net migration by 3.7% or 23 individuals in 2017 but falling to 1.2% or 8 individuals annually by 2024. These effects are expected to decline as closure approaches and Project expenditures fall; with closure, the effects will turn negative as incomes return to baseline conditions.

Table 16.4-4 Estimated Population Change in RSA from Income Effects, 2016-2024

Phase	Year	Income Effects ($ millions)	Log Change In Income	Change In Migration Rate (%)	Annual Net Migration From Income Effects (Annual Individuals)	Total Net Migration From Income Effects (Total Individuals)
Construction	2016	0	-	0.0	0	0
	2017	65	0.057	3.7	23	23
	2018	65	0.052	3.3	21	45
	2019	65	0.047	3.0	20	64
Operations	2020	43	0.026	1.6	11	75
	2021	43	0.023	1.5	10	85
	2022	43	0.020	1.3	9	94
	2023	43	0.020	1.3	9	102
	2024	43	0.019	1.2	8	110

16.4.1.7 Summary of Effects

The combined results of effects from direct Project staffing demands and indirect changes in employment rates and household incomes on RSA population from the period 2016 to 2024 are shown in Table 16.4-5. The rate of population growth within the RSA peaks in 2017 at 0.5% and declines thereafter to 0.0% from 2022 onward. Total change in population from all Project effects is 645 by 2024. These effects are expected to decline as closure approaches and Project expenditures fall; with closure, the effects will turn negative as incomes return to baseline conditions.

Table 16.4-5 Estimated Population Change from Project Effects in RSA, 2016-2024

Phase	Year	Total Change In Population From Project Staffing	Total Change In Population From Employment Effects	Total Change In Population From Income Effects	Total Change In Population From All Effects	Projected Change In Population Growth Rate (Percentage Point)
	2016	0	0	0	0	0
Construction	2017	73	77	23	174	0.5
	2018	140	144	45	329	0.4
	2019	160	204	64	428	0.2
Operations	2020	222	212	75	509	0.2
	2021	327	215	85	626	0.3
	2022	335	211	94	640	0.0
	2023	347	206	102	656	0.0
	2024	335	200	110	645	0.0

The estimated population change from staffing, employment, and income effects are shown in Table 16.4-6. Migration patterns associated with these effects are assumed to follow historic migration patterns for Yukon (Yukon Bureau of Statistics 2011a) with the added assumption that these effects will be limited to communities within the Project's LSA. As a consequence, Whitehorse is expected to receive 95.9% of migrants with Pelly Crossing receiving 1.7% and Carmacks receiving 2.4%. The total effect of the Project as a share of the projected

population is expected to rise by 2024 to 2.9% in Pelly Crossing (or 11 individuals), 2.6% in Carmacks (or 16 individuals), and 2.0% in Whitehorse (or 619 individuals). The rate of change in population is highest during the construction phase, with a projected change in population of 0.6% within the LSA in 2017.

Table 16.4-6 Estimated Population Change from Project Effects by RSA Community, 2016-2024

Phase	Year	Net migration from Project Effects				Effect as Share of Projected Population (%)			
		Pelly Crossing	**Carmacks**	**Whitehorse**	**LSA**	**Pelly Crossing**	**Carmacks**	**Whitehorse**	**LSA**
Share of Migrants (%)		1.7	2.4	95.9	100.0	1.7	2.4	95.9	100.0
Construction	2016	0	0	0	0	0	0	0	0
	2017	3	4	167	174	0.8	0.8	0.6	0.6
	2018	5	8	315	329	1.5	1.4	1.1	1.1
	2019	7	10	410	428	2.0	1.8	1.4	1.4
Operations	2020	9	12	489	509	2.3	2.1	1.6	1.6
	2021	10	15	601	626	2.8	2.6	2.0	2.0
	2022	11	15	614	640	2.9	2.6	2.0	2.0
	2023	11	16	629	656	3.0	2.7	2.0	2.0
	2024	11	16	619	645	2.9	2.6	2.0	2.0

Source: Yukon Bureau of Statistics, 2011a; Yukon Bureau of Statistics, 2011b.

This analysis does not consider effects of the Project on movement between communities. A rise in the employment rate and in median incomes in the LSA's rural communities would be expected to reduce the rate of economic migration from those communities to Whitehorse, although there is insufficient data to quantify this effect.

At the end of operations, some out-migration of operation workers and their families is expected as employment and income returns to baseline conditions. It is difficult to determine the magnitude of the population outflow, since this decision depends on the regional work opportunities available at the time of closure and personal and family interests. Project-related improvements to worker skills and experience will provide residents of the LSA with opportunities to pursue higher-paying jobs in the mining industry or transfer their skills to other industries. Casino Mining Corporation is committed to ongoing investment in workers to enhance employability and to help workers find new employment in the mining industry after production ends.

16.4.1.8 Potential Effects on Community Well-being

Anticipated Project effects on family and community well-being are linked to income changes and family separation during work rotation, and are also, to a lesser extent, linked to behavioural changes associated with Project-related migration. These effects are discussed below. As a result of data limitations and other uncertainties involved with predictions of well-being effects, this assessment is mainly qualitative and based on established economic and social impact assessment theory and best practices. This is due to high uncertainties on family and individual decisions and behavioural changes, which would make a quantitative forecast unreliable.

16.4.1.8.1 Income-Related Effects

Increased income from the Project has the potential to affect family and community well-being in the LSA through three mechanisms: changes in economic hardship, changes in income equity and, more indirectly, through family spending decisions of disposable income.

Economic Hardship Effects

Employment opportunities available to local residents during construction and operations will directly benefit family and community well-being by reducing economic hardship (e.g., reducing unemployment for existing residents, providing higher incomes, and reducing dependency on government transfers). Project-related improvements to worker skills and experience will provide residents of the LSA with opportunities to pursue higher-paying jobs at the mine and potentially elsewhere. Given the length of construction and operations, income-related effects could extend over the 26-year life of the mine.

Increased family income is also associated with improved health and well-being of children. For example, an empirical study using a survey of Canadian children found that cognitive, social, physical, and behavioural development of children was almost always associated with household income of their family (Lethbridge and Phipps 2006). The study found that regardless of age or how income is measured, higher family income was almost always associated with better child well-being. In particular, children's cognitive and behavioural development measures appear to have the strongest associations with levels of family income. Among children in lower income families, incremental increases in household income were found to be associated with better child development outcomes. Increases in income continue to remain associated with better well-being, even once children are out of low income. In fact, the study did not find a point above which high income ceases to benefit children's development (Lethbridge and Phipps 2006).

While other factors also influence well-being, it is well-established that there is a strong association between income and family well-being. Baseline information shows that Pelly Crossing and Carmacks have relatively low CMBI scores compare to the overall Yukon or the urban community of Whitehorse. In particular, education scores in Pelly Crossing and Carmacks are the third and fourth lowest in Yukon (AANDC 2006). By providing additional income, employment, and training during construction and operations, the Project could substantially increase the CWBI scores of the LSA communities, in particular of the First Nation communities.

At closure, the loss of operational employment would result in a large net decrease in local and regional employment and income. However, from a family well-being perspective, the training offered by CMC during construction and operations will provide residents with opportunities to pursue higher-paying jobs elsewhere.

Equity Effects

The distribution of income may result in adverse equity effects on vulnerable sub-populations. In some groups, pre-existing social, cultural, physical, and psychological barriers can limit accessibility to employment and income. While opportunities for employment may be available, they may not be accessible to all community members. Gender, physical and mental ability, cultural dissimilarities, low levels of education and training, and lack of experience are examples of possible barriers.

As described in the Socio-economic Baseline Report (Appendix 13A), First Nation communities experience low participation rates and high unemployment rates. Further, current low levels of education and limited work experience in resource-based industries are constraints to accessing Project-related employment. Without a focus on engagement of underrepresented groups, the Project has the potential to inadvertently exacerbate existing disparities leading to greater income and social inequities.

Spending Decisions

In addition to the direct Project effects discussed above, there could be some indirect income effects on well-being associated to individual and family spending decisions. There are two possible scenarios:

- Positive Scenario: If increased income is saved or invested in social goods such as better housing, education, or lifestyle amenities, overall well-being could be enhanced. For example, the increased employment opportunities and higher salaries could increase perceived returns to education for local families and, therefore, increase incentives to invest in schooling.
- Negative Scenario: If increased income is spent on socially disruptive activities such as alcohol consumption and/or gambling, overall well-being could decline for those directly or indirectly affected by this behaviour. A recent study noted that increased incomes associated with mining can lead to a greater potential for alcohol and drug use, increased sexually transmitted diseases, and other social and health problems (Gibson and Klinck 2005).

In evaluating the potential overall Project effects on family and community well-being, the outcome will largely depend on how workers choose to spend their increased income.

16.4.1.8.2 Population-Related Effects

As discussed earlier, the Project will create population changes in the LSA through migration of long-term Project staffing or through indirect migration driven by changes in local employment rates and household income. This influx of population to the local area could affect existing family and community well-being through behavioural changes. For example, if transient populations engage in socially disruptive or illegal activities, this could create negative well-being effects such as increase in crime, alcohol abuse, or family dysfunction.

As discussed in Section 16.4, influx of people (due to direct or indirect effects) from outside the RSA will be gradual and will begin during the construction phase. The rate of population growth within the LSA peaks in 2017 at 0.6% and declines thereafter to 0.0% from 2022 onward. Total change in population from all Project effects is estimated at 645 (or 248 families) by 2024. These effects are expected to decline, and eventually turn negative, as closure approaches and employment and income returns to baseline conditions. Whitehorse is anticipated to receive the majority of migrants (95.9% or 619 individuals), which would represent 2.0% of its projected population. Pelly Crossing is anticipated to receive 1.7% of migrants (11 individuals) and Carmacks would receive 2.4% (16 individuals). Migrants would represent 2.9% of Pelly Crossing projected population, while they would represent 2.6% at Carmacks.

Attracting and retaining skilled residents has been identified as a priority of Yukon and local governments (Yukon Economic Development 2011a, Village of Carmacks 2006). If the magnitude of effects were considered to be high, the direction may be adverse since a rapid increase in population can challenge the existing social structure. However, the magnitude of effects is low and represents a small change in each community population. The majority of population growth is anticipated to occur in the already rapidly growing city of Whitehorse, which is expected to be highly resilient in managing change.

Behavioural change-related problems, if any, are anticipated to occur early in construction, and are expected to lessen over time as migrants settle into the communities.

16.4.1.8.3 Work Schedule-Related Effects

Separation of workers from their families and dependants for extended periods of time because of the work rotation schedule and the requirement to stay in on-site accommodations could affect family relationships. This

isolation of workers from their families for extended periods could result in stress to the workers and their dependants, altered roles and responsibilities in the home, and potential behavioural issues when a worker returns home because of conflicting needs and priorities of the worker and his/her dependants. A recent study noted that limited family time can lead to family fragmentation, family violence, and behavioural issues in children who grow up with a part-time parent (Gibson and Klinck 2005).

Table 16.4-7 summarizes the potential Project effects on the Community Vitality VC.

Table 16.4-7 Potential Effects on Community Vitality

Mechanism of Interaction	Key Indicator(s)	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
Direct and indirect population changes from Project employment and income	Population and demographics	C, O, CD,	Population changes from out-of-territory mine workers and their dependents moving residency to RSA	Beneficial
Direct and indirect population changes from Project employment and income	Population and demographics	C, O, CD,	Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	Beneficial
Increased disposable income of families from Project employment	Community well-being	C, O, CD,	Employment opportunities and increased income would reduce economic hardship of local families and lead to positive economic well-being effects	Beneficial
Increased disposable income of families from Project employment	Community well-being	C, O, CD,	Spending decisions of additional disposable income could affect family and community well-being: Positive spending decisions would enhance family and community wellbeing (i.e. positive spending on education) Negative spending decisions would reduce family and community wellbeing (i.e., crime, addictions)	Beneficial/Adverse
Increased disposable income of families from Project employment	Community well-being	C, O, CD,	Potential lack of employment and income equity for Aboriginal peoples, women, people with disabilities, and visible minorities	Adverse
Direct and indirect	Community well-being	C, O, DC	Influx of workers and their families	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
population changes from Project employment and income			could create negative behavioural changes and reduce family and community well-being if transient population engages in socially disruptive or illegal activities (e.g., crime, alcoholism)	
Work schedule and fly in/fly out camps	Community well-being	C, O, DC	Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships	Adverse
Decrease of disposable income of families at the end of Project operations	Community well-being	C, O, DC, PC	Loss of jobs and income at closure and potential out-migration could negatively affect family and community well-being	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

In summary, potential adverse Project effects on family and community well-being will be largely attributable to decisions made on spending disposable income, behavioural changes associated with influx of migrants and family separation during work rotation.

16.4.2 Identification of Mitigation Measures and Potential Residual Effects

The Yukon Government has identified attracting people to live in Yukon as a priority, as have communities in the LSA (Section 16.3). Since the Project is expected to support this objective, the effects are considered positive for LSA communities and the RSA, although they may produce challenging secondary effects in terms of housing, and community services and infrastructure (Section 17) and to a lesser extent, in terms of community well-being. Theoretically, if the magnitude of the population effect is large enough to challenge the capacity of communities to accommodate the changes, the direction of effects may be reversed.

Mitigation measures are aimed at decreasing negative effects or enhancing beneficial ones. The main causal factor for effects on Population and Demographics are staffing, employment, and income effects generated by the Project. Casino Mining Corporation plans to fulfill its commitments of hiring locally to the maximum extent practical, which would reduce migration associated with Project staffing. However, the relative scarcity of skilled mining labour in Yukon would necessitate the use of commuting labour (Section 14). Casino Mining Corporation would thus offer incentives to encourage commuting workers to become Yukon residents. Other measures would enhance migration by maximizing the amount of employment and income generated within the RSA.

To summarize, CMC would enhance beneficial effects by:

- Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA;

- Implementing a procurement process that gives preference to suppliers from the RSA and LSA;
- Employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues related to mine staff;
- Monitoring project socio-economic effects and adapting management measures where required;
- Providing on-the-job training to assist local and regional workers to develop mining-specific skills;
- Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; and
- Implementing career training and development opportunities for employees once hired.

In general, Project employment and income will lead to an improvement in family and community well-being. It will create new job opportunities in the LSA and RSA and will increase personal incomes. This additional income will reduce family economic hardship and could enhance quality of life. However, there may also be some potential indirect negative well-being effects associated with employment, income, and population changes. As discussed earlier, these potential negative effects will be largely attributable to decisions made on spending disposable income, behavioural changes associated with influx of people, and family separation during work rotation. Although indirect, and sometimes outside of the Project control, some policies could be implemented to minimize these potential negative effects.

In addition to the policies to manage and enhance population effects, CMC will:

- Offer a direct deposit option to and help identify money management training programs;
- Facilitate and maintain communication between workers and their families by providing phone and Internet services on site;
- Provide flexible rotation schedules, where practical, that could accommodate the needs of local hires and industry practices;
- Work with Yukon Government agencies and Yukon College to identify barriers to employment and offer training programs to improve local hire and retention of staff;
- Implement a zero tolerance policy with respect to drug and alcohol on-site for Project employees and contractors;
- Work with the appropriate agencies to ensure staff have access to counselling services as required;
- Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate.

Table 16.4-8 Proposed Mitigation Measures and Potential Residual Effects for Community Vitality

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Population changes from out-of-territory mine workers and their dependents moving residency to RSA	C, O, CD,	Beneficial	Priority hiring for qualified local residents. employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues related to mine staff	High	Yes
Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	C, O, CD,	Beneficial	Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA; implementing a procurement process that gives preference to suppliers from the RSA and LSA.	Moderate	Yes
Employment opportunities and increased income would reduce economic hardship of local families and lead to positive economic well-being effects	C, O, CD,	Beneficial	None	n/a	Yes
Potential lack of employment and income equity for women, Aboriginal peoples, people with disabilities, and visible minorities	C, O, CD,	Adverse	Implementing a hiring policy that encourages the employment of workers from rural communities within the LSA; Pursuing employment opportunities in negotiation of cooperation agreements with First Nations	High	Yes
Spending decisions of additional disposable income could affect family and community	C, O, CD,	Beneficial/Adverse	Offer to deposit workers salaries in their bank accounts. Facilitate money management training as required to those employees who do not	Moderate	Yes

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
well-being: Positive spending decisions would enhance family and community wellbeing (i.e. positive spending on education). Negative spending decisions would reduce family and community wellbeing (i.e. crime, addictions)			have experience with high wage earnings and working in mines Implement a zero tolerance policy with respect to drug and alcohol at the Project site for Project employees and contractors. Work with local agencies in monitoring Project socio-economic effects and to take corrective actions where appropriate		
Influx of workers and their families could create negative behavioural changes and reduce family and community well-being if transient population engages in socially disruptive or illegal activities (i.e. crime, alcoholism)	C, O, DC	Adverse	The project will have a self-contained camp on site to house workers. A zero tolerance policy with respect to drug and alcohol use will be implemented at the Project site for Project employees and contractors. Facilitate money management training as required to those employees who do not have experience with high wage earnings and working in mines. Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate	High	Yes
Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships	C, O, DC	Adverse	Facilitate communication between workers and their families by providing phone and Internet services on-site. Explore shift schedules that meet the needs of the operation and that are attractive to local hires.	Moderate	Yes

Potential Effect	Project Phase[1] (C, O, DC, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
			Facilitate money management training as required to those employees who do not have experience with high wage earnings and working in mines. Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate.		
Loss of jobs and income at the end of operations and potential out-migration could negatively affect family and community well-being	C, O, DC, PC	Adverse	CMC will work with the community to develop a plan that identifies strategies and actions to help minimize potential adverse effects from closing the mine. Provide training opportunities to help employees get employment elsewhere.	Moderate	Yes

Notes

1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

16.4.3 Significance of Residual Effects

The criteria used to discuss residual effects are discussed in detail in Section 5, Assessment Methods and Frameworks. Table 16.4-9 outlines the seven criteria used to assess significance for the Community Vitality VC.

Table 16.4-9 Determining Significance of Residual Effects for Community Vitality

Criteria	Rating	VC Specific Definitions
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	Effect that occurs might or might not be detectable, but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge
Geographical Extent	Localized	Within the identified Local Study Area
	Widespread	Outside the identified Regional Study Area
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, decommissioning and closures
	Permanent	Effects measureable Post-Closure
Frequency	Infrequent	Effects occur occasionally
	Frequent	Effects are continuous and consistently applied over the period
Reversibility	Reversible	Effect will return to baseline condition after operations, decommissioning and closure
	Irreversible	Effect is persistent after operations, decommissioning and closure
Context	Low Resilience	Effects operate outside of regional experience and represent a challenge to local socio-economic management institutions
	High Resilience	Effects are familiar to local socio-economic management institutions
Probability of occurrence	Low	Effects are unusual under similar circumstances and are not expected to occur with this Project
	Moderate	Effects has a reasonable risk of occurring under similar circumstances or there is not currently sufficient information to assess probability
	High	Effects have consistently occurred under similar circumstances and are expected to occur with this Project

Residual effects on Community Vitality are assessed by these criteria in Table 16.4-10. In general, to be considered to have potential for a significant effect, the residual effect on community vitality must meet one of the following criteria:

- Have a medium magnitude at a regional spatial extent and have a long term or permanent duration;
- Have a high magnitude at a localized spatial extent and be permanent in duration; or
- Have a high magnitude at a regional extent of any duration.

The challenge with socioeconomic assessment is that neither guidelines nor predefined thresholds exist, so the assessment often relies on the setting, intensity, public concerns and professional judgement gained from working on similar projects.

Table 16.4-10 Significance of Residual Effects for Community Vitality

Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Population changes from out-of-territory mine workers and their dependents moving residency to RSA	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	Moderate	Not Significant
Employment opportunities and increased income would reduce economic hardship and improve well-being of local families	Beneficial	Medium	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
Potential lack of employment and income equity for women, Aboriginal peoples, people with disabilities, and visible minorities	Negative	Low	Localized	Long Term	Frequent	Reversible	High Resilience	Low	Not Significant
Positive spending decisions would enhance family and community wellbeing (e.g., positive spending on education)/ Negative spending	Beneficial/ Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	Moderate	Not Significant

Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
decisions would reduce family and community wellbeing (e.g., crime, addictions)									
Influx of workers and their families could create negative behavioural changes and reduce family and community well-being if transient population engages in socially disruptive or illegal activities (e.g., crime, alcoholism)	Adverse	Low	Localized	Short Term	Frequent	Reversible	High Resilience	Moderate	Not Significant
Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships	Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
Loss of jobs and income at the end of operations and potential out-migration could negatively affect family and community well-being	Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant

Note: For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

16.4.4 Discussion of Significance

The direction of population effects are considered to be beneficial because attracting and/or retaining skilled residents has been identified as a priority of Yukon and some community governments (Yukon Economic Development 2011a, Village of Carmacks 2006). If the magnitude of effects were considered to be high, the direction may be adverse since a rapid increase in population can challenge the existing social structure. However, the magnitude of effects is low when considered in the regional context. Approximately 96% of the population effects are expected to occur in the already rapidly growing City of Whitehorse. Whitehorse grew at an annualized rate of 2.6% between 2006 and 2011; in the year of the greatest effect (2017, when noticeable effects from construction begin) total migration is expected to be 0.6% of the total population of the city, or 29% of the total annual growth. The most recent population projections for Yukon published by the Yukon Bureau of Statistics forecast a 2021 population for Whitehorse between 33,179 and 30,721 (Yukon Bureau of Statistics 2011b). The estimated effect of 601 new migrants by 2021 falls well within the variance of these estimates. By 2021, the annual change in population arising from the combined effects of Project staffing, employment, and income is 0.1% or less and are not expected to be noticeable. The Yukon Government and the City of Whitehorse are very familiar with the challenge of dealing with a rapidly growing population and can expect to be highly resilient in managing change.

The geographic extent of population effects are localized to the LSA. Although changes in migration are two-way and some population declines would be expected outside the LSA, the magnitude of these effects is negligible. The duration of population effects are considered to be long term; although the rate of change in population is only noticeable in the period 2017 to 2021, the Project sustains the higher level of population over the operations phase. The sustained and continuous character of population effects are why these effects are characterized as frequent.

All population effects are reversible. Population effects are modelled on staffing, employment, and income effects of the Project, which would be reversed when those effects are removed post-closure. Within this context, the population would return to baseline conditions over the period approaching closure to the post-closure period. Population effects from direct staffing are expected to be highly probable to occur, but the probability of migration from employment and income effects are expected to be only moderately probable. This is due to uncertainty around a number of factors around the migration analysis as it relates to employment and income, in particular the assumption of equitable distribution of income effects and the potential for Project employment to cause structural changes in the workforce rather than changing the employment rate.

As summarized in Table 16.4-11, population effects are considered to be beneficial but not of a magnitude to be significant within the context of a rapidly growing LSA.

Although some potential family and community well-being effects from construction and operations have the potential for adverse consequences, the net effects are expected to be on balance slightly positive because Project-related employment incomes will reduce family economic hardship and enhance quality of life. The proposed mitigation and monitoring is anticipated to be effective as long as the Proponent, communities, and governments cooperate in management initiatives.

Potential residual effects are expected to be localized. Although social effects will spill over into other jurisdictions, as Project employs people from outside the LSA who will commute to work; however, these effects are not likely to be noticeable within the context of other provinces or territories.

The effects are considered to be long term; although behavioural effects, if any, are only expected to be noticeable during the first years of construction and operations as migrants settle into the communities and people adjust to higher incomes. The duration of employment and income and related well-being effects would be long

term and sustained. The duration coincides with the construction (4 years) and operating (22 years) phases. Direct income earned during the Project will reduce economic hardship and will also contribute to the retirement income of the workforce during operations and extend benefits beyond the operational phase of the Project. The effects are also characterized as frequent as they are sustained and continuous.

Well-being effects are reversible and expected to return to baseline conditions during the closure and post-closure phases. However, as discussed in Section 15, investment in training and capacity-development will improve the employability of local residents to pursue higher-paying jobs after closure.

Direct income effects on economic hardship are expected to be highly probable; however, indirect effects on spending decisions and behavioural changes are only moderately probable. This is because there is uncertainty around a number of factors that can affect family decisions and the behaviour of people.

Yukon residents, and in particular LSA residents, are familiar with the cyclical nature and work schemes of the mining industry and also with the challenge of dealing with a rapidly growing population and can expect to be highly resilient in managing change. In general, the effects on community well-being of the Project are anticipated to be not significant.

The magnitude of effects on family relationships are uncertain since they depend on how families adjust to work schedules. There is little information on family characteristics, values, and expectations that would allow us to quantify these effects. However, with mitigation strategies in place, the effects of work schedules are not expected to be significant. Fly-in / Fly-out schemes are a common practice in the mining industry and workers are familiar with these working arrangements. Some workers even find it attractive to have the opportunity to spend long periods of time with their families when off rotation.

The moderate level of confidence associated with most population effects reflects the linked nature of socio-economic analysis; effects on migration and improved well-being from incomes are modelled on estimates of economic effects within the region on employment and income and consequently share the uncertainty of those underlying forecasts. The high level of confidence relating to out-of-territory mine workers and their dependents moving residency to the RSA is based on workforce forecasts with a low margin of error and survey results which show that incentives offer the proponent substantial influence on where workers live. The moderate level of confidence associated with adverse but not significant effects on community vitality in terms of social issues such as crime, substance abuse and deterioration of family relationships is based on the lack of a model or academic consensus on the magnitude of these effects.

Table 16.4-11 Summary of Residual Effects for Community Vitality

Potential Residual Effect	Direction	Significance	Level of Confidence (Low, Moderate, High)
Population changes from out-of-territory mine workers and their dependents moving residency to RSA	Beneficial	Not Significant	High
Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	Beneficial	Not Significant	Moderate
Employment opportunities and increased income would reduce economic hardship and improve well-being of local families	Beneficial	Not Significant	Moderate
Positive spending decisions of increased income could enhance family and community wellbeing (i.e., positive spending on education)	Beneficial	Not Significant	Moderate
Negative spending decisions could reduce family and community wellbeing, (i.e., crime, addictions)	Adverse	Not Significant	Moderate
Influx of workers and their families could create negative behavioural changes and reduce family and community well-being if transient population engages in socially disruptive or illegal activities (i.e., crime, alcoholism)	Adverse	Not Significant	Moderate
Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships	Adverse	Not Significant	Moderate
Loss of jobs and income at the end of operations and potential out-migration could negatively affect family and community well-being	Adverse	Not Significant	Moderate

16.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

16.5.1 Introduction

The effects assessment of the Project on Community Vitality takes into consideration past and existing actions and is based on forecasts for population growth incorporating those actions. Consequently, the assessment is already cumulative in nature. Further, the effects on population growth are considered to be beneficial and thus are not required to be carried forward. In addition, the residual effects on well-being are very small, there is good existing capacity in the RSA, and Project contributions to cumulative effects are unlikely to be detectable. This, and the lack of VC-specific effects data from potentially overlapping projects, means it is impractical to conduct a CEA for well-being effects.

16.5.2 Identification of Other Projects or Activities

The Project's effects on staffing, employment, and income are expected to have a beneficial effect on population in the region. Estimates of population growth are based on forecasted data, which already includes consideration of cumulative effects. As a consequence, no new identification of activities is necessary.

16.5.3 Interactions and Potential Cumulative Effects

Residual effects on population are based on forecasts and thus already include cumulative effects in their analysis. As a consequence, residual effects are already a CEA and no further assessment of cumulative effects is required.

16.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

As the effects assessment of the Project has already been conducted in the context of other proposed projects and their effects on population and well-being, no additional mitigation measures are required.

16.5.5 Significance of Residual Cumulative Effects

The residual cumulative Project effects on community vitality are the same as the effects specific to the Project provided in Table 16.4-10.

16.5.6 Discussion of Significance of Residual Cumulative Effects

The discussion of significance of residual cumulative effects is the same as the discussion provided in Section 16.4.4.1.

16.6 SUMMARY AND CONCLUSIONS

The Community Vitality VC assesses the potential effects of the Project on demographic conditions and well-being of the communities located in the Project LSA.

The Project is expected to affect the LSA population through three interactions: project staffing, employment effects, and income effects. Project staffing increases population through workers hired from outside Yukon who subsequently re-locate to the LSA with their dependents; these are expected to add an average of 42 people per year to the region's population over the period of peak hiring from 2017 to 2024. Employment effects come from the stimulus to economic activity brought to the region by the Project, which raises the relative employment rate and thereby encourages in-migration and discourages out-migration; these are expected to add an average of 68 people per year to the region's population over the final three years of the construction phase but few thereafter as employment rates stabilize in the operations phase. Higher incomes stimulated by Project activities are expected to have similar effects on net migration and income effects are expected to increase net migration by an average of 14 people per year over the period of peak hiring from 2017 to 2024. The Project is expected to increase the population of the RSA by 645 people by 2024, accounting for a 0.5 percentage point increase in the population growth rate in 2017 and declining to 0.2 percentage points in 2019 and a negligible increase by 2022.

Whitehorse is expected to receive 95.9% of migrants, with Pelly Crossing receiving 1.7% and Carmacks receiving 2.4%. By 2024, the total effect of the Project as a share of the projected population is expected to rise to 2.9% in Pelly Crossing (or 11 individuals), 2.6% in Carmacks (or 16 individuals), and 2.0% in Whitehorse (or 619 individuals). These increases would occur in the context of a rapidly-growing Yukon population. Whitehorse grew at an annualized rate of 2.6% between 2006 and 2011; in the year of the greatest effect from the Project (2017, when noticeable effects from construction begin) total migration is expected to be 0.6% of the total population or 29% of the total annual growth. The most recent population projections for Yukon published by the Yukon Bureau of Statistics forecast a 2021 population for Whitehorse between 33,179 and 30,721, for which the estimated effect of 619 new migrants by 2021 falls well within the variance of these estimates. The Yukon Government and the City of Whitehorse are very familiar with the challenge of dealing with a rapidly growing population and can expect to be highly resilient in managing this change.

All population effects are considered to be reversible. Population effects are modelled on staffing, employment, and income effects of the Project, which would be reversed when those effects are removed post-closure. Within this context, the population would return to baseline conditions over the period approaching closure to the post-closure period.

The anticipated Project effects on family and community well-being are linked to income changes and family separation during work rotation, and are also, to a lesser extent, linked to behavioural changes associated with Project-related migration. In general, Project employment and income will lead to an improvement in family and community well-being. It will create new job opportunities in the LSA and RSA and will increase personal incomes. This additional income will reduce family economic hardship and could enhance quality of life. The duration of this effect would extend over the 26-year life of the mine.

However, some potential indirect negative wellbeing effects are anticipated. These potential negative effects will be largely attributable to decisions made on spending of disposable income, behavioural changes associated with influx of people and family separation during work rotation.

The effects on well-being are considered to be long term; although behavioural effects, if any, are only expected to be noticeable during the first years of construction and operations as migrants settle into the communities and people adjust too higher incomes.

The magnitude of effects on family relationships are uncertain since they depend on how families adjust to work schedules. There is little information on family characteristics, values and expectations that would allow us to quantify these effects. However, with mitigation strategies in place, the effects of work schedules are not expected to be significant.

The net effects on well-being are expected to be on balance slightly positive because Project-related employment incomes will reduce family economic hardship and enhance quality of life. The proposed mitigation and monitoring is anticipated to be effective as long as the Proponent, communities, and governments cooperate in management initiatives.

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17 – COMMUNITY INFRASTRUCTURE AND SERVICES

17.1 INTRODUCTION

This section assesses the potential effects of the Project on community infrastructure and services in terms of six key indicators. These indicators were selected to capture concerns expressed by First Nations and communities in the study area and comprise Municipal Infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities); Housing; Transportation; Educational Services; Health and Social Services; and Protective Services.

The data sources used in this analysis include both secondary and primary data. Secondary data were collected from Statistics Canada, Yukon Bureau of Statistics, and Yukon Socio-Economic Web Portal as well as individual communities. A number of other key information sources were consulted, including Canada Mortgage and Housing Corporation (CMHC), the Canadian Homelessness Research Network Press, Inukshuk Planning and Development, Natural Resources Canada, Yukon Health Care Review Committee, Official Community Plans, the Canadian Encyclopaedia, and civic and municipal websites. Other sources of secondary data included the Yukon Environmental and Socio-economic Assessment Board (YESAB).

Primary data were collected through one-on-one interviews conducted mostly in 2012 and 2013 with representatives from the Yukon Government, City of Whitehorse, Whitehorse and Yukon Chambers of Commerce, Yukon Mine Training Association, the Yukon Housing Corporation, Wildland Fire Management, Energy Mines and Resources, Whitehorse International Airport, Selkirk First Nation (SFN), Little Salmon/Carmacks First Nation (LSCFN), Village of Carmacks, Carmacks Renewable Resource Council members, and Tantalus School. Primary information was also gained from community meetings.

17.1.1 Regional Setting

The Project is a proposed open pit mine located approximately 300 kilometres (km) northwest of Whitehorse, Yukon Territory, on Crown land that is administered by the Yukon Government. The property is located within SFN traditional territory. The proposed Project will require construction of a road access, including upgrades to the existing Freegold Road and construction of the Freegold Road Extension on land that falls partially within the SFN and LSCFN traditional territories. The Freegold Road Extension and proposed Freegold Road Upgrade extend for approximately 200 km southeast from the Project to the village of Carmacks.

17.1.2 Rationale for VC Selection

The Community Infrastructure and Services VC was identified based on consideration of the information and issues communicated by the public, Aboriginal groups, local communities, and government stakeholders during the engagement process conducted in support of this Proposal. This VC and specific indicators were also selected based on professional judgement and experience in conducting socio-economic effects assessments.

The potential socio-economic effects of the proposed Project on communities in the study region will ultimately depend on the extent to which proposed Project activities and Project-related population growth will result in increased demands on community infrastructure and services and the ability of these infrastructure and services to cope with increasing demands.

17.2 ASSESSMENT BOUNDARIES

The socio-economic study area for the proposed Project has been defined to include the rural and urban communities that are most likely to experience proposed Project-related effects. Communities were selected based on proximity to the proposed Project and related access routes and potential relationship with the Project development and operations. The socio-economic study area has been broken down into two types: the Local Study Area (LSA) and the Regional Study Area (RSA).

17.2.1 Local Study Area

The LSA includes those communities closest to the proposed Project mine site and proposed access route. These communities represent the closest and most accessible potential sources of direct labour, goods, and services needed for the Project and, therefore, are expected to experience direct Project socio-economic effects. The LSA is shown on Figure 13.1-1 includes the following communities:

- Community of Pelly Crossing (Selkirk First Nation);
- Village of Carmacks and the community of LSCFN; and
- City of Whitehorse.

Whitehorse is included in the LSA due to its potential to contribute supplies, services, and labour to the Project. Given its size and proximity, Whitehorse is likely to serve as a major supply centre and transportation hub for the Project, which has the potential to cause direct socio-economic effects on its residents.

17.2.2 Regional Study Area

Although it is expected that the Project could interact with other socio-economic VCs, such as employment and income, employability, and economic development and business sector within a larger RSA (Yukon), no effects are expected on the Community Infrastructure and Services VC outside the LSA. As such, the focus of both the baseline and the effects assessment on Community Infrastructure and Services VC will be on the LSA.

17.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment are defined in Section 5.2. Details of activities associated with the construction, operation, closure and decommissioning, and post-closure phases of the Project are provided in Section 4.

17.3 BASELINE CONDITIONS

This section presents an overview of baseline conditions for each of the key indicators chosen to assess the potential effects of the Project on Community Infrastructure and Services. The key indicators are:

- Municipal Infrastructure (water supply, water/sewage treatment, landfills, power supply, and recreational facilities);
- Housing;
- Educational Services;
- Health and Social Services;
- Protective Services; and

- Transportation.

Baseline information is presented for each of the three communities included in the LSA: Pelly Crossing, Carmacks, and Whitehorse. Baseline conditions for Yukon are included for comparison purposes. A detailed baseline for this VC is available in the Socio-economic Baseline report (Appendix 13A).

17.3.1 Municipal Infrastructure

17.3.1.1 Yukon

The majority of Yukon residents get their water from private wells, 2,000 of which exist in Yukon (Government of Yukon 2009). Whereas municipalities regulate water services, which are either supplied locally or delivered by truck, most rural communities depend on self-haul or trucked water. Outside of municipal facilities, water treatment is regulated by the Health and Social Services branch of the Yukon Government, which offers free well water testing services. Water supplies are managed by the Community Services department of the Community Development Branch; municipal and private water management and licensing is overseen by the Yukon Water Board, regulated under the Waters Act (Government of Yukon 2002).

Sewage systems in Yukon consist of a combination of private septic as well as piping and treatment systems where available (Government of Yukon 2009). Solid waste, which is regulated under the *Public Health and Safety Act*, consists of a number of community landfill locations throughout Yukon (Government of Yukon 2009). Maintenance of each facility outside of Whitehorse is provided by private contractors or community members. Waste collection is primarily managed by municipal/community staff, although private contractors are used in Whitehorse (EBA 2009).

17.3.1.2 Whitehorse

Whitehorse supplies water to its residents via local government or municipal means from primarily groundwater sources (Government of Yukon 2009). Water is treated with chlorine and distributed by pipe through the city from five reservoirs; this system includes a pumping and booster station. Rural areas around the city are not supplied from the Whitehorse system and rely upon private wells or truck-delivered water.

The Whitehorse wastewater system services the urban part of Whitehorse. Rural areas outside of the city use in-ground septic systems and rely upon private disposal.

The solid waste disposal facility for the Whitehorse area is located north of the city along the Alaska Highway at the War Eagle Landfill. The landfill is expected to have a 60-year lifespan (EBA 2009). The site services approximately 23,000 users from Whitehorse and the surrounding communities (Government of Yukon 2009). A recycling centre is located in town, and the municipality also collects household compost.

Table 17.3-1 presents an overview of the water and sewage treatment services available in Pelly Crossing, Carmacks, and Whitehorse.

Table 17.3-1: Overview of Available Water and Sewage Treatment Services in the LSA

	Pelly Crossing	Carmacks	Whitehorse
Water	Supply is via private wells and truck-delivered water.	Rely on private wells and truck delivered water. LSCFN has a water plant to provide water to membership and non-LSCFN residents outside the municipality boundaries. LSCFN has identified lack of safe drinking water as an issue for many of its members.	Wells draw from underground aquifers. Piped water system distributes water from five reservoirs to the city. Rural areas are served by private wells and truck delivered water. Adequate supply is available for the foreseeable future (20 years).
Liquid Waste	Septic system is available. Sewage trucked to primary filtration treatment pit operated by SFN. No piped sewage is available.	A new secondary treatment facility has a design capacity for twice Carmacks current population but currently serves just the core part of the community. Parts of Carmacks not served by the new sewage facility utilize septic fields. LSCFN residents currently use septic systems for liquid waste treatment.	Wastewater system consists of three separate networks. Rural areas use in-ground septic systems and rely on private disposal. Liquid waste is transferred to treatment facility and lagoon system. The treatment of waste currently involves approximately 4.4 million m3/year with a system capacity of 5 million m3/year.
Solid Waste and Waste Management	No curbside pickup is available. Residents drop off garbage to transfer station or municipal dump. Solid waste is transported to landfill outside the community, where waste is burned weekly.	The only garbage collection available is private collection for housing units owned by Yukon Housing. Solid waste is transported to landfill located outside the community, which operates as a non-burn facility. There is a new recycling facility in the Village of Carmacks. The landfill is expected to have an 18-year lifespan. Private garbage collection is arranged for residents of the community of LSCFN.	Solid waste is transported to landfill located north of the city. Landfill operates as a non-burn facility. The city has a recycling centre and municipality collects household compost.

Source: Government of Yukon 2009; Village of Carmacks 2013; LSCFN 2013

Whitehorse offers a variety of outdoor activities including fishing, hunting, skiing (cross-country and downhill), snowmobiling, dog mushing, canoeing, hiking, biking, camping, baseball, soccer, football, track and field, racquet

sports, and orienteering. There are also a number of venues in which residents can enjoy a variety of outdoor recreation. Recreation services in Whitehorse, both indoor and outdoor, have good capacity and can accommodate additional moderate population growth (Rapp 2013, pers. comm.).

17.3.1.3 Selkirk First Nation / Pelly Crossing

The community of Pelly Crossing utilizes private wells and truck-delivered water to some areas of the community. Additionally, SFN owns a private water well (Infrastructure Development 2012, pers. comm.). Selkirk First Nation built a pump house for water distribution around the community of Pelly Crossing, primarily to membership (Infrastructure Development 2012, pers. comm.). Piped water is now provided to some parts of the community (Infrastructure Development 2012, pers. comm.).

The community of Pelly Crossing uses septic systems, which employ disposal services that truck waste to a primary filtration treatment pit located near the landfill (Government of Yukon 2009). The pit is operated by SFN. At present, there is no piped sewage available in Pelly Crossing (Infrastructure Development 2012, pers. comm.).

Public waste facilities in Pelly Crossing are provided by the Yukon Government and are located at 458 on the Klondike Highway, south of the community. Garbage collection occurs at a transfer station, and there is a municipal dump in the community (Infrastructure Development 2012, pers. comm.).

Although Pelly Crossing is a small community, it accommodates several community and recreational facilities, including a Heritage Centre, community library, community hall, recreational vehicle campground, and a renovated recreation centre housing an arena and curling rink.

17.3.1.4 Little Salmon/Carmacks First Nation and Carmacks

The Village of Carmacks does not provide treated water to community residents (Village of Carmacks 2013, pers. comm.) The residents obtain drinking water from truck delivery and from private, self-haul wells (Government of Yukon 2009; Infrastructure Development 2012, pers. comm.; Tantalus 2013, pers. comm.).

Representatives of LSCFN also noted that the community has a new water treatment plant on LSCFN community land, which started operations two years ago and provides fresh drinking water to LSCFN residents outside the Village of Carmacks boundary and living in the LSCFN community (LSCFN 2013, pers. comm.). Water is also provided to some non-Aboriginal residents in the Village of Carmacks from this source (Village of Carmacks 2013, pers. comm.). Little Salmon/Carmacks First Nation has identified continuing challenges in providing safe drinking water to its citizens.

Sewage in the core section of Carmacks is treated at the Carmacks Sewage Treatment plant, located to the north of the village. This primary treatment facility removes large, solid, and inorganic materials from the water (Government of Yukon 2009, Village of Carmacks 2013, pers. comm). The system utilizes sewer mains (servicing the core of the Village of Carmacks) and discharges into the Yukon River. The community has a new treatment plant that was developed with assistance from the Yukon Government and the Government of Canada (Village of Carmacks 2013, pers. comm.). The Carmacks sewer system serves only the core portion of the town where sewer pipes have been installed, but it has the capacity to serve twice the current population (Village of Carmacks 2013, pers. comm.).

The residents of LSCFN community use septic tanks or septic fields. Little Salmon/Carmacks First Nation government has expressed interest in partnering with the Village of Carmacks to develop additional community infrastructure to service both the Village of Carmacks and the LSCFN community (LSCFN 2013, pers. comm.).

A landfill is located 1.2 km southeast of the Village of Carmacks along the Alaska Highway, which services the Village of Carmacks and the community of LSCFN. The Carmacks landfill does not take waste from other communities and operates as a non-burn facility (Village of Carmacks 2013, pers. comm.). A separate recycling centre was recently constructed. The lifespan of the landfill facility is considered to be at least 18 years.

The Village of Carmacks offers many recreational activities throughout the year. The community has a recreation centre that provides access to a curling rink, rental facilities, an outdoor ice rink, a covered outdoor pool during summer, and several parks and playgrounds. The centre offers extensive programming, including after school programs for children, family dinners, and teen nights. The centre is perceived as having good capacity to serve the Village of Carmacks and surrounding residents (Village of Carmacks 2013 pers. comm.; Tantalus 2013, pers. comm.).

17.3.2 Housing

17.3.2.1 Yukon

Yukon Housing Corporation links families, communities, and the housing industry with programs and services that work to support the housing needs of Yukon residents. The corporation was created due to concern over the quality and availability of affordable housing throughout Yukon. It provides social and staff housing, lending programs, community and industry partnering, and information resources for all aspect of housing in Yukon. As of March 2012, the total number of units under Yukon Housing Corporation management included 669 social units and 153 staff housing units (Yukon Housing 2012). . Eleven staff units were provided in Pelly Crossing, and 16 were provided in Carmacks in addition to 14 social units (Yukon Housing 2013). See Table 17.3-2 for additional data on Yukon Housing.

17.3.2.2 Whitehorse

The 2011 Census reported 9,649 private dwelling units in Whitehorse. This represents an 11.8% increase from 2006. Of the total housing, 9,309 units were occupied by local residents, suggesting that the remainder were being used as temporary or seasonal accommodation or were vacant. The occupancy rate for Whitehorse in 2011 was 96.5%, which was higher than occupancy rates for all the other LSA communities and Yukon as a whole. See housing conditions in Table 17.3-2.

Between 2004 and 2010, the lack of supply affected property values, with the average price of a single family home increasing by 114.5% from 2004 to 2010 (from $188,700 to $404,800). Another recent report estimates that house prices in Whitehorse have increased by 80% between 2005 and 2011, even after adjusting for inflation (Falvo 2012).

However, recent discussions with the City of Whitehorse, Yukon Housing Corporation, and Whitehorse Chamber of Commerce suggest that housing concerns have eased (City of Whitehorse 2012a, pers. comm.; Yukon Housing Corporation 2012a, pers. comm.; Whitehorse Chamber of Commerce 2012, pers. comm.).

Whitehorse experienced increased activity in the housing market in recent years. Housing starts in the city reached a record high in 2011 of 332 units, up 42% from the previous year. Development of existing housing lots such as the Whistle Bend Development (a new subdivision in Whitehorse that will eventually house 8,000 people) has reduced the primary driver (lack of building sites) on housing pressures in the city (City of Whitehorse 2012a, pers. comm., Yukon Housing Corporation 2012a, pers. comm., Whitehorse Chamber of Commerce 2012, pers. comm.). The Whistle Bend project, comprising 20 acres, is set to be Yukon's biggest residential land development project, and will consist of five phases through which 3,000 units will be built. During the next two years up to

1,500 lots for development will be available. As such, the housing market will have good capacity to accommodate moderate population growth (MacDonald 2013, pers. comm.).

Other private developments are also taking place in Whitehorse, including a development of 150 new affordable units at 18 Azure Road. This project received final zoning approval in March 2012 and unit prices will range between $250,000 and $275,000 (Falvo 2012).

Yukon representatives have expressed concerns about rental costs and lack of affordable rental housing in the City of Whitehorse (City of Whitehorse 2012a, pers. comm.; Yukon Housing Corporation 2012a, pers. comm.; Whitehorse Chamber of Commerce 2012, pers. comm.). Average rent, however, has not experienced the same magnitude of increase as the average house price. The average rent in Whitehorse only increased by 6% between 2001 and 2011, after adjusting for inflation (Falvo 2012). More recent statistics show that the average and median rent have continued to increase during the last year. The median rent in Whitehorse increased by a total of 28.8% in the eight-year period between December 2004 and December 2012. After adjusting for inflation the total median rent net increase was 9.9% for the same eight-year period. This indicates an average annual increase rate of 1.2% (Yukon Bureau of Statistics 2012b, 2013b). The median rent in Whitehorse as of March 2013 was $856 (up from $825 in March 2012 and from $700 in March of 2008) (Yukon Bureau of Statistics 2013a, 2013b). This is the highest median rent on record.

As of March 2013, the vacancy rate was 1.5%, down from 4.1% in March 2008 (Yukon Bureau of Statistics 2012d, 2013c). Vacancy rates have slightly recovered since 2010 but remain below 2%. There are also concerns with respect to the state of rental housing, with representatives noting that some rental units are aging and there have been conflicts with landlords over deteriorating conditions. Representatives noted that the Government of Yukon is currently reviewing the Residential Landlord and Tenant Act to rectify these disputes (City of Whitehorse 2012b).

Lack of social housing and affordable rental apartments appears to be an existing concern for the Yukon Government, which has identified homelessness and housing inadequacy as an issue. In 2010, the Yukon Government conducted a survey that identified more than 100 homeless people (0.37% of Whitehorse population). Whitehorse's only emergency shelter is operated at the Salvation Army in downtown Whitehorse (Falvo 2012). More than 250 people stay one or more nights per year at the shelter, and conditions at the shelter are strained. On a typical night, shelter residents may have to sleep on a mat or even on a chair (Falvo 2012).

17.3.2.3 Selkirk First Nation / Pelly Crossing

The 2011 Census reported 145 private dwelling units in Pelly Crossing, approximately 15% more than in 2006. Of these, 132 (or 91.0%) were considered to be permanently occupied by usual residents, suggesting that the remainder were being used as temporary or seasonal accommodation or were vacant. There are no developed lots available for future building, as SFN first decides if or when to build and then the lot is developed for the intended purpose (SFN 2013, pers. comm.). More detailed information on housing in the study communities is available from the 2006 Census and is provided in Table 17.3-2.

Table 17.3-2: Housing Characteristics, 2006

Population Segment	LSA				RSA
	Pelly Crossing	Carmacks	Whitehorse	Total LSA	Yukon
2011 Census					
Total Private Dwellings (Count)	145	246	9,649	10,040	16,259
Occupied Dwellings	132	196	9,309	9,637	14,117
Occupancy Rate (%)	91.0	79.7	96.5	96.0	86.8
2006 Census					
Total Private Dwellings (Count)	126	221	8,631	8,978	15,296
Occupied Dwellings	115	173	8,280	8,568	12,615
Occupancy Rate (%)	91.3	78.3	95.9	95.4	82.5
Percent Rented (%)	66.7	44.0	32.6	32.9	32.3
Constructed Before 1986 (%)	29.2	41.2	64.1	63.2	59.9
Needs Major Repair (%)	34.8	32.4	11.7	12.5	14.9
Average Number of rooms	4.7	5.2	6.3	6.3	5.9
Average Value ($)	n/a	135,647	224,673	n/a	211,008

Source:
Statistics Canada 2007, 2012a.

Note:
Due to the small population numbers data may contain rounding errors and/or omissions derived from original source.

A 2011 SFN newsletter suggests that lack of housing continues to be a major issue in Pelly Crossing. During the last few years, SFN built more than 20 homes in Pelly Crossing but these are insufficient to meet demand (SFN 2011). To address continued demand, the SFN chief and council are considering forming a Housing Authority to meet the needs for new home construction. The newsletter also suggests that increasing home ownership among SFN members is a priority.

In discussions with Yukon Housing Corporation, representatives noted there may be a lack of housing supply in Pelly Crossing. This could be exacerbated by a lack of sufficient land base for construction, prohibitive construction costs associated with more remote Yukon communities, and CMHC lending regulations, which may limit lending in industry towns (Yukon Housing Corporation, 2012).

17.3.2.4 Little Salmon/Carmacks First Nation and Carmacks

In 2011, there were approximately 246 private dwelling units in Carmacks, 11% more than in 2006. Of these, 196 (or 79.7%) were considered to be permanently occupied by usual residents. This represents the lowest occupancy rate among the LSA communities, which has almost remained invariant since the 2006 Census (Table 7-1 in Appendix 13A). Census data for 2006 also shows that Carmacks had a higher percentage of rented housing (44.0%) than the overall LSA (32.9%). The average value of housing in Carmacks was $135,647, approximately 36% below the Yukon average. There is land available for development that would serve both single family and multiple residential needs within the Village of Carmacks (Village of Carmacks 2013, pers. comm.).

During interviews, LSCFN representatives identified high construction costs as the main driver for high housing prices and a main barrier for housing development. The average price of a home in the community is estimated to reach $250,000 to $300,000 (LSCFN 2013, pers. comm.). This price is almost twice the average value reported in the 2006 census. Representatives also noted that access to housing loans is limited for aboriginal communities.

In discussions with Yukon Housing Corporation, representatives noted there may also be a lack of housing supply in Carmacks. This could be exacerbated by a lack of suitable land, prohibitive construction costs, and CMHC lending regulations (Yukon Housing Corporation 2012a). It was also noted that there is a shortage of single family dwellings and apartments in the community and in particular there is a lack of housing for seniors (Tantalus 2013, pers. comm.). Another informant noted that there are many abandoned houses in Carmacks, but that they cannot be rented out since they are on First Nations land (EMR 2013, pers. comm.) LSCFN has informed CMC that lack of housing for its members is a continuing problem.

17.3.3 Educational Services

17.3.3.1 Yukon

There are 28 primary and secondary schools in Yukon, with 14 in Whitehorse and 14 situated in the rural communities. Enrolment numbers range from less than 10 students to more than 600.

Yukon College is the only post-secondary institution in Yukon. It is based in Whitehorse (Ayamdigut Campus) and has campuses located in 12 other communities in Yukon, including Dawson City, Carmacks, Mayo, and Pelly Crossing. Each of the 12 community campuses offers online courses and video-conferencing capabilities (Yukon College 2012).

Enrolment at Yukon College has continued to grow by approximately 5%–10% per year (Yukon College 2012) and representatives noted that there are some funding constraints. Representatives also noted that mining activity has increased in Yukon and it is viewed as key to economic development. As a result, the college recently created a School of Mining and Technology (Yukon College 2012). In addition, a new Mining Industry Advisory Committee was created to assist Yukon College in being more responsive to mining-related trends in the region. The Advisory Committee, which comprises representatives primarily from mining organizations in the region, assists the college in identifying gaps, technologies, skills shortages, and mining trends (Yukon College 2012).

Apprenticeship training is offered extensively at Yukon College. Although the college has not experienced challenges in attracting students to the program, it is facing constraints in finding businesses that are willing to provide on-the-job training to apprentices (Yukon College 2012).

The Yukon College is equipped with mobile training infrastructure equipment and is capable of providing training directly to mining workers on site. Underground and surface mine training services / simulators are available from the college. Additional funding was approved in 2013 and the college is prepared to accommodate the training of additional mining tradespersons and employees (Rowles 2013, pers. comm.).

A number of labour-related training programs exist in Yukon, many of which focus on the mining industry, as well as on building skills within Aboriginal communities. The following are several examples of these educational initiatives.

Centre for Northern Innovation in Mining: Yukon College’s new Centre for Northern Innovation in Mining (CNIM) was recently announced by the federal and Yukon governments. Prime Minister Steven Harper and Yukon Premier Darrelll Pasloski on August 19, 2013. It is expected to provide comprehensive skills and trades training as well as facilitating access to applied research specific to the Northern minerals and mining industry.

The CNIM has dedicated trades facilities at the Ayamdigut Campus in Whitehorse. It also offers a mobile trades school, making comprehensive trades training possible anywhere in Yukon that is accessible by road. The Centre for Northern Innovation in Mining is planning to offer heavy equipment operator, underground mining, pre-apprenticeship heavy equipment mechanic, industrial electrical and industrial welding programs. Casino Mining Corporation expects to work closely with the CNIM in delivering training programs for future Yukon-based workers.

Yukon Mine Training Association: The Yukon Mine Training Association (YMTA) links Yukon First Nations with some of Yukon's mining and resource–related industries. The central goal is the training and development of a skilled workforce made up of First Nations and Yukon residents to meet the current and future needs of the mining and resource sectors. Yukon Mine Training Association partners with communities, corporations, and industry to offer courses and on-the-job learning opportunities (YMTA 2010). A new funding agreement of $2 million over two years was confirmed early in 2013 and sources the Federal Skills and Partnership Fund. This new funding is client-driven and focuses on providing life and career coaching and training. Once training is finished, clients search for employment and can access a wage subsidy (YMTA 2013, pers. comm.).

Aboriginal Labour Market Programs: Aboriginal Labour Market Programs are available to increase workforce participation and help Aboriginal people prepare for, find, and maintain jobs. These programs are delivered across Canada by Aboriginal agreement holders (Human Resources and Skills Development Canada (HDRDC) 2013). In Yukon, the Council of Yukon First Nations and the Aboriginal Labour Force Alliance are Aboriginal agreement holders and receive funding through this program.

Yukon Department of Education: The Advanced Education branch of the Yukon Department of Education also provides programs and support services for the Yukon labour force. The branch develops and implements programs in partnership with other Yukon government departments, the federal government, businesses, labour organizations, Yukon College, First Nations, equity groups, and other provincial jurisdictions. Programs include apprenticeship and trades training programs, student training and employment, student financial assistance, community training funds, literacy programs, targeted initiatives for older workers, Yukon nominee program for critical impact worker and skilled worker, and registration of trades schools (Yukon Department of Education 2011a).

17.3.3.2 Whitehorse

There are 14 public schools located in the City of Whitehorse, including 10 elementary schools, three secondary schools, and one kindergarten to grade 12 French Language School. Like all schools in Yukon, the curriculum is based on BC Ministry of Education curriculum, and students are eligible to write BC departmental exams. As of 2011, total primary and secondary enrolment in Whitehorse schools was 4,100 students and capacity for students in Whitehorse is not identified as being a constraint as there has been declining enrolment (Yukon Department of Education 2013).

17.3.3.3 Selkirk First Nation / Pelly Crossing

There is one school in Pelly Crossing. The Eliza Van Bibber School offers education from kindergarten to grade 12. According to the school's website, overall student enrolment is at 65 for 2012, with professional staff numbering 15.

The Pelly Crossing Yukon College campus is located in SFN's previous administration office and was constructed in 2011. The cost of the building was approximately $1.4 million and was funded by the federal government (Yukon College 2012). The facility offers three classroom spaces, with capacity for 12 to 15 students per

classroom, as well as office space. Representatives from Yukon College estimated that there is capacity to teach nearly 400 students per year (three to four classes per day in addition to the potential for weekend classes).

The campus at Pelly Crossing has a Northern Tutchone name, Hets'edan ku', which means “learning house.” Staff at Hets'edan ku', in partnership with SFN, offer programming that is locally relevant (SFN 2012). In addition, courses are available through video-conferencing and include credentialed courses such as early childhood education, accounting, or academic upgrading.

17.3.3.4 Little Salmon/Carmacks First Nation and Carmacks

The Tantalus School in Carmacks offers education from kindergarten to grade 12. School amenities include a gymnasium, library, and computer lab. According to the school’s website, student enrolment for 2012 exceeds 104 students. Approximately 98% of students are of First Nation Ancestry (Tantalus 2011, 2013, pers. comm.). The school employs nine teachers, two educational assistants, two learning assistant teachers, two administrative assistants, and a principal (Tantalus 2013, pers. comm.).

School programs reflect the Northern Tutchone values and follow the BC curriculum and BC exams. Currently the school has 5 to 10 graduates per year. School representatives noted that most students who complete grade nine are very likely to graduate. Representatives also noted that the school can accommodate considerably more students, in particular, in the kindergarten and high school programs. Currently there are 35 students in high school, but it could easily enrol up to 150 to 175 students (Tantalus 2013, pers. comm.). The school has a new building and is undergoing additional renovations, including adding another classroom.

Yukon College also has a campus in the Village of Carmacks, providing adult education programs to the community. The local campus staff work with the LSCFN, developing and delivering training courses and programs designed to enhance local administrative capacity. Other programs at the campus include academic upgrading, employability skills, craft and small business, computer skills, first aid, accounting, pre-trades and trades, and youth employment training.

17.3.4 Health and Social Services

17.3.4.1 Yukon

Health services in the Yukon are delivered and administered out of Whitehorse General Hospital (WGH). The hospital serves as a regional referral center for the Yukon and serves the rural nursing stations through a system of ground and air ambulance as well as other communication means such as tele-medicine.

The sustainability of Yukon’s health care system appears to be a concern. A recent health care review commissioned by the Premier and the Minister of Health found that Yukon residents believe the quality of health care in the Yukon is being jeopardized by such issues as extended wait times; a lack of family doctors; inadequate access to long-term, palliative and home care; fraudulent use of Yukon’s health care system; limited substance abuse treatment and programming; patient transport issues; limited mental health services; and lack of prevention programs and human resources in communities (Yukon Health Care Review Committee 2008).

17.3.4.2 Whitehorse

A full range of health care services is available in Whitehorse, including services provided by WGH (e.g., medical daycare, visiting clinics for specialist doctors, gynaecology, medical imaging, cancer care and chemotherapy, and emergency clinic care) (WGH 2012, pers. comm.). Fifteen visiting specialist physicians provide clinic services such as ophthalmology, orthopaedics, and ear, nose, and throat on a regular basis. First Nations Health

Programs are also provided at the hospital, and they aim to provide care that is culturally sensitive. Dentists' services are readily available, as is a full-time ambulance service. There are also three extended-care facilities, seniors' housing, and a senior citizens' centre. In addition, there are a number of family doctors and four walk-in clinics available (WGH 2012, pers. comm.).

Whitehorse General Hospital has an average annual operating budget of $70 million, providing approximately 55 beds with a staff of 111 nurses. Representatives from WGH noted that there is an average of 100 patients per day visiting the emergency room (WGH 2012, pers. comm.). Expansion plans to increase the size of the emergency department and add an additional 10 beds were approved in 2013 and are expected to be completed by 2020 (Sapronak 2013, pers. comm.).

Whitehorse General Hospital provides maternity care as well. Whitehorse General Hospital representatives noted that in 2011 there were 420 births at the hospital. It is expected that this number will continue to grow (WGH 2012 pers. comm.); however, high-risk pregnancies are not accommodated at the hospital and are transferred out to hospitals in larger centres in British Columbia and Alberta.

In addition to WGH, Whitehorse also has several private medical dental and optometry clinics available throughout the city.

The Yukon Family Services Association and the Yukon Housing Corporation provide services from their main offices in Whitehorse, and the Yukon Government Health and Social Services department provides a range of services in the Whitehorse area. A women's transition house, Kaushee's Place, provides emergency shelter as well as longer-term housing assistance and counselling services.

The Kwanlin Dun First Nation and Ta'an Kwach'an Council provide a range of social services to their members, including social assistance and elder care.

17.3.4.3 Selkirk First Nation / Pelly Crossing

Pelly Crossing has a local community health centre with regular hours from Monday to Friday, as well as a 24-hour emergency service. An informal discussion was held in the early summer of 2012 regarding the temporary nurse who is stationed at the health centre, and additional discussions about Pelly Crossing’s nursing support continued in 2013. To date, the following aspects about the community health centre have been noted:

- There has been no permanent nurse based in the community, with staffing provided by temporary staff who work under contract and who temporarily live in the community for the duration of their contract;
- The operational hours were respected by the community members and there was a positive relationship with the health staff;
- Specialist services are provided on an infrequent basis by doctors or other health providers who periodically visit the community;
- The ability exists to obtain remote, real-time medical advice by contacting staff in Whitehorse; and
- Patients in need of emergency care are transported to hospitals either by ambulance or aircraft from the local airstrip.

There is one social worker in town that is stationed at the SFN office while a Yukon Government employee provides health and social services on a half-time basis (the health and social services worker divides her time between Pelly Crossing and Mayo).

A representative from the Yukon Government Health and Social Services department was interviewed regarding services available in Pelly Crossing. Services provided by the Yukon Government include child welfare (e.g., responses to reports of child abuse or neglect), foster home services, family support services, social assistance (assessments for benefits), youth justice–related services, youth probation services, and adult protection–related services (Government of Yukon Health and Social Services 2012, pers. comm.).

The SFN Department of Health and Social Programs provide services to members in the areas of social assistance, recreation, community wellness, and elder home care and benefits. Programs offered are tailored to expecting parents, elders, students, and youth. Native court worker services are administered through the Northern Tutchone Council in Pelly Crossing.

Representatives noted that a hospital is being constructed in Dawson City and was set to open in April 2013 (WGH 2012), though this has been delayed until the December 2013. It is likely that residents of Pelly Crossing would receive emergency services at the hospital in Dawson City, once it is open.

17.3.4.4 Little Salmon/Carmacks First Nation and Carmacks

The Village of Carmacks offers a community health centre that operates from Monday to Friday, 8:00 a.m. to 4:30 p.m. The centre also provides after-hours emergency service and ambulance dispatch. Occasionally, dental clinics are offered by dentists from Whitehorse (Village of Carmacks 2013 pers. comm.). A visit to the health centre and interviews with key representatives during 2012 and 2013 reveal the following aspects about the community health centre (ibid):

- The current health centre is not large enough to accommodate the Village of Carmacks. The centre has two exam rooms: one can be used for trauma as required and only one room is available to see patients. The centre also has an x-ray machine, a laboratory, and a pharmacy. Each room has cameras that allow conferencing with doctors in Whitehorse.
- The centre has two nurses stationed in the community and is currently lobbying to have a third nurse. It was noted that staffing for community centres in Pelly Crossing and Carmacks are lower than in other Yukon communities such as Mayo or Faro with comparable populations.
- Major health concerns in the community include diabetes, high blood pressure, and injuries from motor vehicle accidents.
- The centre offers specialized programming for women such as the Well Woman Program (provides preventative health screening services to women) and pre-natal care.
- The Minto Mine is more likely to use the Carmacks health centre to treat injuries than the centre in Pelly Crossing.

Other community social services include Yukon Health and Social Services social workers (estimated to be three staff committed to this community as of 2013), a Yukon Housing Corporation part-time office, a safe house for women and children, and a daycare centre. The Yukon Family Services Association provides itinerant services from its Whitehorse office. Probation services are also provided from Whitehorse. The types of services provided in Carmacks from Yukon Health and Social Services include child welfare (e.g., responses to reports of child abuse or neglect), foster home services, family support services, social assistance (assessments for benefits), youth justice–related services, youth probation services, and adult protection–related services (Health and Social Services 2012, pers. comm.).

Little Salmon/Carmacks First Nation also offers social services to its members, including counselling, social assistance, adult care, and homecare, and the Yukon Health and Social Services department is currently looking for opportunities to partner with LSCFN in Carmacks (Health and Social Services 2012, pers. comm.). Native court worker services are administered through the Northern Tutchone Council in Pelly Crossing.

In 2007, the Integrated Community Sustainability Plan (ICSP) noted the health and social service building was too small to meet the needs of the First Nation community. Aspects of the services provided require a degree of privacy that was difficult to accommodate in the building. A newly constructed community health and social service building has been recently opened. Staffing and staff continuity were also noted as an issue. The report identified a need for more family support workers to relieve some of the burden on the current social workers and families under care by providing a respite during stressful times.

It is likely that residents of Carmacks would also receive emergency services at the new regional hospital in Dawson City, once it is open.

17.3.5 Protective Services

17.3.5.1 Yukon

The Yukon headquarters of the RCMP operates in Whitehorse and provides policing with approximately 40 officers, including an inspector and First Nation community constables. An aircraft section of the RCMP, based out of Whitehorse, has one aircraft. The RCMP also has a satellite office in McIntyre subdivision. Services provided by the RCMP include:

- Community policing;
- Prevention and enforcement of criminal activity that involves violent, criminal, or property crime;
- Volunteer victim's assistance programs;
- Awareness training in schools to prevent drug and alcohol abuse; and
- Basic policing services (Whitehorse RCMP 2012, pers. comm.).

Probation services are provided in Whitehorse, which is also the location for Yukon's main correctional centre, a secure facility for young offenders, and a halfway house.

The Yukon Workers' Compensation Health and Safety Board (YWCHSB) administers workers' compensation and occupational health and safety in Yukon. The organization promotes safety awareness, provides training and education, and conducts inspections, compliance, and investigations.

17.3.5.2 Whitehorse

Key issues in the city include family violence, drug and alcohol abuse, mischief, and petty crime (Whitehorse RCMP 2012, pers. comm.). These issues were not limited to any particular ethnic or age group, but criminal activity was noted to increase in the summer due to a rise in activity resulting from increased tourism.

The City of Whitehorse has a fire department staffed by a chief, 20 full-time employees, and approximately 30 volunteer firefighters. The fire department operates 24 hours a day from two well-equipped fire halls. The fire department responds to approximately 500 to 600 incidents per year, which averages out to 5 to 10 calls per week and fluctuates throughout the year (Whitehorse Fire Department 2013). The fire department is not running at capacity and can accommodate moderate population growth (ibid).

The fire department provides fire suppression, rescue, hazardous material response and fire prevention, and public education services to the community:

A 911 service is available in Whitehorse and surrounding areas to respond to emergency police, fire, and ambulance situations in the city and surrounding community.

Table 17.3-3 summarizes the RCMP and fire services available in Pelly Crossing, Carmacks and Whitehorse.

Table 17.3-3: RCMP and Fire Protection Services in the LSA communities

Community	No. of RCMP Staff	Fire Department	
		No. of Firefighters	Average No. of Calls per Year
Pelly Crossing	1 corporal and 2 constables	1 fire chief and 6 volunteers	Not available
Carmacks	1 sergeant and 2 constables	10 volunteers	Not available
Whitehorse	40 officers, including 1 inspector and First Nation community constables	1 fire chief, 20 full-time employees, and approximately 30 volunteers	500–600

Source: Whitehorse RCMP 2012; Whitehorse Fire Department 2013, pers. comm.

17.3.5.3 Selkirk First Nation / Pelly Crossing

In terms of protective services, the RCMP operates a detachment in Pelly Crossing, which is staffed by a corporal and two constables. Probation officer and native court worker services are provided from Mayo. A chief and six volunteers provide fire department services.

17.3.5.4 Little Salmon/Carmacks First Nation and Carmacks

Responsibility for protective services and policing in Carmacks is provided by one sergeant and two constables out of the local RCMP detachment. Probation services are delivered from Whitehorse, and fire and ambulance services are provided through a volunteer service. There are 10 volunteer firefighters in the community, and known challenges include finding volunteers, retention, and training (Village of Carmacks 2013, pers. comm.). Community representatives noted that search and rescue services are disorganized. Volunteers lack of appropriate training and there are concerns over liability (EMR 2013, pers. comm.).

Public safety concerns mentioned in the ICSP for Carmacks include the lack of a street numbering system and pedestrian movement along the Klondike Highway and across both bridges (Inukshuk 2007).

The Wildland Fire Management Division of the Department of Community Services provides wildfire management services. Pelly Crossing and Carmacks are served by the Tatchun Regional Fire Management Area. The division has 11 staff in Carmacks (only 1 permanent) and 3 staff in Pelly Crossing. Most positions are seasonally filled through 4–6-month contracts that run from May to August or April to September. The division mandate is to protect the communities, and it is heading towards an all-risk protection strategy that also includes flood management and other community protection services (Wildland Fire Management 2013, pers. comm.).

17.3.6 Transportation

17.3.6.1 Highways

There are 12 primary highway routes in Yukon, totalling 2,027 km of core, northern, and remote networks (Transport Canada 2008, Government of Yukon 2009). The Klondike Highway (Highway 2) and the Alaska

Highway (Highway 1) are most closely associated with the LSA and RSA (Government of Yukon's Department of Highways and Public Works 2012, pers. comm.). Approximately 1,900 km of roads in Yukon have a bituminous surface treatment, as an inexpensive sealed surface alternative to asphalt. Bituminous surface treatment is used as an asphalt replacement for general road repairs and has been utilized since the 1970s in Yukon due to its ease of use and the road system's frequent need of maintenance caused by annual freeze / thaw damage (Government of Yukon's Department of Highways and Public 2008).

Because much of the Yukon highway system is exposed to extreme freezing and thawing episodes throughout the year, roadways are subject to more damage from truck traffic than normal paved roads. As a result, the Yukon Government imposes seasonal weight restrictions on highway traffic in the spring when the frost is coming out of highways and other public roads. Weight restrictions to 75% of maximum legal weight (63.5 tonnes) are typically in effect from the second week in April to second week in May on the Klondike and Alaska Highways; these dates are variable depending on weather conditions and are set by Highways and Public Works each year. However, it is possible to secure a special bulk commodity permit for heavy haul vehicles throughout the year and during the weight restriction period to enable the carrier to increase the maximum gross weight of the (ALCAN RaiLink Inc. 2008).

The Klondike Highway runs south–north, from the BC border south of Carcross to Dawson City, and is approximately 630 km long. South of Carcross, the highway passes through a small section of BC before entering Alaska via Highway 9 that ends at the Port of Skagway. The road distance from Skagway to Carmacks is approximately 356 km.

In 2011, sections of the Klondike Highway experienced an annual average daily traffic (AADT) volume ranging from 241 vehicles at the US border crossing near Skagway to 2,045 vehicles near Whitehorse and to 625 vehicles near Carmacks. The average summer daily traffic (ASDT) volumes at these locations increased to 477, 2,550, and 425 vehicles respectively (Government of Yukon's Department of Highways and Public Works 2011).

The Yukon Department of Highways and Public Works has indicated that the Klondike Highway is currently in good condition and no upgrades are planned because traffic volumes are well below the design capacity of this highway. The design capacity of the highway is 1,500 vehicles per hour per lane but the capacity can range from 1,200 to 1,800 vehicles per hour per lane depending on road geometry, terrain, and other factors (Government of Yukon's Department of Highways and Public Works 2012, pers. comm.).

The Alaska Highway runs east–west from Watson Lake, through Whitehorse, west to Haines Junction, and then northwest into Alaska. East of Watson Lake the Alaska Highway enters BC and becomes Highway 97. The first major community in BC on Highway 97 is Fort Nelson.

In 2011, AADT volumes on the Alaska Highway (Highway 1) ranged from 561 vehicles at Watson Lake to 2,045 vehicles near Whitehorse. ASDT volumes increased to 786 and 2,550 at these locations on the Alaska Highway (Government of Yukon's Department of Highways and Public Works 2011).

As is the case with the Klondike Highway, the design capacity of Highway 1 is 1,500 vehicles per hour per lane but can range from 1,200 to 1,800 vehicles per hour per lane depending on road geometry, terrain, and other factors (TRB 2010). Sources with the Yukon Department of Highways and Public Works indicate that the Alaska Highway is in good condition but there will be upgrades in 2013.

17.3.6.2 Freegold Road

The Freegold Road is a two-lane gravel resource access road that extends approximately 83 km west from the Village of Carmacks. It was developed in the late 1970s by the Yukon Government as part of the Access to Resources Yukon initiative.

In 2008, a pneumatic counter placed at Kilometre 0 on the Freegold Road near Carmacks recorded average daily traffic of 26 vehicles but traffic on the road largely occurred during the period from April to October. Short-term traffic counters placed on the road during summer months in prior years recorded average daily traffic that ranged from 11 vehicles to 41 vehicles (Government of Yukon's Department of Highways and Public Works 2008).

In 2012, the condition of the Freegold Road was reported to be poor and only suitable for exploration-type projects with low intensity and low activity on the road (Government of Yukon's Department of Highways and Public Works 2012, pers. comm.).

17.3.6.3 Commercial Trucking / Hauling

At least 30 commercial trucking companies serve Yukon, providing ground transport and logistics services throughout the territory and other parts of Canada. The majority of companies are based out of Whitehorse and provide truck freight, bus, dump truck, food transport, towing, or specialized services such as heavy equipment moving. In order to ship goods within or outside of Yukon a Freight Vehicle pass is required from the Yukon Department of Highways and Public Works.

17.3.6.4 Air

Yukon’s airport infrastructure includes 29 landing strips of which 16 are classified as aerodromes. There is one international, three regional, and nine community airports operated by the Yukon Government (Department of Highways and Public Works 2008c, Transport Canada 2008). The majority of airstrips in Yukon are gravel surfaced.

The Erik Nielsen International Airport at Whitehorse is the largest airport and the primary air transportation hub in Yukon. It has three asphalt runways (548 m, 1,225 m, and 2,896 m long) that are equipped for aircraft instrument approach. The original airport terminal built in 1920 was replaced in 1985 and further expanded in 2012. The airport can accommodate up to 280 passengers at peak volume times (Government of Yukon 2013).

Between 1987 and 2012 the annual total of air passengers using the airport increased from 110,000 to 295,000 respectively (Seaman 2013, pers. comm.). In 2012 the airport handled 19,711 aircraft movements (flights from one airport to another) compared to air traffic volumes of 17,312 in 2009 and 22,810 in 2011.

Air services provided out of the Whitehorse airport includes commercial passenger and cargo services to major urban centres beyond Yukon and passenger, freight, and charter services to regional and community airstrips within Yukon. Commercial air carriers with scheduled service to Whitehorse from Vancouver, Calgary, Edmonton, Dawson City, and Kelowna include Air Canada, and Air North. Seasonal flights are provided by Condor, West Jet, and Air North to such destinations as Frankfurt, Mexico, and Las Vegas.

There is a community airstrip at Carmacks (EX4) and four other airstrips located near the Project area between Carmacks and Mayo: McQuesten (FP4), Minto (no indicator), Pelly Crossing (FQ6), and Ft. Selkirk (no indicator).

There is a small airstrip at the Casino mine site that will be replaced during Project construction with a larger airstrip. It will have a 1,600 m gravel runway with 60 m overruns at either end. The airstrip is designed to accommodate a Hawker-Sidley HS 748 turbo-prop aircraft and/or a Bombardier Dash 8-100 or 200 turbo-prop

aircraft. The Hawker-Sidley aircraft can be configured to carry 48–56 passengers while the Bombardier Dash 8-100 or 200 have 37–39 seats.

The new airstrip engineering and design will conform to the most current version of the Transport Canada Aerodrome Standards and Recommended Practices (TP 312).

17.3.6.5 Port Facilities

The Port of Skagway has been used as the main industrial ocean shipping point for Yukon industries since the late 1960s. Starting in the 1990s, Skagway has catered to the cruise ship tourism business.

The Port of Skagway includes:

- A deep water port with year-round ice-free docking facilities;
- Nahku Ore Terminal – a barge dock with about 1,114 m^2 of open storage space;
- Ore dock – 487 m in length for barges transporting ore and bulk fuel;
- AML barge dock – for weekly resupply barge service from Seattle;
- White Pass railroad dock – 538 m in length to accommodate two large cruise ships at one time;
- Broadway dock – 198 m in length for small cruise ship and timber hauling vessels; and
- Petro Marine Bulk Fuel Storage – 24.2 MM litres of storage tankage for petroleum products.

The port has historically exported up to 600,000 tonnes annually of lead and zinc concentrates to other locations on the west coast and Asia. Currently, the port exports copper concentrates from Capstone Mining, Minto operation. It is also the primary point for inbound marine freight and fuel for Yukon. The current port infrastructure has the capacity to export up 3 million tonnes of mineral concentrates and coal per year.

The Yukon Government considers Skagway the most viable option for port re-development, given its existing infrastructure and ability to handle moderate traffic (KPMG LLP and Gartner Lee 2006).

Skagway is connected to BC and Yukon by Highway 9 in Alaska and the Klondike Highway (Highway 2) in BC and Yukon, starting at the US/Canadian border crossing.

17.4 PROJECT-SPECIFIC EFFECTS

17.4.1 Project Interactions and Potential Effects

Table 17.4-1 shows potential interactions between the Project components and activities (as defined in Section 4) and the Community Infrastructure and Services VC. The identified interactions warrant further analysis because they may result in positive or negative effects on local infrastructure and services during the Project life. These potential effects are evaluated and describe in subsequent sections.

Project components that may affect directly or indirectly this VC during the mine construction, operations, and closure and decommissioning phases include:

- Mine Staffing;
- Contracted Employment;
- Freegold Road Upgrade;

- Freegold Road Extension;
- Traffic (equipment and materials to site); and
- Mine Development.

These Project components are expected to interact with the Infrastructure and Services VC through two mechanisms: population changes and traffic changes and project activities.

Project Employment Demands and Related Population Changes

The Project will result in considerable direct employment as well as contracted employment, which could cause population changes on the local communities (e.g., encourage an influx of new residents into local communities). This increase in population will, in turn, increase demand for local infrastructure and services. The Project population effects would depend on whether Project-related jobs are filled by residents or by non-residents, and on whether non-residents relocate to the area or commute to work. This will also depend on the current capacity of the local infrastructure and services and their ability to handle increasing demands. Some out-migration is anticipated following a decline in employment opportunities, specifically towards the end of operations and during decommissioning and closure, which would decrease the demand for local infrastructure and services.

Traffic Changes

The transportation of equipment, supplies, materials, consumables, mine products, and labour will be an essential component throughout all phases of the proposed Project, and this activity will directly interact with the regional transportation infrastructure. Transportation activities will create additional vehicle traffic and workforce traffic and additional demand on transportation infrastructure.

Mine Development and Project Activities

Accidents at worksite could increase demand for regional health services and interact with regional infrastructure and services.

Freegold Road Extension and Upgrade

The Project includes upgrading the existing 83 km Freegold Road and construction of the Freegold Road Extension for approximately 120 km southeast from the Project to the existing Freegold Road, which extends to the village of Carmacks. This component was identified because the upgrade and extension will create additional infrastructure. The extension will be a controlled access resource road, in which use is carefully controlled by CMC. Some projects may have right of access that predates this road.

Table 17.4-1: Potential Interactions between the Project and Community Infrastructure and Services

Project Components and Activities	Project Phase[1] (C, O, CD, PC)	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	No	No specific interaction with this socio-economic VC
Aggregate sources / Borrow Sites	C,	No	No specific interaction with this socio-economic VC
Airstrip and Airstrip Access Road	C, O, CD,	No	No specific interaction with this socio-economic VC
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O,	No	No specific interaction with this socio-economic VC
Concentrate Transport and Loading	O,	No	No specific interaction with this socio-economic VC
Concrete Batch Plant Operation	C, O,	No	No specific interaction with this socio-economic VC
Contracted Employment	C, O, CD,	Yes	Proposed Project employment would encourage in-migration, which would in turn create demands on community infrastructure and services in the region.
Cyclone Sand Plant	C, O,	No	No specific interaction with this socio-economic VC
Dismantling of Facilities	CD,	No	No specific interaction with this socio-economic VC
Diversion of Canadian Creek	C, O,	No	No specific interaction with this socio-economic VC
Drilling and Blasting	C, O,	No	No specific interaction with this socio-economic VC
Fish Habitat Compensation Construction	C, O,	No	No specific interaction with this socio-economic VC
Freegold Road Extension	C, O, CD,	Yes	Improved access to the area for CMC. Other potential industrial users will be limited by the road being private and access controlled.
Freegold Road Upgrade	C, O, CD,	Yes	Improved access to the area from CMC and other users
Fuel Storage and Distribution System	C, O,	No	No specific interaction with this socio-economic VC
Gold Extraction Plant / Oxide Ore Processing	C, O,	No	No specific interaction with this socio-economic VC
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C,	No	No specific interaction with this socio-economic VC
Hazardous Materials Storage, Transport, and Disposal	C, O,	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, CD, PC)	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Heap Leach Facility	C, O,	No	No specific interaction with this socio-economic VC
Heap Leach Pad	C, O,	No	No specific interaction with this socio-economic VC
Laydown Areas	C, O,	No	No specific interaction with this socio-economic VC
LNG Transport to site	C, O,	No	No specific interaction with this socio-economic VC
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O,	No	No specific interaction with this socio-economic VC
Maximum Disturbance Area	C, O, CD,	No	No specific interaction with this socio-economic VC
Mine Development	C, O, CD,	Yes	Accidents at worksite could increase demand for regional health services.
Mine Staffing	C, O, CD,	Yes	Proposed Project employment would encourage in-migration, which would in turn create demands on community infrastructure and services in the region.
On-site Equipment and Vehicle Use	C, O, CD,	No	No specific interaction with this socio-economic VC
Open Pit Mining	C, O,	No	No specific interaction with this socio-economic VC
Ore Conveyors	C, O,	No	No specific interaction with this socio-economic VC
Ore Crushing	C, O,	No	No specific interaction with this socio-economic VC
Ore Hauling	C, O,	No	No specific interaction with this socio-economic VC
Ore Stockpiles	C, O,	No	No specific interaction with this socio-economic VC
Processing Facilities for Sulphide Ore	O,	No	No specific interaction with this socio-economic VC
Reagent Storage and Distribution	C, O,	No	No specific interaction with this socio-economic VC
Site Reclamation / Re-Vegetation	O, CD,	No	No specific interaction with this socio-economic VC
Site Security and Fencing	C, O, CD,	No	No specific interaction with this socio-economic VC
Surface Water Management (Contact Water)	C, O, CD,	No	No specific interaction with this socio-economic VC
Surface Water Management (Non-Contact Water)	C, O, CD,	No	No specific interaction with this socio-economic VC

Project Components and Activities	Project Phase[1] (C, O, CD, PC)	Potential Interaction	Mechanism of Interaction (or Rationale for No Interaction)
Tailings Management Facility	C, O, CD,	No	No specific interaction with this socio-economic VC
Topsoil Stockpiles	C, O,	No	No specific interaction with this socio-economic VC
Traffic (Equipment and Materials to Site)	C, O, CD,	Yes	Transportation of workers, equipment, services, and materials to and from mine site will create additional vehicle traffic and workforce traffic and additional demand on transportation infrastructure.
Waste management: garbage and sewage waste facilities	C, O,	No	No specific interaction with this socio-economic VC
Waste Rock and Overburden Disposal	C, O,	No	No specific interaction with this socio-economic VC
Water Supply	C, O, CD, PC	No	No specific interaction with this socio-economic VC

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

The population assessment examined how the proposed Project will add to the existing and future expected population in the LSA. Non-residents who relocate to the LSA will create a population effect and by extension, increase the demand on Community Infrastructure and Services. Whether it is new home construction, rental activity or temporary accommodations in hotels, motels or recreational vehicle / camp sites, these new residents will require utilities, communication services, and recreation facilities.

As discussed in Section 16.4, the influx of people (due to direct or indirect effects) from outside the LSA is expected to be gradual and will begin during the construction phase. The rate of population growth within the LSA peaks in 2017 at 0.6% and declines thereafter to 0.0% from 2022 onward. Total change in population from all Project effects is estimated at 645 (or 248 families) by 2024. These effects are expected to decline and eventually turn negative as closure approaches and employment and income returns to baseline conditions.

Whitehorse is anticipated to receive the majority of migrants (96 of total migrants) due to its wider range of services and facilities and broader housing supply than any other community in the LSA. The city offers a full range of urban amenities and is the centre for health, education, transportation, shopping, and business in Yukon. It is estimated that up to 619 individuals (or 238 families) would relocate to Whitehorse. This would represent 2.0% of its projected population.

Pelly Crossing is anticipated to receive 1.7% of migrants or 11 individuals, which represents 2.9% of its projected population, while Carmacks would receive 2.4% of migrants (or 16 individuals), which represents 2.6% of its projected population.

There will be a limited increase in the demand for regional infrastructure associated with the increase in population due to in–migration of non-resident workers and their families. This demand will begin with the onset of construction; it will increase gradually and stabilize by the end of 2024. While there will be an adjustment period

between the second year of construction and the beginning of operations, demand will essentially remain continuous until the end of operations. At closure and decommissioning, there may be some drop-off in population and demand as conditions return toward the base case.

At the end of operations, some out-migration of operation workers and their families is expected. It is difficult to determine the magnitude of the population outflow, since this decision depends on the regional work opportunities available at the time of closure and personal and family interests. Project-related improvements to worker skills and experience will provide residents of the LSA with opportunities to pursue higher-paying jobs in the mining industry or transfer their skills to other industries. Casino Mining Corporation is committed to developing a Mine Closure Plan, which may include ongoing investment in workers to enhance employability and to help workers find new employment in the mining industry after production ends. Casino Mining Corporation will work with local service providers to incorporate decline in population in planning.

In general, effects are negative when reflecting increases in demand for a range of local infrastructure and services and positive when this demand declines. An increase in demand is predicted to be adverse mainly because of the strain that is expected to be placed on existing infrastructure, services, programs, and government resources. The additional demand has the potential to create congestion in public infrastructure and services. However, this would depend on the current excess capacity of the services and on the ability of expanding the supply of those services.

The LSA communities and, in particular, Whitehorse have a good capacity of infrastructure and services and approved expansion plans (Section 17.3) that can easily accommodate the potential additional demands created by the arrival of 645 people (619 people to Whitehorse, 16 to Carmacks, and 11 to Pelly Crossing). This population increase would represent 0.6% of the total LSA population. Attracting and retaining skilled residents has been identified as a priority of Yukon and local governments (Yukon Economic Development 2011, Village of Carmacks 2006). The magnitude of effects is low and represents a small change in each community population.

There will be an increase in demand for housing (238 families in Whitehorse, six families in Carmacks, and four families in Pelly Crossing). While vacancy rates are currently low, the availability of developed lots in Whitehorse and Carmacks and the ability to service and build based on demand in Pelly Crossing indicate that there is the existing potential to increase housing and rental accommodation. In Whitehorse, this is demonstrated by developers purchasing serviced lots in developments such as Whistle Bend. The duration of the YESAB review process, coupled with the duration of Project construction, allows the market to anticipate and position itself to accommodate additional families in Yukon. While there have been smaller mines developed, Casino is unique in the large scale of the mine and the mine life. Coupled with the emphasis on hiring local staff and encouraging staff to relocate to the Yukon, this suggests that no long-term significant effects are expected in housing prices or rents in the communities.

The transportation of equipment, goods, services, and workers to and from the mine would place demands on the regional transportation network. Construction at the proposed mine site and extension of the Freegold Road will require delivery of a range of freight, including construction equipment, permanent mining equipment, camp-related buildings, fuel and lubricants, and a range of materials, e.g., structural steel, pipe, concrete, gravel, aggregate, and mechanical products.

Over the four-year construction period, the average daily number of vehicles (all types and sizes) making return trips to the mine site via the Klondike Highway and the upgraded Freegold Road and Extension will increase from four in the first year of construction to 18 in the second year to 28 in the third and fourth years. Heavy trucks including Tridem trucks and B-Train Doubles will make up 85% of the average daily traffic in Year 1, about 52% in Year 2 and Year 3, and 37% in Year 4. Light vehicles include cars and light trucks with up to 10 ton capacity.

Peak traffic may approach 200%–250% of the average daily return trips; however, this will occur only for limited durations.

Annual daily vehicle return trips to the mine site via the Klondike Highway and the Freegold Road Extension, including light traffic, is estimated at 56 inbound loads per day, 68 outbound loads per day, and 72 outbound loads during peak periods (note that these numbers are referring to the number of loads, not vehicles; some trucks may return empty and are therefore not counted as a load). Buses, vans, and light trucks account for 20 inbound and outbound vehicles per day or 36% of the inbound loads and 29% of the outbound loads. Heavy trucks are primarily Tridem trucks and double trailer trucks.

Traffic estimates during decommissioning and closure have not been calculated because they will be well within the baseline traffic range on the Klondike Highway. Mine-related traffic during the post-closure phase would be undetectable. See Table 17.4-2 for more details on potential effects on Community Infrastructure and Services per Project phase.

Table 17.4-2: Potential Effects on Community Infrastructure and Services

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
Construction and Operation Phases				
Project Employment Demands and Related Population Changes	Municipal Infrastructure: water supply water/sewage treatment landfills power supply recreational facilities	C,O, CD	Population change will alter demand for municipal infrastructure. The arrival of up to 248 families or 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) to the LSA will create additional demand on municipal infrastructure.	Adverse
Project Employment Demands and Related Population Changes	Housing and Temporary Accommodation	C, O, CD	The arrival of up to 248 families or 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) to the LSA will create additional demand on housing and temporary accommodation.	Adverse
Project Employment Demands and Related Population Changes	Education Services	C, O, CD	Project hiring requirements will increase incentive for educational attainment, which in turn will increase demand for education training services (college education, training programs, apprenticeship programs, etc.). The arrival of up to 248 families or 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) to the LSA will create additional demand both for schools and higher education services. If 16% of in-migrants are below 15 years of age based on existing Canadian trends, approximately 103 additional children will be requiring primary and secondary education.	Adverse / Beneficial
Project Employment Demands and Related Population Changes	Health and Social Services	C, O, CD	The arrival of up to 248 families or 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) to the LSA will create additional demand on health and social services.	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, CD, PC)	Potential Effect	Direction
Construction and Operation Phases				
Mine Development and Activities	Health and Social Services	C, O, CD	Accidents at worksite could increase demand for regional health services.	Adverse
Project Employment Demands and Related Population Changes	Protective Services	C, O, CD	The arrival of up to 248 families or 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) to the LSA will create additional demand on protective services.	Adverse
Transportation of Workers, Equipment, Services and Materials to and from Mine Site	Transportation; Health and Social Services; Protective Services	C, O, CD	Transport of, equipment, services, and materials will increase road traffic and the risk for motor vehicle collisions on the Klondike Highway and Freegold Road that provide access to the mine. Increase in Project-related traffic could create increased demand on first responders (RCMP, fire department, ambulance) along the access route and health services due to potential increase in motor vehicle accidents. Trucking of supplies and consumables to mine will increase risk of spill of non-hazardous and hazardous materials. Project-related traffic could result in increased road wear and maintenance on the Klondike Highway and Freegold Road that provide access to the mine. The arrival of workers to the LSA will create an increase in air passenger volumes and demands on air transportation infrastructure.	Adverse
Freegold Road Upgrade and Extension	Transportation	C, O, CD	Road extension and upgrades will improve transportation infrastructure for CMC.	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

17.4.2 Identification of Mitigation Measures and Potential Residual Effects

Discussion of appropriate mitigation measures is a shared responsibility between the Proponent, the government, and the public. Governments are responsible for planning and implementing social programs and delivering public services that address social effects concerns. Individuals and families must make lifestyle decisions that are consistent with enhanced social circumstances. The Proponent needs to fulfill its commitments in hiring from within Yukon and providing competitive work packages and training when relevant. As a result, all these parties must share responsibility for social effects management for it to be effective.

Mitigation and enhancement measures that CMC identified in order to reduce potential Project's effects on Community Infrastructure and Services in the LSA include the following:

- Local fresh water supply, sewage treatment plant, and power supply will be provided at the mine site. Potable water will be sourced from groundwater wells at the mine site. The Project Water Management Plan contains detailed information on the overall mine site water management approach. A permanent waste management facility will be established at the mine site during the construction phase. The pioneer accommodation camp and surface facilities on site will be serviced by the Supplementary Power Plant located at the accommodation camp. The pioneer camp will have indoor and outdoor recreation services.
- All construction and operation activities will follow best practices and are outlined in CMC's Environmental Health and Safety (EHS) Management System. CMC will provide, at the site and the camp, health and medical equipment and personnel and will make arrangements to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA.
- Casino Mining Corporation will work closely on an ongoing basis with WGH, local fire departments, RCMP, and Yukon Ambulance to ensure that the appropriate information on the changes in area transportation volumes, mine operations, and local population are considered.
- Casino Mining Corporation will provide contracted security services that will focus on ensuring a secure and safe work site with the following policies: no alcohol or drugs on-site, a respectful workplace, no harassment, safety and security measures, multi-cultural workforce considerations, and Aboriginal awareness training.
- Casino Mining Corporation will implement a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA.
- Casino Mining Corporation will implement a procurement process that gives preferences to the extent economically feasible to suppliers from the RSA and LSA.
- Casino Mining Corporation will employ a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services planning issues related to mine staff.
- Casino Mining Corporation will monitor project socio-economic effects and will adapt management measures where required.
- Casino Mining Corporation will provide on-the-job training to assist local and regional workers to develop mining-specific skills.
- Casino Mining Corporation will provide training and education for potential employees from Yukon and in particular the rural communities within the LSA.

- Casino Mining Corporation will implement career training and development opportunities for employees once hired.
- Casino Mining Corporation will partner with First Nation communities to access additional funding for training.
- Casino Mining Corporation will require cultural awareness training for employees and contractors.
- Casino Mining Corporation will implement a Road Use Plan.
- Casino Mining Corporation will implement an Emergency Response Plan.
- Casino Mining Corporation will build a new larger airstrip close to the proposed Project and provide transportation between the airstrip, the mine, and the camp.
- Casino Mining Corporation will implement a Mine Closure Plan in cooperation with LSA communities and Yukon Government.

Given the long duration of the Project, some operations workers may choose to relocate, with their families, to the LSA. According to the population assessment, up to 645 people (619 to Whitehorse, 16 to Carmacks, 11 to Pelly Crossing) may choose to move in permanently, with their families, to the LSA. The relatively small number of migrants (0.6% of the total LSA population), the current good capacity of community infrastructure and services in Whitehorse, and the communities' desires for attracting new residents suggest that the effects on Community Infrastructure and Services will be low and within the capacity of Whitehorse. If up to 16 people choose to live in Carmacks and up to 11 people choose to live in Pelly Crossing, these workers are expected to be original residents in these communities who are returning back to their residence due to job availability and will therefore place no additional demand on community infrastructure and services. More details on proposed Project effects and their mitigation and enhancement measures per each identified indicator are available in Table 17.4-3. Table 17.4-5 includes residual effects following mitigation and their significance and Table 17.4-6 includes a summary of all residual effects.

Table 17.4-3: Proposed Mitigation Measures and Potential Residual Effects for Community Infrastructure and Services

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
The arrival of workers and their families to the LSA will create additional demand on municipal infrastructure.	C, O, CD	Adverse	Providing a fly in\fly out camp. The pioneer camp will have local water and power supply and on-site sewage treatment plant and indoor and outdoor recreation services, which will offset Project's demand for municipal infrastructure; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services/planning issues related to mine staff; Monitoring project socio-economic effects and adapting management measures where required.	Moderate	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
The arrival of workers and their families to the LSA will create additional demand on housing and temporary accommodation.	C, O, CD	Adverse / Beneficial	Implementing priority hiring for qualified local residents; Providing incentives for workers hired from outside Yukon to relocate; Employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues related to mine staff; Providing a fly in/fly out camp to partially offset Project's demands for housing services; Monitoring project socio-economic effects and adapting management measures where required.	Moderate	Yes
The arrival of workers and their families to the LSA will create additional demand on education services.	C, O, CD	Adverse / Beneficial	Providing a fly in/fly out camp; Providing support programs and initiatives at local schools and Yukon College; Implementing a Recruitment, Training, and Employment Plan; Monitoring project socio-economic effects and adapting management measures where required.	Moderate	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
Population change will alter demand for health and social services.	C, O, CD	Adverse	Providing a camp will partially offset Project's demands for regional health services; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services/planning issues related to mine staff; Monitoring project socio-economic effects and adapting management measures where required.	Moderate	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
Accidents at worksite could increase demand for regional health services and emergency services.	C, O, CD	Adverse	Requiring all construction and operation activities to follow best practices as outlined in CMC's Environmental Health and Safety (EHS) Management System; Providing, at the site and the camp, health and medical equipment and personnel as well as arrangements to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA; Providing full firefighting equipment and trained personnel to meet all on-site fire and rescue needs; Providing, at the mine site, trained mine rescue personnel and mine rescue equipment security; Monitoring project socio-economic effects and adapting management measures where required.	High	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
The arrival of workers and their families to the LSA will create additional demand on protective services.	C, O, CD	Adverse	Committing to work closely on an ongoing basis with WGH, local fire departments, RCMP, and Yukon Ambulance to ensure that the appropriate information on the changes in area transportation volumes, and the change to the local population are considered; Providing contracted security services that will focus on ensuring a secure and safe work site with the following policies: no alcohol or drugs on-site, a respectful workplace, no harassment, safety and security, multi-cultural workforce considerations, and Aboriginal awareness training; Monitoring project socio-economic effects and adapting management measures where required.	High	Yes
Traffic volumes to and from mine site would increase demand for health services and protective services (RCMP, fire department, ambulance) along the access road if accidents occur.	C, O, CD	Adverse	Developing a Materials Transport Plan and Emergency Response Plan; Controlling speed limits; Committing to perform regular vehicle maintenance and regular road maintenance to reduce risk to motor vehicle safety; Monitoring project socio-economic effects and adapting management measures where required.	High	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
The arrival of workers and their families to the LSA will create additional pressure on traffic and transportation infrastructure.	C, O, CD	Adverse	Monitoring ground and air transportation infrastructure traffic and mitigation measures; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services planning issues related to mine staff; Monitoring project socio-economic effects and adapting management measures where required.		Yes
Commuting workers from outside the LSA will create additional air passenger volumes and demands on air transportation infrastructure.	C, O, CD		Socio-economic monitoring including monitoring ground and air transportation infrastructure traffic and mitigation measures; Liaising with Whitehorse Airport authority re. Worker Transportation Plan and evaluate peak passenger/aircraft volumes; as necessary, stagger work rotation schedule to minimize airport and passenger congestion; Monitoring project socio-economic effects and adapting management measures where required.		

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
Transport of equipment, services, and materials to and from the mine site will increase traffic and the risk for motor vehicle collisions on Klondike Highway and Freegold Road that provide access to the mine. Trucking of supplies and consumables to mine will increase risk of spill of non-hazardous and hazardous materials. Project-related traffic could result in increased road wear and maintenance on Klondike Highway and Freegold Road that provide access to the mine.	C, O, CD	Adverse	Implementation of Casino Road Use Plan that includes: Adherence to posted speed limits Regular truck inspection and maintenance Signage and verbal and written notification about wildlife crossings Truck traffic communications and codes on access road Travelling in convoys in extreme winter conditions Regular inspection, maintenance, dust suppression, and snow removal on Freegold Road and extension Implementation of Emergency Response and Spill Management Plan Carriers of dangerous goods will be in compliance with all international and territorial guidelines, acts, and regulation and will carry appropriate documentation Drivers of dangerous goods vehicles will be required to be familiar with all aspects of the Emergency Response and Spill Management Plan Monitoring of ground and air transportation infrastructure traffic and mitigation measures Building a new airstrip/access road at mine site and bussing workers from airstrip to onsite camp.	High	Yes

Potential Effect	Project Phase (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure[1]	Predicted Effectiveness	Residual Effect
Construction and Operations					
Freegold Road Extension and upgrade to all weather access will improve access and motor vehicle safety to the mine site.	C, O, CD	Beneficial	A 24/7 manned security and gate at start of Freegold Road Extension to control access to permitted users	High	Yes

Notes

1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

17.4.3 Significance of Residual Effects

The criteria used to discuss residual effects are discussed in detail in Section 5, Assessment Methods and Frameworks. Table 17.4-4 outlines the seven criteria used to assess significance for the Community Infrastructure and Services VC.

Table 17.4-4: Determining Significance of Residual Effects for Community Infrastructure and Services

Criteria	Rating	VC Specific Definitions
Magnitude	Low	Effect that occurs might or might not be detectable but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represent a management challenge
Geographical Extent	Localized	Within the identified LSA
	Widespread	Outside the identified LSA
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, closure and decommissioning
	Permanent	Effects measureable post-closure
Frequency	Infrequent	Effects occur occasionally
	Frequent	Effects are continuous and consistently applied over the period
Reversibility	Reversible	Effect will return to baseline condition after operations, closure and decommissioning
	Irreversible	Effect is persistent after operations, closure and decommissioning
Context	Low Resilience	Effects operate outside of regional experience and represent a challenge to local socio-economic management institutions
	High Resilience	Effects are familiar to local socio-economic management institutions
Probability of occurrence	Low	Effects are unusual under similar circumstances and are not expected to occur with this Project

Criteria	Rating	VC Specific Definitions
	Moderate	Effects has a reasonable risk of occurring under similar circumstances or there is not currently sufficient information to assess probability
	High	Effects have consistently occurred under similar circumstances and are expected to occur with this Project

The significance of potential residual effects from the Project on Community Infrastructure and Services VC are determined based on the criteria presented above in Table 17.4-4, and summarized below in Table 17.4-5.

Table 17.4-5: Significance of Residual Effects for Community Infrastructure and Services

Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Increase in demands for municipal infrastructure that are within the current LSA capacity and approved expansion plans	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Increase in housing demands that are within the current LSA capacity and approved expansion plans	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Increase in demands for education services that are within the current LSA capacity; Project will expand education supply and enhance local qualifications	Beneficial	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Increase in demands for health services that are within the current LSA capacity	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Accidents at worksite could increase demand for regional health services and emergency services	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
The arrival of workers and their families to the LSA will create additional demand on protective services	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
The arrival of workers and their families to the LSA will create additional pressure on traffic and transportation infrastructure.	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Traffic volumes to and from mine site would increase demand for health services and protective services (RCMP, fire department, ambulance) along the access road if accidents occur	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Commuting workers from outside the LSA will create additional air passenger volumes and demands on air transportation infrastructure	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Project transportation activities will increase traffic, road wear, and risk of accidents (e.g., collisions, spills, etc.) along the access road	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Road extension and upgrades will improve transportation infrastructure	Beneficial	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

Note:

1 For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

17.4.4 Discussion of Significance

Project construction effects on community infrastructure and services are characterized as low in magnitude, local, long-term, frequent, reversible, and highly probable (Table 17.4-5).

Approximately 96% of the population effects are expected to occur in the already rapidly growing City of Whitehorse. Whitehorse grew at an annualized rate of 2.6% between 2006 and 2011; in the year of the greatest effect (2017, when noticeable effects from construction begin) total migration is expected to be only 0.6% of the total population of the city.

Given the good capacity of infrastructure and services in Whitehorse, the effects of limited increase in demand associated with in-migration are considered to be Not Significant. The housing market is able to react to new housing demand given the large number of serviced lots either already purchased by developers or available to the public and given the adequate time for the market to respond to anticipated demand. The key residual effects of the Project, following mitigation, are anticipated to be slightly increased demand for protective services (ambulance services, first responders, and police) from the movement of workers and goods to the mine during construction and operations. In addition, any injury or illness will see workers transferred to health care services in

the LSA. There will also be arrangements made to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA. These effects are considered Not Significant because of their relatively low magnitude and proposed mitigation. Finally, there will be an enhancement of workforce experience and skills base resulting from additional training provided by the Project.

The duration of population effects and therefore increases in demand for local infrastructure and services are considered to be long term. Although the rate of change in population is only noticeable in the period 2017 to 2021, the Project sustains the higher level of population over the operations phase. Similarly, transportation effects will be continuous during the construction and operation phases, with only minor seasonal changes. The sustained and continuous character of population effects and transportation effects are why these effects are characterized as frequent.

All increases in demand for infrastructure and services are reversible, since they depend on population effects and mine activities that would be reversed post-closure. Within this context, population, traffic, and additional demand for Community Infrastructure and Services would return to baseline conditions over the period approaching closure to the post-closure period.

All identified residual effects, after mitigation, will have a final impact rating of not significant, and no additional mitigation is required. Demand for Infrastructure and Services will depend on the migration/movement of people to Yukon. We have high confidence in the capacity of infrastructure and services to meet needs but only moderate confidence in the actual number of people who move to the Yukon. See Table 17.4-6 for a summary.

Table 17.4-6: Summary of Residual Effects for Community Infrastructure and Services

Potential Residual Effects	Direction	Significance	Level of Confidence (Low, Moderate, High)
Construction			
Increase in demands for municipal infrastructure that are within the current LSA capacity and approved expansion plans	Adverse	Not Significant	High
Increase in housing demands that are within the current LSA capacity and approved expansion plans	Adverse	Not Significant	Moderate
Increase in demands for education services that are within the current LSA capacity; Project will expand education supply and enhance local qualifications	Beneficial	Not Significant	High
Increase in demands for health services that are within the current LSA capacity	Adverse	Not Significant	Moderate
The arrival of workers and their families to the LSA will create additional demand on protective services	Adverse	Not Significant	Moderate
The arrival of workers and their families to the LSA will create additional pressure on traffic and transportation infrastructure	Adverse	Not Significant	Moderate
Traffic volumes to and from mine site would increase demand for health services and protective services (RCMP, fire department, ambulance) along the access road if accidents occur	Adverse	Not Significant	High

The arrival of workers from outside the LSA will create additional air passenger volumes and demands on air transportation infrastructure	Adverse	Not Significant	High
Project transportation activities will increase traffic, road wear, and risk of accidents (e.g., collisions, spills, etc.) along the access road	Adverse	Not Significant	High
Road extension and upgrades will improve transportation infrastructure	Beneficial	Not Significant	High

17.5 CUMULATIVE EFFECTS ASSESSMENT (CEA)

The effects assessment of the Project on Community Infrastructure and Services takes into consideration past and existing actions and is based on forecasts for population growth incorporating those actions. Consequently, the assessment is already cumulative in nature. This, and the lack of VC-specific effects data from potentially overlapping projects, means it is impractical to conduct a cumulative effects assessment for this VC. For these reasons, cumulative effects are not considered further in this assessment.

17.6 SUMMARY AND CONCLUSIONS

The potential effects of the proposed Project on community infrastructure and services in communities in the LSA ultimately depend on the extent to which proposed Project activities and Project-related population growth result in increased demands on those services. Different indicators were used in this assessment. Municipal Infrastructure indicators included water supply, waster/sewage treatment, landfills, power supply, and recreational facilities, and Community Services indicators included Housing, Educational Services, Health and Social Services, Protective Services, and Transportation.

The assessment concludes that most of the population increase and associated increase in demand for Community Infrastructure and Services will be concentrated in Whitehorse. The LSA communities and, in particular, Whitehorse have a good capacity of infrastructure and services and approved expansion plans (Section 17.3) that can easily accommodate the potential additional demands created by the arrival of 645 people (619 people to Whitehorse, 16 to Carmacks and 11 to Pelly Crossing). This population increase would represent 0.6% of the total LSA population. Importantly, attracting and retaining skilled residents has been identified as a priority of Yukon and local governments (Yukon Economic Development 2011, Village of Carmacks 2006). The magnitude of effects is low and represents a small change in each community population.

The key residual effects of the Project are anticipated to be slightly increased demand for protective services (ambulance services, first responders, and RCMP) from the movement of workers and goods to the mine during construction and operations. In addition, any injury or illness will see workers transferred to health care services in the LSA. There will also be arrangements made to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA. These effects are considered Not Significant because of their relatively low magnitude and proposed mitigation. Finally, there will be an enhancement of workforce experience and skills base resulting from additional training.

At closure and decommissioning, there may be some drop-off in population and demand as conditions return toward the base case.

The assessment concludes that all identified residual effects following mitigations and enhancement measures were not significant. No additional mitigation is required.

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18 – CULTURAL CONTINUITY

18.1 INTRODUCTION

18.1.1 Regional Setting

The Project is located approximately 300 km northwest of the City of Whitehorse, Yukon Territory on Crown land that is administered by the Yukon Government. The Regional Study Area (RSA) for the Cultural Continuity VC includes the Selkirk First Nation (SFN) and Little Salmon/Carmacks First Nation (LSCFN) traditional territories. The Yukon River is located approximately 20 km north of the Casino mine site.

18.1.2 Rationale for VC Selection

The Cultural Continuity VC assesses the potential effects of the Project on the ability of a community or individual to sustain their cultural identity through having access to resources that support cultural retention and opportunities to participate in cultural activities. This VC was deemed important from consultation with local First Nation and other regional residents. For example, practicing culture may include participating in local community events, speaking a local language and participating in traditional land uses such as hunting and fishing. Resources that support cultural retention would include preservation of historical places, museums, and provision of language programs in schools. Cultural identity is based on shared behaviours, practices, beliefs, and values of a community that are gained over time.

From an Aboriginal perspective, maintaining cultural identity requires the use of land for harvesting traditional resources, opportunities to transfer traditional knowledge and skills, and speaking the local language. From a Yukon or northern lifestyle perspective, recreational hunting, fishing, and gathering are culturally important. This is evident from the high proportion of Yukon residents participating in subsistent and recreational hunting. In many cases, baseline data about land uses (e.g., hunting) were not differentiated between First Nation and non-First Nation land users. This VC is therefore representative of the broader culture practiced by all Yukon residents using the Project area as part of their culture. Where differences exist between the two, these differences are noted in the text.

The Cultural Continuity VC will specifically assess the following VC indicators:

- Language – from the standpoint of potential Project effects on the use of local First Nation languages;
- Places of historical, cultural, and archaeological value – from the standpoint of potential Project effects on places that are protected by the Yukon Government, or are considered important to local communities for retaining cultural identity;
- Social, community, and cultural events – from the standpoint of potential Project effects on participation in events that are considered important to retaining cultural identity;
- Subsistence and recreational harvesting – from the standpoint of potential Project effects on recreational and subsistence hunting, trapping, fishing, and plant harvesting; and
- Traditional knowledge – from the standpoint of potential Project effects on conveying or acquiring traditional environmental knowledge.

The rationale for the selection of the Cultural Continuity VC was based on available information compiled in the Socioeconomic Baseline Report (Appendix 13A) and Land Use and Tenure Baseline Report (Appendix 19A) as well as other published sources. Subsequent to the review of baseline information, including information received

during consultation activities and an assessment of the potential for impact, the above-identified VC indicators were selected. The VC indicators were validated through a consideration of the proposed issues (in the context of baseline conditions), a review of the Project Description (Section 4), and consideration of identified stakeholder and First Nation concerns. Potential concerns and issues associated with the Cultural Continuity VC were identified through consultation with the following groups:

- Territorial and federal government agencies;
- Local government representatives;
- First Nations; and
- General public and other stakeholders.

Traditional Knowledge

Traditional knowledge (TK) is gained and shared through oral communication and practicing Aboriginal traditional land uses and ceremonies. Traditional Ecological Knowledge (TEK) is defined using Usher's TEK category 1 and 2 TEK or TK. which is considered factual or rational knowledge about the environment and about past and current use of the environment (Usher 2000).

Information about wildlife, climate, plants, hydrology, and many other topics are included in TK. It is generally considered to be the body of knowledge of a people, often transmitted through oral means, about the land and natural resources that they use. TK information that is provided to developers is typically included in relevant sections of an impact assessment (such as this Proposal) or other development planning documents. Generally, TK adds to the robustness of western science. Recorded TK may also be useful in a general sense in the identification of indicator species for VCs.

Traditional Land Use

Traditional Land Use (TLU) is generally defined as an Aboriginal community's practice of their Aboriginal and Treaty rights. Information on TLU is usually provided by Aboriginal people with consent through interviews and workshops, and summarized in a TLU study report. These reports provided by Aboriginal communities are generally used as the main source of TLU information for an impact assessment, to be supplemented if required by other published sources of traditional use information. Information on modern TLU (such as plant harvesting, hunting, and trapping) is provided in a TLU report, as well as information on cultural sites and activities.

In this case, a TLU and/or TK study has not been completed for the Project. Offers of funding and capacity support to complete a TLU and/or TK study by CMC were declined. Secondary sources were used to compile the baseline provided in the Socioeconomic Baseline Report (Appendix 13A) and the Land Use and Tenure Baseline Report (Appendix 19A). Information about potential effects on TLU and/or TK were also gleaned from: *Opening the Land: A study of the impacts of the Casino Trail on the Northern Tutchone of Pelly Crossing and Carmacks, Yukon Territory (1988)*. This document was recommended to CMC by the SFN as relevant source of information. Many of the predicted effects in this section of the Proposal are therefore necessarily based on secondary data and should be verified through consultation with the LSCFN and SFN.

The ability of a community to continue to convey or acquire TK is tied to the ability of that community to practice TLUs, to speak their own language, to visit and use sites of historic/cultural importance and to participate in community, social, and cultural events. An assessment of potential Project effects on the ability to transmit or obtain TK is therefore reliant on the potential effects of the Project to these other VC indicators.

It should be noted that there is overlap between the effects assessment on hunting, trapping, and fishing in this section and in Section 19 (Land Use and Tenure). The latter is meant to be a general overview of potential effects on First Nation Settlement lands and this section of the Proposal is meant to provide more details on traditional harvesting, if appropriate, and tie the VC indicators into predictions of potential effects on cultural continuity.

18.2 ASSESSMENT BOUNDARIES

18.2.1 Spatial Boundaries

18.2.1.1 Local Study Area

The Local Study Area (LSA) for the assessment of the Cultural Continuity VC depends on the VC indicators assessed. For the VC indicators of language, and social, community and cultural events, the LSA includes the following communities closest to the Project site and the transportation route (Figure 13.1-1):

- Community of Pelly Crossing and SFN;
- Village of Carmacks and LSCFN; and
- City of Whitehorse.

The people living in Pelly Crossing and Carmacks are primarily members of the SFN and LSCFN whose traditional territories overlap with the LSA and RSA for the effects assessment and who would therefore have the greatest potential for their cultural continuity to be affected by the Project. The City of Whitehorse is included in the LSA due its importance as the Yukon capital and its role in providing cultural activities to its residents (17% of who are Aboriginal identity), the surrounding regional residents and visitors.

The spatial scale (LSA) used to describe effects on VC indicators that are related to land uses such as: places of historical, cultural and archaeological value, TK, and subsistence and recreational harvesting is identical to that used for the Land Use LSA (Figure 19.2-1). This LSA is comprised of a 500-m buffer around the entire Project footprint.

18.2.1.2 Regional Study Area

Similar to the LSA, the regional spatial scale used to determine cumulative effects will depend on the VC indicator assessed. For the language and social, community and cultural events, the RSA comprises Yukon and provides a broader geographic context for understanding how Project and other future foreseeable projects in the region could affect these cultural continuity indicators. For places of historical, cultural, and archaeological value, TK, and subsistence and recreational harvesting the Land Use RSA are used. This RSA is based on defined Game Management Areas (GMAs) and provides a representative buffer around the Land Use LSA that overlaps land uses potentially indirectly affected by the proposed Project. Information collected and summarized for the Land Use RSA is used to develop the list of other projects and activities occurring proximate to the proposed Project that may overlap temporally and spatially with potential Project effects. This information is incorporated into the cumulative effects assessment.

The temporal boundaries for the effects assessment is defined in Section 5.2 as the life of the Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project is provided in Section 4.

18.3 BASELINE CONDITIONS

Baseline conditions are provided in the sections below for the following indicators selected to assess potential effects on the Cultural Continuity VC:

- Language;
- Places of historical, cultural, and archaeological value;
- Social, community, and cultural events;
- Subsistence and recreational harvesting; and
- Traditional knowledge (transmission and retention).

Additional information about the baseline conditions with respect to Cultural Continuity is located in Appendix 13A: Socioeconomic Baseline Report.

18.3.1 Language

Within the LSA, the Aboriginal identity population comprises the majority of residents of Pelly Crossing (91%) and Carmacks (76.5%) and a smaller percentage of residents in Whitehorse (17%). Knowledge of or the ability to conduct a conversation in an Aboriginal language is considered a key indicator of cultural continuity. It is one reflection of the integration of culture into daily life and the continuance of culture from generation to generation.

The SFN and LSCFN are part of the Northern Tutchone and Athapaskan language group. Knowledge of an Aboriginal language varies throughout the LSA communities with residents of Carmacks being the most likely to have knowledge of an Aboriginal language. In 2006, 32% of Aboriginal residents in Carmacks reported knowledge of an Aboriginal language, compared to 7% in Whitehorse and 25% in Pelly Crossing. The percentage of the Aboriginal population in Carmacks, Whitehorse, and Yukon as a whole who speak an Aboriginal language at home decreased between 2001 and 2006. The Census data related to language were unavailable for Pelly Crossing in 2006 and therefore it is not known whether or not the knowledge and use of an Aboriginal language has decreased or increased in this community.

Across Canada, the loss of Aboriginal languages is the trend and norm for a variety of reasons including the residential school experience. The loss of the Northern Tutchone language and traditional practices were noted as concerns by community representatives. There are current efforts underway, particularly in Pelly Crossing and Carmacks, to revitalize and increase the use of the Northern Tutchone language. These efforts include the integration of Northern Tutchone culture and beliefs within the school curriculum and the development of booklets on Northern Tutchone history and culture by Tutchone elders (LSCFN 2013 pers. comm.; Tantalus 2013 pers. comm.). For SFN and LSCFN, language training is a key element of this integrated approach to culture.

18.3.2 Places of Historical, Cultural, and Archaeological Value

Places of historical, cultural, and archaeological value have been identified through archaeological and heritage investigations of the Project area, engagement with Aboriginal communities, and public and government consultation efforts and are considered an indicator of cultural continuity. The Project area has a recorded history of access for mining purposes dating back to 1917. Studies conducted in the Project area have identified historical and archaeological sites, namely Britannia Creek, Patton Gulch, and Patton Hill.

The Casino mine site footprint falls within the SFN traditional territory. Within the mine footprint area, there are a total of 11 archaeological sites and 19 historic sites, identified between 1994 and 2013. Of these sites, additional

exploratory excavations were undertaken at six sites to determine the type of archaeological resource and appropriate mitigation measures for each site. Five of the six sites were intact and undisturbed and the sixth was inadvertently disturbed by construction activities related to the upgrading and re-alignment of the Britannia Creek Road. All six sites are being protected from further disturbance by 'no work zone' tape around each site with a 30 m buffer. The Yukon Heritage Unit recommends these and the other 19 historic sites for avoidance pending review of the Heritage Resources Impact Assessment (HRIA) final report. If effects cannot be avoided, then staged archaeological mitigation of the archaeological sites and recording and archival research of the 19 historical sites are recommended. A Stage 1 Archaeological Mitigation Report for the Casino mine site is included as Appendix 18A of the Proposal.

The Freegold Road Upgrade and Freegold Road Extension fall within the SFN and LSCFN traditional territories. With respect to the Freegold Road Upgrade and Freegold Road Extension, heritage resource assessments identified five historic sites (e.g., log cabins, caches, pits) located along the Freegold Road Extension, within proposed borrow pit locations, and within the Freegold Road Upgrade realignment between kilometre 33 and kilometre 66 (Ecofor 2013). A Historic Resource Impact Assessment of the Freegold Road is included as Appendix 18B of the Proposal. The Yukon Heritage Unit recommends these five historic sites for avoidance pending review of the final report. If impacts are unavoidable for the area of any of the remaining sites, then review of proposed impacts and possible mitigation measures need to be discussed with the Yukon Heritage Resources Unit.

The Freegold Road Extension will generally follow the Casino Trail. The Casino Trail is a historic trail that has provided access into the Dawson Range for subsistence harvesting and travel, and historically, provided access to Fort Selkirk via a connecting trail (Dalton trail) for trading and cultural events. Fort Selkirk overlaps the northern edge of the RSA; it is a historic trading post along the Yukon River. Prior to establishment of Fort Selkirk for trading purposes, the Northern Tutchone people lived and gathered there for hunting and fishing activities as well as feasts and potlatches. Fort Selkirk is a heritage site and continues to be a culturally important place to the Northern Tutchone people.

The following areas are located outside the RSA (Figure 19.2-1) but are culturally important to the Northern Tutchone people:

- Ddhaw Ghro Habitat Protection Area, previously known as the McArthur Wildlife Sanctuary, is a habitat preserve (including a sacred healing place, hot spring) that was created to encourage conservation and support SFN harvesting practices;
- Lhutsaw Wetland Habitat Protection Area is an important wetland complex that was designated a habitat preserve to encourage conservation and support SFN harvesting practices;
- Ta'Tla Mun Special Management Area is an important food fish lake that was designated a habitat preserve to encourage conservation and support SFN harvesting practices; and
- Nordenskiold (Ts'awnjik Chu) Habitat Protection Area is a major wetland complex that was designated a habitat preserve to encourage conservation and support LSCFN harvesting practices.

To date, the only known spiritual or aesthetic location identified for the Project is the Yukon River (AECOM, 2009).

18.3.3 Social, Community, and Cultural Events

The LSA communities of Carmacks, Pelly Crossing, and Whitehorse are active with respect to hosting social, community, and cultural events. In Carmacks and Pelly Crossing, these occasions are wide-ranging and include numerous cultural events, which are based upon and promote the Northern Tutchone culture. Stick gambling, a

traditional game, remains popular in both Carmacks and Pelly Crossing, as do potlatches and other community cultural activities. Both communities enjoy sport-related events and host checkpoints along the 1,600 km Yukon Quest International Sled Dog Race that runs between Whitehorse and Fairbanks, Alaska. Interviews with community representatives from LSCFN have indicated that attendance at social and community events has decreased.

Whitehorse hosts and sponsors numerous community events throughout the year for residents and surrounding communities. Whitehorse maintains a vibrant arts and cultural community with many active arts groups and cultural facilities, including museums, historical archives, and performing arts theatres. It also serves as the starting point for the annual Yukon Quest International Sled Dog Race.

18.3.4 Subsistence and Recreational Harvesting

Most Yukon First Nations have a Final Agreement in place that set out harvesting rights. First Nation members can give, trade, barter, or sell meat or fish obtained through their subsistence rights with other beneficiaries of the Final Agreements or of adjacent Trans-boundary Agreement for domestic purposes but not for commercial purposes (meat and fish cannot be traded or sold to non-First Nation people).

The development of hunting and the traditional economy have been identified by the SFN as a priority (SFN 2011) and many members obtain a significant portion of their food supply through this means (Yukon Community Profiles 2004a). Similarly, the LSCFN's Integrated Community Sustainability Plan identifies subsistence hunting, fishing, and trapping as a way of life for their membership (Inukshuk Planning and Development, 2007).

18.3.4.1 Hunting

Hunting in the Yukon is both a subsistence and recreation activity and regulated under the *Wildlife Act* through Environment Yukon, which oversees permitting for hunting. Within the Project area, there are seven Game Management Areas (GMAs), which are legal boundaries for the regulated management of big game. First Nations do not require hunting licenses to harvest within their traditional territory where a Final Agreement is in place; however, to hunt on another First Nation's traditional territory, members require a license or written consent from that First Nation. Outside of traditional territories, or where Final Agreements are not in place, First Nation members require a valid license to hunt.

Harvested meat can have a high replacement cost value for First Nation households, and the subsistence harvesting activities represent an invaluable cultural and traditional experience for First Nation harvesters and a meaningful recreational pursuit (AECOM 2009).

18.3.4.2 Trapping

Trapping in the Yukon is regulated under the *Wildlife Act* by the Yukon Environment Provisions for management and use of wildlife, including trapping can also be found in the Yukon First Nation Land Claims Umbrella Final Agreement (including individual First Nation Final Agreements) (Council of Yukon First Nations, 1990). There are 333 registered trapping concessions, which are land parcels on which the holder is granted the rights to harvest fur-bearing animals. There are also 18 group areas, which are typically held by a family or First Nation.

Traditionally, trapping is an important part of the First Nation lifestyle, providing economic and subsistence benefits. An estimated 50% of Yukon trappers are First Nation (Environment Yukon 2013a). Within the RSA there are 30 registered trapping concessions; with 11 overlaps (Geomatics Yukon 2013). Traplines in the Project area are remote and access to the traplines can be time-consuming and costly (Registered Trapline Holders 2012 pers. comm.).

18.3.4.3 Fishing

Fishing in the Yukon is regulated by the Canadian government under the *Yukon Territories Fisheries Regulations*. Environment Yukon oversees the permitting. Similar to hunting, First Nations do not require fishing licenses to harvest within their traditional territory where a Final Agreement is in place; however, to fish on another First Nation's traditional territory, members require a license or written consent from that First Nation. Outside of traditional territories, or where Final Agreements are not in place, First Nation members require a valid license to fish. Salmon fishing in fresh waters is regulated through the Department of Fisheries and Oceans Canada.

SFN and LSCFN members are highly involved in salmon fishing; however, salmon populations are declining and in 2012, local residents were advised to reduce the catch of salmon (LSCFN 2013).

18.3.4.4 Plant Harvesting

Northern Tutchone people traditionally relied on plant gathering and harvesting as sources of food, medicine, and construction materials depending on their seasonal availability. This included birch bark and sap for canoe and basket construction; berries and other edible plants for medicinal purposes; and stones, copper, birch bark, and spruce roots for tools and utensils.

18.3.5 Traditional Knowledge and Traditional Use

To date, no Project-specific TK and/or TLU studies have been conducted. Discussions with SFN identified a lack of capacity within the community to conduct a TK and/or TLU study (SFN pers. comm. 2012); discussions between the SFN and CMC have continued and it is anticipated that a study may be conducted sometime in the future. Discussions with LSCFN have indicated that a TK and/or TLU study may be considered after the Proposal submission has been made and the community have had an opportunity to review the predicted Project effects (LSCFN pers. comm. 2013).

The RSA is primarily situated in the SFN and LSCFN traditional territories; these First Nations have historically lived in the Project area. The First Nations signed Final and Self-Government Agreements with the governments of Yukon and Canada in 1997 and 1998, respectively (SFN, Government of Canada and Government of Yukon 1997; LSCFN, Government of Canada and Government of Yukon 1998).

SFN and LSCFN are members of the Northern Tutchone, and as such, carry out similar traditional activities in varying parts of their respective territories. Traditional use of fish, wildlife, and plant species were managed to ensure population sustainability. Changes in activities, such as rotation or relocation, within the traditional territories were made to manage population availability and regeneration. Traditional activities continue to play an important role in providing food, medicine, and materials as well as supplementing income and store-bought foodstuffs/materials. There is an inter-relationship between the traditional (bush economy) and non-traditional (cash economy) economies with the latter helping to fund traditional activities. Distant areas within the traditional territory are important to First Nations; however, the high costs associated with accessing these distant areas limit traditional usage. First Nations access these distant areas when population numbers are high and there is an increased demand.

Originally, SFN people lived in the vicinity of Fort Selkirk where they had a trading relationship with the Coastal Tlingit and would meet to trade during summer fish camps (SFN 2013; Yukon Bureau of Statistics 2013a; Pearse and Weinstein 1988). SFN people settled there on a more permanent basis after the fur-trading fort was built, and continuing to hunt, trap, fish, and gather year-round in their traditional areas. SFN people moved to Minto with the construction of the Klondike Highway and later on, settled in Pelly Crossing and other communities. Traditionally, they relied on the land and one another for survival, travelling by foot over long distances for hunting, trading, and

celebrations (SFN 2013). Culture, traditions, customs, and survival skills were passed to children, who learned by listening and practicing. Members maintains strong links to hunting with many members obtaining a significant portion of their food supply through this means (SFN 2013)

The LSCFN traditional territory is rich in renewable and non-renewable resources. Their people lived on the land, using the rich supply of game animals, fish, birds, and plants, and travelled throughout their traditional territory during the year. The oral history of the LSCFN reveals early contacts and trade relationships with explorers and traders in the area.

Hunting, trapping, fishing, and gathering remain important traditional activities for First Nations throughout the year. Hunting, fishing, and gathering are now practiced more frequently than trapping. Caribou was once the principal food source hunted, but as their populations declined, moose became increasingly important and is now the major food source hunted (McClellan 1981). The First Nation communities are concerned that the Freegold Road Upgrade and Extension along with the increase in mining-related activity could affect the habitat and populations of wildlife and fish, and therefore, the First Nations' traditional use of these special places (ibid).

18.4 PROJECT-SPECIFIC EFFECTS

The following discussion summarizes how the Cultural Continuity VC could be affected by the Project in each of the four Project phases.

18.4.1 Project Interactions and Potential Effects

18.4.1.1 Project Components/Activities and Potential Interactions with VC Indicators

Potential interactions between the Project components and the Cultural Continuity VC indicators are described below and summarized in Table 18.4-1. Project components and activities that may directly or indirectly affect Cultural Continuity VC indicators during the Project construction, operation, decommissioning and closure, and post-closure phases include:

- Maximum Disturbance Area;
- Traffic;
- Reclamation and re-vegetation (associated with closure); and
- Employment.

The list of Project components and activities considered was derived from the Project Description (Section 4) and the potential interactions discussed below.

Table 18.4-1 Potential Interactions between the Project and Cultural Continuity

Project Components and Activities	**Project Phase[1]** (C, O, DC, PC)	**Potential Interaction** (Y/N)	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	No	Included in Maximum Disturbance Area
Aggregate Sources/Borrow Sites	C,	No	Included in Maximum Disturbance Area
Airstrip and Airstrip Access Road	C, O, CD,	No	Included in Maximum Disturbance Area

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O,	No	Included in Maximum Disturbance Area
Concentrate Transport and Loading	O,	No	Included in Maximum Disturbance Area
Concrete Batch Plant Operation	C, O,	No	Included in Maximum Disturbance Area
Contracted Employment	C, O, CD,	Yes	Change in opportunities to participate in cultural activities
Cyclone Sand Plant	C, O,	No	Included in Maximum Disturbance Area
Dismantling of Facilities	CD,	No	Included in Maximum Disturbance Area
Diversion of Canadian Creek	C, O,	No	Included in Maximum Disturbance Area
Drilling and Blasting	C, O,	No	Included in Maximum Disturbance Area
Fish Habitat Compensation Construction	C, O,	No	Included in Maximum Disturbance Area
Freegold Road Extension	C, O, CD,	Yes	Change (direct loss/disturbance) in area; Change in access to area; Change in local ambience due to Project footprint; Change in abundance of plant/animal resources available for harvesting
Freegold Road Upgrade	C, O, CD,	Yes	Change (direct loss/disturbance) in area; Change in access to area; Change in local ambience due to Project footprint; Change in abundance of plant/animal resources available for harvesting
Fuel Storage and Distribution System	C, O,	No	Included in Maximum Disturbance Area
Gold Extraction Plant/Oxide Ore Processing	C, O,	No	Included in Maximum Disturbance Area
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C,	No	Included in Maximum Disturbance Area
Hazardous Materials Storage, Transport, and Disposal	C, O,	No	Included in Maximum Disturbance Area
Heap Leach Facility	C, O,	No	Included in Maximum Disturbance Area
Heap Leach Pad	C, O,	No	Included in Maximum Disturbance Area
Laydown Areas	C, O,	No	Included in Maximum Disturbance Area
LNG Transport to site	C, O,	No	Included in Maximum Disturbance Area
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O,	No	Included in Maximum Disturbance Area
Maximum Disturbance Area	C, O, CD,	Yes	Change (direct loss/disturbance) in area; Change in access to area; Change in local ambience due to Project footprint; Change in abundance of plant/animal resources available for harvesting

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Y/N)	Mechanism of Interaction (or Rationale for No Interaction)
Mine Development	C, O, CD,	No	Included in Maximum Disturbance Area
Mine Staffing	C, O, CD,	Yes	Change in opportunities to participate in cultural activities
On-site equipment and vehicle use	C, O, CD,	No	Included in Maximum Disturbance Area
Open Pit Mining	C, O,	No	Included in Maximum Disturbance Area
Ore Conveyors	C, O,	No	Included in Maximum Disturbance Area
Ore Crushing	C, O,	No	Included in Maximum Disturbance Area
Ore Hauling	C, O,	No	Included in Maximum Disturbance Area
Ore Stockpiles	C, O,	No	Included in Maximum Disturbance Area
Processing Facilities for Sulphide Ore	O,	No	Included in Maximum Disturbance Area
Reagent Storage and Distribution	C, O,	No	Included in Maximum Disturbance Area
Site Reclamation / Re-Vegetation	O, CD,	Yes	Change (direct loss/disturbance) in area; Change in access to area; Change in local ambience due to Project footprint; Change in abundance of plant/animal resources available for harvesting
Site Security and Fencing	C, O, CD,	No	Included in Maximum Disturbance Area
Surface Water Management (Contact Water)	C, O, CD,	No	Included in Maximum Disturbance Area
Surface Water Management (Non-Contact Water)	C, O, CD,	No	Included in Maximum Disturbance Area
Tailings Management Facility	C, O, CD,	No	Included in Maximum Disturbance Area
Topsoil Stockpiles	C, O,	No	Included in Maximum Disturbance Area
Traffic (Equipment and Materials to Site)	C, O, CD,	Yes	Change in local ambience; Change in abundance of plant/animal resources available for harvesting
Waste Management: garbage and sewage waste facilities	C, O,	No	Included in Maximum Disturbance Area
Waste rock and Overburden Disposal	C, O,	No	Included in Maximum Disturbance Area
Water Supply	C, O, CD, PC	No	Included in Maximum Disturbance Area

Note:

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

Maximum Disturbance Area

- Interaction: Change (direct loss or disturbance) in area

Due to the Maximum Disturbance Area, the potential exists for a direct loss or disturbance of areas, plant and animals within the maximum disturbance area that may be used for cultural activities or for cultural purposes (such as subsistence hunting). This effect would occur in construction, operation, and closure and decommissioning phases and to a lesser extent in the post-closure phase. Project components and activities that contribute to this potential loss or disturbance include: clearing and preparing the mine site area; building the Project components (such as accommodations and ancillary buildings, fuel storage, processing facilities, surface water management facilities, water pipeline, airstrip and airstrip access road); development of stockpile areas for overburden, topsoil, waste rock and ore; open pit; and TMF. During the post-closure phase, most of the area will be reclaimed and the area could potentially be used for cultural activities and support resources used for cultural purposes. The Project will create new wetlands that may be available for future use, post closure.

The Freegold Road Upgrade will primarily follow the existing Freegold Road. Construction of the Freegold Road Upgrade will include a combination of cut and fill activities and overlanding. Cut and fill construction will involve excavating suitable material and placing it to construct the road embankment. Overlanding will be used through areas of low-lying wetlands and areas of permafrost, and will involve the placement of suitable embankment material over organic material. Borrow pits will be required as a source for embankment and road surfacing material. The maximum disturbance area includes the required borrow pits and laydown areas, which will be located along the Freegold Road Upgrade corridor within the Land Use LSA. Borrow pits will be progressively decommissioned when they are no longer needed by grading, restoring natural drainage patterns and re-vegetating. Where the Freegold Road Upgrade does not follow the existing road, in order to achieve design criteria, the potential effect would be a loss of area that may be used for cultural activities or to support resources used for cultural purposes. This effect would be experienced in the construction, operation and active phases of closure of the Project.

The Freegold Road Extension will mostly follow the existing Casino Trail that has been used intermittently for over 30 years to service the Project site and historically (and potentially currently), to access cultural sites (such as Fort Selkirk, and traditional harvesting areas such as the Dawson Range, Nansen, and Freegold areas as well as the mouth of Big Creek, and SFN traditional territory). Prior to the construction phase, the existing Casino Trail has provided limited access for equipment and fuel during the winter months as a winter road. It is anticipated that the construction will occur over a four-year period and be complete prior to the Operation Phase. Initially, a “first stage road” will be developed along the alignment to provide a single lane, low speed, access route from Carmacks to the mine site for fuel and materials and to mobilize heavy equipment required for construction. Construction activities for the first stage road will include limited clearing and grubbing, bridge construction and limited earthmoving.

The Freegold Road Extension will provide a route between the mine site and the Village of Carmacks, which allows for transportation to and from Whitehorse, the Port of Skagway, and Fort Nelson. The Freegold Road Extension will be a 120 km long, two-lane, gravel resource road designed for all-weather use by haul trucks with highway legal loads and will support the level of traffic anticipated with year-round haulage of materials. A new alignment is required along the extension of Freegold Road in areas where the existing Casino Trail does not support design criteria. CMC intends to work with First Nations to ensure that any change in access formerly provided by the Casino Trail for cultural purposes is mitigated by a road use agreement for the Freegold Road Extension.

- Interaction: Change in access to area

Access to the Casino Mine Site will be restricted throughout the Project life and potentially limit access to areas that may have been historically used by First Nations to practice cultural activities. A security gate will be located

at the entrance to the Casino mine site and another security gate may be installed on the existing access road that generally follows the water pipeline. The effect of limiting access to the Project site will occur throughout the life of the Project and be reversed in the post-closure phase.

During the construction phase of the Freegold Road Upgrade, it is anticipated that access will be limited due to periodic road closures due to weather, requirement for repairs or others factors as may be required. The schedule and duration of closures will be determined as the Project proceeds, and whenever possible, one lane will remain open. These temporary closures may negatively affect access to areas that may be used for cultural activities.

The Freegold Road Upgrade will result in improved access after construction due to improved safety design of the road. The improvement will be experienced during the Operation Phase through the post-closure phase for individuals using the road for non-mining purposes north of Carmacks to kilometre 106.

Access along the Casino Trail will be limited once construction of the Freegold Road Extension commences to ensure safety of workers and the public. Conflicts with construction traffic may occur and gated access to the mine site at Big Creek will be implemented. Traffic allowed past the security gate will primarily be limited to mine site traffic and negotiated with permitted land users. It is the intent of CMC to negotiate a Freegold Road Extension Access Management Agreement with the Yukon Government, SFN and LSCFN. This agreement will address how the private road and access control could be managed to meet the Project requirements with consideration of existing tenure holders and individuals. Periodic, short-term road closures may be required. The schedule and duration of these road closures will be determined as the Project proceeds, and whenever possible, one lane will remain open. The Freegold Road Extension may facilitate easier and year-round access (compared to the Casino Trail which currently offers limited winter access to some areas) to relatively remote areas for some permitted users. This effect would last in all Project phases. Public access will not be allowed. This effect would be reversed in the post-closure phase when the Freegold Road Extension is removed and re-vegetated.

- Interaction: Change in local ambience

The local ambiance in the environment surrounding the maximum disturbance area, which includes the Freegold Road corridor and airstrip (and associated traffic), will be disturbed by emissions and noise from mine site vehicles and construction equipment, aircraft and the corresponding change in the landscape. This could detract from the area from being used for cultural activities and harvesting. This effect is expected to occur throughout the life of the Project and be reversed in the post-closure phase.

- Interaction: Change in abundance of plant/animal resources available for harvesting

For resources (such as plants, wildlife, fish) that are used for cultural purposes (such as subsistence hunting), there is a potential for a direct loss of resources or disturbance of a resource's habitat resulting in their relocation due to the Maximum Disturbance Area. This effect is expected to occur throughout the life of the Project and be reversed in the post-closure phase.

<u>Traffic (Equipment and Materials to/from Site)</u>

- Interaction: Change in local ambience

Construction along both the existing Freegold Road Upgrade and Extension will change the local ambiance due to increased vehicle traffic and associated emissions and noise. This effect is expected throughout the life of the Project and be reversed in the post-closure phase. As noted previously, during the construction phase, sections of the Freegold Road Upgrade and Extension will have traffic limitations.

- Interaction: Change in abundance of plant/animal resources available for harvesting

Increased traffic along the Freegold Road Upgrade and Extension will increase potential for wildlife mortality and dust deposition on adjacent plants. These effects could reduce the abundance or availability for subsistence hunting, and limit areas where culturally important plant species are harvested. Though there is expected to be no public recreational hunting from the Freegold Road Extension. These effects are expected throughout the life of the Project and be reversed in the post-closure phase when the Freegold Road Extension will be decommissioned.

Reclamation and Re-vegetation

- Interaction: Change (direct loss/disturbance) in area

The majority of the Maximum Disturbance Area will be reclaimed and re-vegetated during the post-closure phase. The Freegold Road Upgrade will remain in place, whereas the Freegold Road Extension will be reclaimed and re-vegetated.

- Interaction: Change in access to area

The majority of the Maximum Disturbance Area will not have access restrictions post closure; however, two areas (the open pit and TMF) will be modified which may restrict or change cultural uses. As well, increased accessibility associated with the Freegold Road Extension will end with the decommissioning of this section of the corridor.

- Interaction: Change in local ambience

Areas previously experiencing negative effects due to Project noise, emissions or traffic will cease to be disturbed during the closure/decommissioning and post-closure phases. This may increase the desirability of the area for cultural activities.

- Interaction: Change in abundance of plant/animal resources available for harvesting

The removal and re-vegetation of the Freegold Road Extension will eliminate the potential for wildlife mortality and dust deposition on adjacent plants due to traffic. These effects could increase the abundance or wildlife available for subsistence and recreational hunting and increase areas where culturally important plant species could be harvested. However, two areas (the open pit and TMF) will remain inaccessible for plant/animal resources habitat and associated harvesting.

Employment

- Interaction: Change in opportunities to participate in cultural activities

The Project is expected to employ an average of approximately 140 Yukon-based personnel during the during the last 3 years of the construction phase, approximately 470 personnel during the first 5 years of the Operation Phase (and progressively decrease over the remaining 18 years of operations), and a small fraction of the Operation Phase workforce in the decommissioning and closure phase. Limited workforce will be required for the post-closure phase due to limited activities associated with monitoring and inspection. Laborers and contractors are expected to be sourced locally, as much as possible (estimated average of 75% during the first 5 years of the Operation Phase), and is expected to have a positive effect (increase) on employment in the RSA communities. Due to employment time commitments, this could result in less time available for participation in cultural activities and events such as subsistence or recreational harvesting, potlatches and the like; however, it could provide the necessary economic resources to enable participation. The primary language that will be used at the Project site will be English, which could negatively affect cultural continuity through less exposure to Aboriginal languages.

These effects would be expected through the life of the Project and potentially into the post-closure phase as well if there has been no exposure to traditional language.

18.4.1.2 Summary of Potential Effects on VC Indicators

The following discussion summarises the potential effects (interactions) on the indicators selected for the Cultural Continuity VC in each of the four development phases using the information summarized in Table 18.4-2. Potential Project effects are primarily associated with the following issues:

- Change (direct loss/disturbance) in area;
- Change in access to area;
- Change in local ambience;
- Change in abundance of plant/animal resources available for harvesting;
- Change in opportunities to participate in cultural activities; and
- Change (direct loss/disturbance) in area.

The following indicators were used to assess the potential effect that the Project may have on the availability of area for the Cultural Continuity VC:

- Places of historical and archaeological value; and
- Subsistence and recreational harvesting.

Places of Historical and Archaeological Value

HRIA final reports have been submitted to the Yukon Heritage Unit. The potential effects associated with places of historical, cultural and archaeological value include the disturbance or destruction of these places.

Subsistence and Recreational Harvesting - Hunting

During the construction, operations, and closure/decommissioning phases, areas used for hunting that overlap with the Maximum Disturbance Area may be unavailable for subsistence and recreational harvesting. This affects 21,299.9 ha (.5%) of the SFN traditional territory, 1,280.1 ha (0.3%) of the SFN traditional territory, which is SFN Category A Land. The Maximum Disturbance Area also effects 8,757.6 ha (.4%) of the LSCFN traditional territory, 2692.8 ha (1.0%) of the LSCFN traditional territory, which includes overlaps of 2,570.0 ha (1.6%) of their Category A Land and 122.8 ha (0.1%) of their Category B Land.

During the post-closure phase, most of the mine site (with the exception of the open pit and TMF) and the Freegold Road Extension will again be available for hunting.

Hunting of caribou is presently limited to only one male animal in GMAs overlapping with portions of the Project site (522 – 526) and closed in 509-511 nearest to the proposed mine site. The GMAs that would be accessible to hunters for hunting moose (one of the most important food sources and sport-hunting species in Yukon) from the Freegold Road Upgrade (GMAs: 522–524, and 526) have been closed to licensed moose hunting since 1987. GMAs 509–511 are closest to the mine site and have historically had relatively low levels of moose harvest (≤1 moose harvested per year). The effects on other big game species resulting from habitat loss (Section 12) were assessed as not significant (Section 12).

Related potential effects are covered in separate sections, covering wildlife (Section 12), fish and aquatic (Section 10), vegetation (Section 11), and Land Use and Tenure (Section 19).

Subsistence and Recreational Harvesting – Trapping

The effects on trapping concessions are documented in the Land Use and Tenure effects assessment (Section 19). The effects are determined to be not significant during any of the Project phases.

Subsistence and Recreational Harvesting – Fishing

During the construction, operation, and decommissioning and closure phases, there are no popular fishing destinations that overlap with the Maximum Disturbance Area. Portions of Big Creek, which was historically and could still be used for fishing, overlap with the LSA adjacent to the Freegold Road corridor but will not be overprinted by it (bridge crossings will be constructed over the creek). Project effects on Big Creek and the sport/subsistence fish within it are documented in the Fish and Aquatic Resources effects assessment (Section 10). These effects are expected to be not significant and thus fishing in Big Creek would also not be negatively affected.

Fresh and make-up water for the Project is sourced from the Yukon River valley and will be piped from a well to the mine site. Project effects on the Yukon River and the sport/subsistence fish within it are documented in the Fish and Aquatic Resources effects assessment (Section 10). These effects are expected to be not significant and thus fishing in the Yukon River would also not be negatively affected.

The open pit is located between the headwaters of Casino Creek and Canadian Creek and occupies an area of approximately 300 ha. The initial water requirements for oxide ore processing will be met by pumping water retained behind a temporary cofferdam located within the TMF catchment area along Casino Creek until initial water usage is replaced by process water reclaimed from the TMF and processing plant. Canadian Creek will be partially impacted by the Maximum Disturbance Area (which includes the open pit), but the section of impact is within a non-fish bearing area. All of Casino Creek will be affected, with 50% completely removed by the TMF. Both creeks have grayling for 6 months of the year (these creeks are frozen to substrate in winter). Project effects on Casino Creek and Canadian Creek and any sport/subsistence use fish within them are documented in the Fish and Aquatic Resources effects assessment (Section 10). These effects are expected to be not significant.

Subsistence and Recreational Harvesting – Plant Harvesting

There is no spatial information about plants (or plant parts) such as birch bark/sap, spruce roots, Arctic raspberry, Labrador tea, cranberries, blackberries, or mushrooms harvested in the LSA or RSA. As such it is not known whether any areas of cultural importance will be affected by the Maximum Disturbance Area.

The Rare Plants and Vegetation Health effects assessment (Section 11) indicates that the majority of the Project is within the boreal biogeoclimate zone, with areas of subalpine and alpine occurring mainly in the western portion of the LSA. Plants in the boreal biogeoclimate zone consist mainly of open forest stands of white spruce (*Picea glauca*) and/or black spruce (*Picea mariana*). Mixed forests of aspen (*Populus tremuloides*) and/or birch (*Betula neoalaskana*) also occur and are common on well-drained slopes. Stunted aspen stands with associated grass and forbs (broad leafed, non-woody plants that die back to the ground in winter) dominate steep dry slopes, and are common features in the area. Subalpine areas are dominated by open coniferous stands with a dense shrub layer. Low and dwarf shrubs dominate as elevation increases. Tors (high rock piles) are common features, with graminoids (grasses and grass-like plants) and forbs present on ledges and in crevices. Alpine areas support mainly dwarf shrubs, forbs, mosses, and lichens. For the purposes of Cultural Continuity effects assessment, it is assumed that the plants used for subsistence and recreational harvesting are widespread and common throughout the Land Use LSA and RSA.

The Rare Plants and Vegetation Health effects assessment (Section 11) assesses the effect of the Project on rare plants and vegetation health and does not provide information about the amounts of individual plant types that

may be harvested for recreation or subsistence purposes that may exist in the Maximum Disturbance Area and are harvested due to their proximity to the roadway/historic Casino Trail. This would represent the maximum potential loss of plants harvested for recreation or subsistence use from the Project footprint. Approximately 2.3% of the RSA would be unavailable for plant harvesting during construction, operations, closure, and decommissioning phases of the Project. This effect would be reversed in the post-closure phase of the Project with the exception of the open pit and TMF.

Change in Access to Area

In general, improved accessibility to the area due to the upgrade of the existing public Freegold Road may attract additional interest and use of the area. Other land use activities may be easier to conduct on the upgraded road with less travel time and effort to access areas. The following indicators were used to assess the potential effects that the Project may have on access in the area for the Cultural Continuity VC:

- Places of historical and archaeological value; and
- Subsistence and recreational harvesting.

Places of Historical and Archaeological Value

HRIA final reports have been submitted to the Yukon Heritage Unit. Access to places of known (and unknown) historical and archaeological value will be facilitated by the Freegold Upgrade or restricted through gated access to controlled portions of the Freegold Road corridor (at kilometre 106 and the mine site).

Without a Project-specific TK and/or TLU study, there has been no consideration of places which may have historical and archaeological value from that perspective. The Freegold Road Upgrade will provide improved access into areas that may have been difficult to access previously. This access may result in increased disturbance of these places; however, access past kilometre 106 will be controlled.

Subsistence and Recreational Harvesting - Hunting

Access to hunting areas will either be facilitated by the Freegold Road Upgrade or restricted through gated access to controlled portions of the Freegold Road Upgrade corridor (at km 106 and the mine site).

Although there is no information on First Nation hunting from a Project-specific TK and/or TLU study, the SFN and LSCFN traditional territories and specifically the Category A and B Lands within the Land Use RSA and adjacent to the Freegold Road corridor could mean that these areas are accessed by the Casino Trail. Similarly, for other hunters, GMAs would also be accessed by the Casino Trail.

During construction, operations, and decommissioning and closure phases, access for hunting will not be restricted (other than by temporary construction delays) by CMC along the existing Freegold Road Upgrade section. The Freegold Road Extension beyond the security gate at kilometre 106 will be a private resource road with limited access; an agreement will be established between the Yukon Government, SFN, and LSCFN. There will be no public access and hunting on or adjacent to the mine site and Freegold Road Extension will not be permitted. From a First Nation perspective, the potential effect of limits to hunting and road access beyond the kilometre 106 gate may be considered positive since it reduces access to non-First Nation hunters in GMAs. From the perspective of non-First Nation hunters, this would be considered adverse. Both First Nation and non-First Nation hunters would be adversely affected by limited access to areas that may have been used for hunting, such as the Casino mine site.

Hunting of big game in the LSA is already limited with four of the seven GMAs that overlap with the Project (522–524, and 526) having been closed to licensed moose hunting since 1987. GMAs 509–511 are closest to the mine

site and have historically had relatively low levels of moose harvest (≤1 moose harvested per year). Hunters will not be permitted to hunt on active mining areas to provide for the safety of workers and mining infrastructure.

Related potential effects are covered in separate sections, covering Wildlife effects assessment (Section 12), and Land Use and Tenure effects assessment (Section 19).

Subsistence and Recreational Harvesting - Trapping

The effects on trapping concessions due to changes in access are documented in the Land Use and Tenures effects assessment (Section 19). The effects are determined to be not significant in any of the Project phases.

Subsistence and Recreational Harvesting - Fishing

During the construction, operation, and decommissioning and closure phases, the Freegold Road Upgrade will improve year-round access for subsistence and recreational fishing while the Freegold Road Extension will provide improved, year-round access to permitted land users only. The latter may be considered a positive effect for First Nations fishers since limiting fishers will limit competition for fish, but negative to other “general public” fishers who would not be able to access fishing areas beyond the km 106 security gate. This is not expected to be important to the general public, since there are no popular fishing destinations that overlap with Maximum Disturbance Area, and there are many other fishing sites with good road access available throughout Yukon.

Subsistence and Recreational Harvesting – Plant Harvesting

During the construction, operations, and decommissioning and closure phases, the Freegold Road Upgrade will improve year-round access for subsistence and recreational plant harvesting while the Freegold Road Extension will provide improved, year-round access to permitted land users only. Like hunting and fishing, the latter may considered a positive effect for First Nations plant harvesters since limiting other plant harvesters will limit completion for plant resources, but negative to the “general public” who would not be able to access plant harvesting areas beyond the km 106 security gate. This is not expected to be important to the general public, since plants harvested for recreational or subsistence purposes are common and widespread throughout the region.

Change in Local Ambience

Potential receptors that could be adversely affected by the Project have been identified so that potential changes in local ambience could be considered. Based on a review of available information, it was determined that for the purpose of cultural continuity effects assessment, the mine site and road access was considered remote and relatively inaccessible; therefore, potential receptors were limited to the guide outfitting and trapper concession areas and the SFN and LSCFN traditional territory areas that are intersected by the proposed mine site. The following Subsistence and Recreational Harvesting indicator was used to assess the potential effects that the Project may have on local ambience and wilderness experience associated with the Cultural Continuity VC:

Subsistence and Recreational Harvesting – Hunting, Trapping, Fishing and Plant Harvesting

The ability to conduct harvesting may be affected by Project-related disturbances. During the construction phase, noise and emissions as well as traffic may adversely affect the local ambience (such as the wilderness experience) often sought as part of harvesting practices. These effects would be felt during construction, operations, closure/decommissioning phase and be reversed post closure.

Related potential effects are covered in separate sections, covering Land Use and Tenure (Section 19).

Change in Abundance of Plant/Animal Resources Available for Harvesting

The following indicators were used to assess the potential effects that the Project may have on abundance of wildlife (including fish) and plant resources available for harvesting in the area for the Cultural Continuity VC:

- Subsistence and recreational harvesting; and
- Traditional knowledge (transmission and retention).

Subsistence and Recreational Harvesting – Hunting and Trapping

Due to the improved, year-round access to the RSA from the Freegold Road Upgrade and Expansion, there is the potential for an increase in hunter competition for and hunting of wildlife resources that may affect their abundance. Increasing numbers of hunters affecting wildlife abundance is not expected to occur since access to hunting areas beyond the kilometre 106 security gate is not expected to increase for non-First Nation hunters and not change for First Nations hunters (as noted above).

Mortality of wildlife (and therefore reduced availability/abundance for hunting and trapping) related to Project effects such as increased hunter access, collisions with vehicles, and having to destroy animals as a result of human-wildlife conflict are assessed in the Wildlife effects assessment (Section 12) and are considered not significant. Similarly, wildlife avoidance of the Maximum Disturbance Area (and therefore reducing availability/abundance for hunting) due to Project disturbances was also considered not significant.

An assessment of Project effects on wildlife species that are trapped (such as snowshoe hare, red fox, lynx) was not conducted as they are not listed as a Species at Risk under the *Species at Risk Act*, and their populations (abundance) is considered secure.

Subsistence and Recreational Harvesting – Fishing

The effect of the Project on abundance of fish was determined to be not significant (Section 10).

Subsistence and Recreational Harvesting – Plant Harvesting

As noted earlier, there is no spatial information available about plants (or plant parts) such as birch bark/sap, spruce roots, Arctic raspberry, Labrador tea, cranberries, blackberries, or mushrooms harvested in the LSA or RSA. As such, it is not known whether the availability of these plant species in areas where they are harvested will be affected by the Project.

For the purposes of the cultural continuity effects assessment it is assumed that the plants used for subsistence and recreational harvesting are widespread and common throughout the Land Use LSA and RSA and that if the entire LSA is unavailable for plant harvesting, that this will affect 2.3% (the Maximum Disturbance Area or LSA) of the RSA during the Project construction, operations, closure and decommissioning phases. This effect would be reversed in the Project post-closure phase with the exception of the open pit and TMF.

Traditional Knowledge (Transmission and Retention)

As noted earlier, TK is gained and shared through oral communication and practicing Aboriginal TLUs and ceremonies (including participation in cultural events). Opportunities to share or gain TK could be impaired due to the Project if it results in lower abundance of the wildlife and plant resources.

Change in Opportunity to Participate in Cultural Activities

The following indicators were used to assess the potential effects that the Project may have an individual's ability to participate in cultural activities as a result of employment for the Cultural Continuity VC:

- Language;
- Social, community and cultural events;
- Subsistence and recreational harvesting; and
- Traditional Knowledge (transmission and retention).

Language

The loss of Northern Tutchone language is a known concern amongst the First Nation communities. During all Project phases, and primarily for safety and security reasons, English will be language of business operations and communications at the mine site. All employees and contractors will be required to understand, speak and read basic English during work hours. As a result, employment at the mine could further erode the use and practice of the Northern Tutchone language.

Social, Community, and Cultural Activities

The potential effects on social, community and cultural events by the Project are employment-related and are both adverse and beneficial. Due to work schedules and the remoteness of the mine site, individuals may not attend or participate in these events. However, because of employment, individual may have the economic resources available to participate in events that they previously may not have due to economic limitations.

Subsistence and Recreational Harvesting – Hunting, Trapping, Fishing, and Plant Harvesting

The ability to conduct recreational or subsistence harvesting may be impaired by Project employment since times for harvesting may overlap with shift work.

Conversely the ability to participate in hunting, trapping, fishing and plant harvesting may be improved since equipment (and associated maintenance) needed for these activities such as guns, ammunition, traps, ATVs and fuel would be purchased using employment income.

Traditional Knowledge (Transmission and Retention)

Generally, TK is gained and shared through oral communication and practicing Aboriginal TLUs and ceremonies (including participation in cultural events). Opportunities to share or gain TK could be impaired due to Project employment if times for participating in TLUs and ceremonies may overlap with shift work. Conversely, opportunities to participate in TLUs (hunting, trapping, fishing, and plant harvesting) and ceremonies may be facilitated through employment income as described earlier.

Table 18.4-2 Potential Effects on Cultural Continuity

Mechanism of Interaction	VC Indicator(s)	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
Change (direct loss/disturbance) in area	Places of historical and archaeological value	C, O, CD,	Some archaeological sites might be affected by overprinting from the Freegold Road Upgrade, Freegold Road Extension, or mine site infrastructure (Maximum Disturbance Area)	Adverse
	Subsistence and recreational harvesting	C, O, CD,	Areas within the Project footprint that may be used for harvesting will not be available for use during the construction, operation, and decommissioning/closure phases	Adverse
Change in access to the area	Places of historical and archaeological value	C, O, CD,	Some historical and archaeological sites may be permanently affected	Adverse
	Subsistence and recreational harvesting	C, O, CD,	Temporary loss of road access via the existing Casino Trail	Adverse
		C, O, CD,	Improved access for subsistence or recreational harvesting	Beneficial/Adverse
		C, O, CD,	Removal of improved access with decommissioning/closure of Freegold Road Extension	Adverse
		C, O, CD,	Loss of or decreased area for recreational or subsistence harvesting	Adverse
Change in local ambience	Subsistence and recreational harvesting	C, O, CD,	Increased noise, emissions and traffic may affect the wilderness experience	Adverse
Change in abundance of plant/animal resources available for harvesting	Social, community, and cultural events	C, O, CD,	Plant and animal resources used in events may not be available due to changes in abundance	Adverse
	Subsistence and recreational harvesting	C, O, CD,	Change as a result of increased competition for resources, decrease in resources due mortality or unavailability of resources	Adverse
	Traditional Knowledge (transmission and retention)	C, O, CD,	Opportunities to share or gain traditional knowledge could be impaired due to Project if it results in lower abundance of the wildlife and plant resources upon which it is dependant	Adverse

Mechanism of Interaction	VC Indicator(s)	Project Phase[2] (C, O, DC, PC)	Potential Effect	Direction
Change in opportunities to participate in cultural activities	Language	C, O, CD,	Employment at the mine could further erode the use and practice of the Northern Tutchone language	Adverse
	Social, community, and cultural events	C, O, CD,	Increased local employment may result in reduced participation in social, community, and cultural activities	Adverse
	Subsistence and recreational harvesting	C, O, CD,	Increased local employment may result in reduced participation in harvesting activities	Adverse
		C, O, CD,	Increased employment income would lead to increased resources to support subsistence harvesting activities	Beneficial
	Traditional Knowledge (transmission and retention)	C, O, CD,	Opportunities to share or gain traditional knowledge could be impaired due to Project employment if times for participating in traditional land uses and ceremonies may overlap with shift work	Adverse
		C, O, CD,	Opportunities to participate in traditional land uses and ceremonies may be facilitated through employment income	Beneficial

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

18.4.2 Identification of Mitigation or Enhancement Measures

Mitigation measures are outlined below to help avoid or minimize potential effects of the Project. Mitigation measures are not appropriate for potential beneficial effects. For potential beneficial effects, if enhancement measures are recommended they will be denoted in italics. Mitigation or enhancement measures will be organized by Project interaction.

Generally, social or community effects associated with the Project will be managed through a socioeconomic management plan. Socioeconomic management plans are recognized internationally by organizations such as the International Council on Mining and Metals as being an effective mechanism for enhancing the potential beneficial socioeconomic or cultural effects or mitigating any potential negative effects of mining projects. To be effective, socioeconomic management plans must be developed jointly with community and regional partner organizations such as training institutions, economic development agencies, and municipal and provincial/territorial government agencies. Successful mitigation of socioeconomic and cultural effects depends more on establishing an ongoing joint process for monitoring and addressing issues than by identifying specific conditions to be addressed by CMC alone.

Mitigations for Maximum Disturbance Area

Decreased areas available for cultural activities and overprinting of any archaeological or culturally important areas will be minimized or avoided by:

- Designing the Project to have as compact a mine site footprint, to the extent practical;
- Progressive reclamation of the Maximum Disturbance Area (with the exception of the open pit and TMF) back to pre-mine conditions; and
- Effects on archaeological sites will be mitigated through Heritage Resource Protection Plan.

A Heritage Resource Protection Plan (Section 22) will be developed to detail the methods for avoiding, mitigating, reporting, and recovering any heritage resources that are found during Project development activities. Employees and contractors will be trained on the heritage resource protection policies and mandatory actions, as well as how to identify and record potential finds.

In general, the proposed mitigation measures include avoidance of known or suspected historical, cultural, or archaeological places. If the places cannot be avoided, then the necessary stage archaeological mitigation of the archaeological sites and recording and archival research as well as excavation and removal will be completed following the Yukon Heritage Policy.

Mitigations for Access

A Road Use Plan (Appendix 22A) will be developed for the Project in coordination with First Nations and the Yukon Government. The purpose of the plan will be to:

- Manage and limit public access to the mine operating area and site;
- Manage the potential for increased hunting pressures on wildlife;
- Reduce possible wildlife-human conflicts; and
- Protect existing wildlife-dependent land users (e.g., First Nations).

The Freegold Road Extension will be managed as a privately owned and operated road from kilometre 106, on which there will be no public access. Use of the road will be restricted to mine-related activities. Some limited use by others may be required; however, this is subject to negotiations with the land users as well as agreement by the First Nations and Yukon Government under the terms of Project-specific management plans. Key elements of the transportation component of the Road Use Plan (Appendix 22A) include:

- No public access (access by permit, as directed and agreed by the Steering Committee);
- Controlled, gated, manned access (located at the new bridge over Big Creek – or as otherwise agreed); and
- Develop a stakeholder communication/engagement plan to ensure concerns are identified and addressed.

During the construction phase, there is the potential for road closures along both the Freegold Road Upgrade and Extension. Wherever possible one lane will be kept open to allow travel (limited to permitted uses along the Freegold Road Extension); however, complete closures may be required periodically. To ensure users are informed of the current road status, a traffic communication bulletin/update will be circulated in local communities and to key stakeholders on a routine basis. An information line will also be established to answer questions regarding the Project status.

A monitoring program will also be implemented to aid in identifying and reporting potential alternative access points that may be created by local land users (i.e., recreational hunters) along the existing Freegold Road that parallel the gated Freegold Road Extension or provide access to areas that were previously inaccessible. The specific requirements and deliverables for this monitoring program will be developed in consultation with the Yukon Government, First Nations, and stakeholders to ensure local interests and concerns are adequately addressed and mitigated.

At closure, public health and safety assessment will be conducted for the mine site to identify potential risks and develop appropriate, specific long-term mitigation and management measures (such as fencing and signage).

Mitigations for Ambience

Change in local ambience, such as traffic, noise and emissions, and related wilderness experience will be mitigated by:

- Minimizing traffic noise and emissions by incorporating accepted best management practices;
- Employees flown to mine site to avoid multiple busses creating additional traffic on access road;
- Ensuring on-site equipment is regularly maintained to control noise and emissions;
- Proper sound buffering of the ore processing facility on site;
- Implement an Air Quality Management Plan; and
- Ongoing communications and engagement with First Nations will ensure that potential effects associated with traffic, emissions and noise along the Freegold Road corridor will be identified, documented and addressed.

Mitigations for Availability of Plant/Animal Resources

This will be managed in part through limited access at kilometre 106 and also by the Freegold Road Upgrade sections through provincially regulated hunting draws for big game. In addition, mine employees and contractors will be restricted from harvesting within the mine site footprint and while on shift at any time.

Other mitigations for managing wildlife mortality are contained in the Wildlife effects assessment (Section 12).

Mitigations for Opportunities to Participate in Cultural Activities

The effects associated with employment opportunities at the mine (such as reduced participation in harvesting activities or harvesting competition with non-Aboriginal employees) could be mitigated through:

- Shift flexibility to accommodate subsistence harvesting and participation in cultural activities/events, as appropriate for continuity with mining activities;
- Support efforts to revitalize Northern Tutchone language and incorporate Northern Tutchone language into mine signage in consultation with the SFN and LSCFN;
- Incorporating Aboriginal ceremonies at the mine site in consultation with the SFN and LSCFN;
- Providing support for community cultural events based on input from SFN and LSCFN and other local communities; and
- Conduct cultural awareness training for all employees and contractors working at the mine site.

Table 18.4-3 Identification of Mitigation Measures and Potential Residual Effects for Cultural Continuity

Potential Effect	Project Phase[1] (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure	Predicted Effectiveness	Residual Effect
Some sites of historical, cultural and archaeological value may be overprinted by Project infrastructure in construction phase	C, O, CD	Adverse	Avoidance of sites, Heritage Management Plan, Access Management Strategy	High	No
Loss of or decreased area for recreational or subsistence hunting and plant harvesting in construction, operations and closure/decommissioning phases	C, O, CD	Adverse	Reclamation and Closure Plan; compact Project footprint; Access Management Strategy	High	Yes
Improved access for recreational and subsistence harvesting during operations, closure and active decommissioning phases	C, O, CD	Adverse/ Beneficial	Access Management Strategy; Project employees and contractors will be restricted from hunting and fishing while on the job at any time	High	Yes
Temporary loss of road access during construction	C, O, CD	Adverse	Traffic Management Plan (in conjunction with Yukon Government, SFN, and LSCFN); Communications Plan (ensuring ongoing communications with First Nations)	High	No
Increased noise, emissions and traffic in construction, operations, closure and decommissioning phases may affect the wilderness experience	C, O, CD	Adverse	Implement appropriate EMPs (i.e. Air Quality Management Plan); equipment maintenance; sound buffering equipment/buildings; employees flown to site; Communications Plan (ensuring ongoing communications with First Nations and local stakeholders)	High	Yes

Potential Effect	Project Phase[1] (C, O, CD, PC)	Direction	Proposed Mitigation (or Enhancement) Measure	Predicted Effectiveness	Residual Effect
Increased local employment may result in reduced participation in cultural activities (language, community events, harvesting activities)	C, O, CD	Adverse / Beneficial	Support efforts to revitalize Northern Tutchone language and incorporate Northern Tutchone language into mine signage as appropriate; Shift flexibility to accommodate Aboriginal community and cultural events, deaths, illnesses, as appropriate for continuity of mining activities; Incorporating Aboriginal ceremonies at the mine site in consultation with the SFN and LSCFN; CMC support for community cultural events based on input from SFN and LSCFN and other local communities; Conduct cultural awareness training for all employees and contractors working at the mine site.	High	No
Abundance and availability of plant/animal resources available for cultural activities and harvesting	C, O, CD	Adverse	Project employees and contractors will be restricted from harvesting within the mine footprint while on the job at any time; implementation of an Access Management Plan.	High	No

Notes

1. C (Construction), O (Operation), DC (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socioeconomic benefits are included as proposed enhancement measures.

18.4.3 Significance of Residual Effects

The residual effects carried forward for assessment of significance are:

- Loss of area for recreational or subsistence harvesting (hunting and plant harvesting);
- Changes to access for recreational and subsistence harvesting; and
- Increased noise, emissions, and traffic affecting the wilderness experience/ambience.

The specific matrices developed for determining the significance of residual effects for the indicators selected to assess the Cultural Continuity VC are presented in Table 18.4-3. These criteria describe both the characteristics

of the effect (e.g., direction, magnitude) and the characteristics of the VC being considered (e.g., context). Quantitative values (i.e., 2.3%), are used preferentially (when available) over qualitative criteria. Professional judgement is used in determining if a criterion is given more or less weight in assigning impact significance and the justification for the weighting is provided where necessary for clarification. The level of confidence associated with the assessment is described for each effect.

In general, to be considered to have a significant effect, the residual effect on the VC indicator being assessed must meet one of the following criteria:

- Have a medium magnitude at a regional spatial extent and have a long term or permanent duration;
- Have a high magnitude at a localized spatial extent and be permanent in duration; or
- Have a high magnitude at a regional extent of any duration.

The challenge with socioeconomic and cultural assessments is that neither guidelines nor predefined thresholds exist, so the assessment often relies on the setting, intensity, public concerns, and professional judgement gained from working on similar projects.

Table 18.4-4 Determining Significance of Residual Effects for Cultural Continuity

Criteria	Rating	VC Specific Definitions
Magnitude	Low	Effect that occurs might or might not be detectable, but is within the normal range of variability
	Medium	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge
	High	Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge
Geographical Extent	Localized	Within the identified Local Study Area
	Widespread	Outside the identified Local Study Area
Duration	Short Term	Effect is limited to the construction period
	Long Term	Throughout operations, decommissioning and closures
	Permanent	Effects measureable Post-Closure
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the interaction.
	Irreversible	Pre-Project conditions will not return following the cessation of the interaction.
Context	Low Resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High Resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur
	High	High likelihood that the predicted residual effect will occur.

Significance of Loss of Area for Recreational or Subsistence Harvesting

Hunting

An adverse residual effect is predicted during the construction, operations, and closure and decommissioning phases associated with the loss of area available for recreational and subsistence harvesting (hunting, trapping, fishing, and plant harvesting).

The effects on hunting will be, at most, an overlap of .5% of the SFN traditional territory and .4% of the LSC/FN traditional territory. Hunting of caribou is limited to only 1 male animal in GMAs overlapping with portions of the Project site (522 – 526) and closed in 509-511 nearest to the proposed mine site. The GMAs that would be accessible to hunters for hunting Moose (one of the most important food sources and sport-hunting species in the Yukon) from the Freegold Road Upgrade (GMAs: 522–524, and 526) have been closed to licenced moose hunting since 1987. GMAs 509–511 are closest to the Mine Site and have historically had relatively low levels of moose harvest (≤1 moose harvested per year). The effects on other game species (Section 12) were assessed as not significant. Therefore effects on hunting related to loss of area from the maximum disturbance area of the Project is considered low in magnitude, localized, long-term and infrequent (occurs during hunting seasons). The effect is reversible at closure and hunters are expected to adapt to the effect (high resilience) and the probability of occurrence is high. The effect is therefore considered not significant.

Plant Harvesting

Effects on areas that may be used for harvesting plants is considered low in magnitude since at most 2.3% of the land use RSA would be unavailable for this use. This effect is localized (within the Land Use LSA), long term (lasting throughout the life of the Project), frequent (occurs during spring, summer, and fall when plants are primarily harvested), and reversible at closure. Since plants available for harvesting are widespread and common in the region, plant harvesters are expected to adapt easily to the effect (high resilience). The probability of occurrence is moderate since specific information about locations where plants are harvested is not known. The overall significance rating is therefore not significant.

Significance of Access for Recreational and Subsistence Harvesting

Hunting

Access for hunting is determined by the Yukon Government and will be determined by the Access Management Agreement that will be negotiated by the Governments of Yukon, SFN, and LSCFN with CMC. Hunting on or adjacent to the mine site will not be permitted. From a First Nation perspective the effect of limits to hunting access beyond the kilometre 106 gate may be considered positive since it reduces access to non-First Nation hunters in GMAs. From the perspective of non-First Nation hunters this would be considered adverse. Both First Nation and non-First Nation hunters would be adversely affected by limiting access to areas that may have been used for hunting at the mine site. Given the relatively low levels of licensed hunting (for the purpose of this assessment licensed hunters are assumed to be non-First Nation) that occurs in the land use RSA, this is considered a low magnitude effect, negative (for non-First Nations hunters) and positive (for First Nations hunters), widespread (affecting access to GMAs outside of the LSA), long-term (lasting for the life of the Project), frequent (occurs regularly during hunting seasons), and reversible at closure. Hunters are expected to adapt easily to this effect as the bag limits for this area are already restricted although it may increase competition for game in other GMAs. The probability of occurrence of the effect is high as the potential effects are relatively well understood. Overall, the effect on recreational/subsistence hunters is considered not significant.

Plant Harvesting

During the construction, operations, and closure/decommissioning phases, the Freegold Road will improve year-round access for subsistence and recreational plant harvesting while the Freegold Road Extension will provide improved, year-round access to permitted land users only. Similar to hunting, the latter may considered a positive effect for First Nations plant harvesters since limiting access for non-First Nation plant harvesters will limit completion for plant resources, but negative to the general public who would not be able to access plant harvesting areas beyond the kilometre 106 security gate (if access is by motor vehicle). This is not expected to be important, however, to the general public, since plants harvested for recreational or subsistence purposes are common and widespread throughout the region. Effects on access to areas that may be used for harvesting plants is considered low in magnitude since access would be limited only for those non-First Nation plant harvesters who would currently use the Casino Trail to access remote harvesting areas presumed to be very few people. This effect is localized (within the Land Use LSA), long-term (lasting throughout the life of the Project), infrequent (occurs during spring, summer and fall when plants are primarily harvested), and reversible at closure. Since plants available for harvesting are widespread and common in the region, plant harvesters are expected to adapt easily to the effect (high resilience). The probability of occurrence is moderate since specific information about locations where plants are harvested is not known. The overall significance rating is therefore: not significant.

Significance of Increased Noise, Emissions, and Traffic (Ambience)

The wilderness experience/ambience experienced during recreational or subsistence harvesting will be adversely affected due to increased noise and air emissions from Project traffic along the Freegold Road as well as emissions from equipment operating at the mine site. Noise emissions will be limited to the area surrounding the mine site. This effect is considered medium in magnitude since it is not within the normal range of variability in this relatively remote area but is unlikely to post a serious risk to the VC. The effect is localized (within the Land Use LSA), long term (lasting for the life of the Project), and frequent (occurs often and continuously throughout all Project phases), and land users are not expected to adapt easily to the effect (low resilience) and may choose to conduct recreational or subsistence harvesting practices in different areas as a result. The probability of occurrence of this effect is high. Overall, the significance of the effect is not significant.

Table 18.4-5 Significance of Residual Effects for Cultural Continuity

Residual Effect	Predicted Degree of Effect After Mitigation (or Enhancement) Measures								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Loss of or decreased area for recreational or subsistence hunting	Adverse	Low	Localized	Long Term/ Permanent	Infrequent	Reversible	High Resilience	High	Not Significant
Loss of or decreased area for recreational or subsistence plant harvesting	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High Resilience	Unknown	Not Significant
Access for recreational and subsistence hunting	Adverse/ Beneficial	Low	Widespread	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
Access for recreational and subsistence plant harvesting	Adverse/ Beneficial	Low	Localized	Long Term	Infrequent	Reversible	High Resilience	Moderate	Not Significant
Increased noise, emissions and traffic	Adverse	Medium	Localized	Long Term	Frequent	Reversible	Low Resilience	High	Not Significant

18.4.4 Discussion of Significance

An assessment of the potential Project interactions with the VC indicators selected for cultural continuity, showed that with the application of mitigation measures the significance of the residual effects are predicted as not significant. The rationales for selecting not significant as the overall residual effects rating are:

- The loss of area directly associated with the Project maximum disturbance area for harvesting is determined to be relatively minor when compared to the total available area in the region for these activities.
- After application of the Access Management Plan, access for First Nations recreational or subsistence harvesters will be not adversely affected for the majority of the LSA and to most areas of their traditional territories. Access is only restricted on the Freegold Road Extension beyond the gate at kilometre 106 – access for an all-weather road that did not exist prior to the mine being built. The exception will be at the mine site itself where no hunting, trapping, fishing or plant harvesting will be permitted. For non-First Nation or hunters/trappers that do not have permitted/licensed need to access areas beyond the security gate at kilometre 106, the effect is considered adverse.

- Increased traffic and mining activities will increase noise and air emissions at the mine site and along Freegold Road, which is expected to detract recreational and subsistence harvesters from using the area.

The ability of a community to continue to convey or acquire TK is tied to the ability of that community to practice TLUs, to speak their own language, to visit and use sites of historic/cultural importance and to the participate in community, social, and cultural events. An assessment of Project effects on the ability to transmit or obtain TK is therefore reliant on effects to these other VC indicators. Since the effects to these VC indicators are considered not significant, the ability to transmit or obtain TK may also not be adversely affected. This would be one of the social elements under the proposed socioeconomic monitoring. This determination should be discussed and verified with the SFN and LSCFN.

Table 18.4-6 Summary of Residual Effects for Cultural Continuity

Potential Residual Effects	Direction	Significance	Confidence
Loss of or decreased area for recreational or subsistence harvesting in construction, operations and closure/decommissioning phases	Adverse	Not Significant	Moderate
Improved access for recreational and subsistence harvesting during operations, closure and decommissioning phases	Adverse and Beneficial	Not Significant	Moderate
Increased noise, emissions and traffic in construction, operations, closure and decommissioning phases affecting the wilderness experience/ambience	Adverse	Not Significant	Moderate

Moderate confidence ratings were assigned based on the following factors: lack of primary data on recreational and subsistence of this specific area and relatively small proportion of the RSA that is affected by the Maximum Disturbance Area.

18.5 CUMULATIVE EFFECTS ASSESSMENT

The Land Use and Tenure section provides a cumulative effect assessment (CEA) of increased placer and quartz staking and exploration activities due to the improved access associated with the upgrade and extension of Freegold Road (Section 19). This assessment is considered similar and relevant to the VC indicators with residual effects for cultural continuity and is not re-stated here.

Additional mitigation measures were recommended to manage cumulative effects such as collaborative (First Nation and Yukon Government) decisions about permitting access to new placer and quartz claims, and monitoring traffic along Freegold Road. With these mitigation measures in place, the significance of the residual cumulative effect was considered not significant.

18.6 SUMMARY AND CONCLUSIONS

The Cultural Continuity VC assesses the potential effects of the proposed Project on the ability of a community or individual to sustain their cultural identity through having access to resources that support cultural retention and opportunities to participate in cultural activities. From an Aboriginal perspective, this includes the use of land for harvesting traditional resources and engaging in related traditional practices such as opportunities to transfer TK and skills, and speak Aboriginal languages. From a Yukon or northern lifestyle perspective, recreational hunting,

fishing, and gathering are culturally important. This is evident by the high proportion of residents participating in subsistent and recreational hunting.

The Cultural Continuity VC assessed the following VC indicators:

- Language – from the standpoint of potential Project effects on traditional, non-English languages;
- Places of historical, cultural and archaeological value – from the standpoint of potential Project effects on places that are considered significant to a community or individual;
- Social, community and cultural events – from the standpoint of potential Project effects on participation in events that are considered significant to a community or individual;
- Subsistence and recreational harvesting – from the standpoint of potential Project effects on non-commercial hunting, trapping, fishing and gathering activities (primarily for subsistence or recreation); and
- Traditional knowledge – from the standpoint of potential Project effects on conveying or acquiring traditional environmental knowledge – which is differentiated from TLUs that are assessed in Section 19.

VC indicators were assessed within a LSA, which was defined for community/individual based effects on language and social, community, and cultural events as:

- Community of Pelly Crossing and SFN;
- Village of Carmacks and LSCFN; and
- City of Whitehorse.

The LSA used to describe effects on land-based VC indicators such as places of historical, cultural, and archaeological value, and subsistence and recreational harvesting was a 500-m buffer around the entire Project footprint (or maximum disturbance area). Effects were assessed by Project phase including construction, operation, closure/decommissioning and post-closure.

With the application of mitigation measures, there were no residual effects on: language; places of historical, cultural, and archaeological value; and social, community, and cultural events. Residual effects were determined to be felt as a result of loss of land base from the maximum disturbance area (Project footprint) for recreational and subsistence harvesting (hunting, trapping, fishing, and plant harvesting), and as a result of changes to access to the region from the upgrade and extension of the Freegold Road. Additional residual effects to recreational and subsistence harvesting are expected to result from increased noise and air emissions from mining activities at the mine site and traffic along Freegold Road. None of these residual effects were considered significant since:

- The loss of area directly associated with the Project maximum disturbance area for harvesting is determined to be relatively minor when compared to the total available area in the region for these activities;
- After application of the Access Management Plan, access for First Nations recreational or subsistence harvesters will be not adversely affected for the majority of the LSA and to most areas of their traditional territories. The exception will be at the mine site itself where no hunting, trapping, fishing or plant harvesting will be permitted and road access will be restricted to permitted users beyond the security gate at kilometre 106, the effect is considered adverse; and
- Increased traffic and mining activities will increase noise and air emissions at the mine site and along Freegold Road, which is expected to detract recreational and subsistence harvesters from using the area.

The ability of a community to continue to convey or acquire TK is tied to the ability of that community to practice TLUs, to speak their own language, to visit and use sites of historic/cultural importance and to the participate in community, social and cultural events. An assessment of project effects on the ability to transmit or obtain TK is therefore reliant on effects to these other VC indicators. Since the effects to these VC indicators are considered not significant, the ability to transmit or obtain TK may also not be adversely affected. This determination should be discussed and verified with the SFN and LSCFN.

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19 – LAND USE AND TENURES

19.1 INTRODUCTION

19.1.1 Regional Setting

The Project is a proposed open pit mine located approximately 300 kilometres (km) northwest of Whitehorse, Yukon Territory (Yukon) on Crown land that is administered by the Government of Yukon. Primary access to the remote mine site will be by the 200 km Freegold Road Upgrade and Freegold Road Extension from the Village of Carmacks located to the east. The Land Use RSA is primarily situated in the Selkirk First Nations (SFN) and Little Salmon/Carmacks First Nations (LSCFN) Traditional Territory. A 1,600 m airstrip will be constructed approximately 15 km southwest of the mine site to facilitate access by aircraft. The Yukon River, which will not be affected by the Project, is located approximately 20 km north of the mine site.

19.1.2 Rationale for VC Selection

The Land Use and Tenure Valued Component (VC) examines the potential interactions of the Project on other land users in the area. The indicators selected for the Land Use and Tenure VC are based on the available information compiled in the Land Use and Tenure Baseline Report (Section 19A). There are a variety of land use activities in the study area, all of which were reviewed as potential indicators for the proposed Project. The various land uses examined include: Traditional and Domestic Use, Parks and Protected Areas, Hunting, Trapping and Guide Outfitting, Fishing, Forest Uses (firewood collection and gathering), Recreation and Tourism, Mining and Exploration Activities, Oil and Gas, Water Resources and Licenses, Other Land Tenures, Transportation and Access, and Utilities.

Following a review of the available baseline information, including input received during consultation activities from various agencies and stakeholders, representative indicators for the Land Use and Tenure VC were selected for the effects assessment. The relevance of the individual indicators was validated through consideration of the proposed issues in the context of the existing baseline conditions of the proposed Project, review of the Project Description (Section 4), and a consideration of identified stakeholder concerns. Potential concerns / issues associated with the Land Use and Tenure VC were identified through consultation with the following groups:

- Territory and federal government agencies;
- Local government representatives;
- First Nations (FN); and
- The general public and other stakeholders.

Table 19.1-1 below summarizes the rationale for selecting the indicators for assessing potential effects for the Land Use and Tenure VC.

Table 19.1-1 Selection Rationale of Indicators for the Land Use and Tenure VC

Issue	Potential Interaction	Falls within Project Area	Include in Land Use EA?	Rationale for Selection
FN Settlement Lands	Direct loss of available area along Freegold Road Upgrade and Extension; noise; visual; traffic conflicts; and access	Yes	Yes	Settlement Lands for both Selkirk First Nations (SFN) and Little Salmon/Carmacks First Nations (LSCFN) are located within the Land Use RSA.
Traditional and domestic use	Direct loss of available area; land clearing/mine operations; noise; visual; traffic conflicts; and access	Yes	Yes	The Land Use RSA is primarily situated in the Selkirk First Nations (SFN) and Little Salmon/Carmacks First Nations (LSCFN) Traditional Territories. The SFN and LSCFN have historically lived in the Project area. In addition to hunting, trapping and fishing activities SFN and LSCFN in the area participate in a variety of traditional land uses.
Parks and protected areas	No	No	No	No parks or protected areas are overlapped by the Project area.
Hunting / guide outfitting / trapping	Direct loss of available area; land clearing/mine operations; noise; visual; traffic conflicts; and access	Yes	Yes	Available information indicates that recreational hunting does occur in the Project area. The mine site and access route overlaps a portion of eleven trapping concession areas. Trapping tenure (#334164) located within the area proposed as the access road to the airstrip is also incorporated into this indicator. The mine site and access route overlaps a small portion of three guide outfitting areas.
Fishing	Traffic conflicts	No	No	No direct effects on recreational or commercial fishing are predicted. There is the potential for project related traffic to conflict with existing traffic (i.e. residents accessing Gloria Lake II) on the Freegold Road (see transportation assessment in Section 17 Community Infrastructure and Services; and Section 22 Road Use Plan)
Forestry	Direct loss of available tenure area; traffic conflicts	No	No	There are areas designated for personal use fuel wood harvesting along the existing Freegold Road. However, it was determined that local residents harvesting dead and down material for heating will not be affected as many of the public access corridors in the Yukon are designated as Personal Use Fuelwood areas. Permitted commercial forestry operations are not located within the Land Use LSA.
Recreation and	Noise; visual; traffic conflicts;	Yes	Yes	No direct effects on recreation areas. There is the potential for indirect effects associated with project noise, changes to the landscape, traffic conflicts and

Issue	Potential Interaction	Falls within Project Area	Include in Land Use EA?	Rationale for Selection
tourism	and access			access on recreation and tourism.
Mining, prospects, exploration and mineral tenures	Direct loss of available tenure area and area available for prospecting; traffic conflicts	Yes	Yes	Several exploration projects and a variety of quartz and placer claims and leases overlap the Project area. No active mines overlap the Project area. Activities associated with the historical Mount Nansen Mine, located 20 km south of the existing Freegold Road, are not predicted to overlap with the proposed Project.
Oil and gas	No	No	No	No overlap with the Whitehorse Trough Sedimentary Basin
Water resources and licenses	Accident / spill along Freegold Road	Yes	No	One water license (water source Whirlwind Pup and Revenue Creek) is located within 500m of existing Freegold Road. Potential Project interaction limited to spills along the Freegold Road (see Section 21 Accidents and Malfunctions and Section 22 Spills Prevention and Contingency Plan)
Other permits, licences and land tenures	Direct loss of available tenure area and; clearing/mine operations; traffic conflicts; access	No	No	Several permitted quarries are located along the existing Freegold road which are either in use or approved for future use. It is assumed that these borrow sources were permitted in support maintaining / upgrading the existing Freegold Road. For the purpose of this assessment these quarries (and any others that may be advanced in support of the Project) are presumed to be scoped into the maximum disturbance area for the Project footprint. Trapping tenure (#334164) located within the area proposed as the access road to the airstrip is incorporated into the discussion for the within the trapping indicator. The bridgehead located along the existing Freegold Road will be addressed as required as part of the permitting process for the Freegold Road Upgrade.
Transportation and access	Noise; visual; traffic conflicts; access; and safety	Yes	Yes	Access to mine site area will be changed. Project traffic may conflict with local traffic. Local ambience in area may be affected by traffic emissions and noise. Safety of other land users may be affected. (see transportation assessment in Section 17 Community Infrastructure and Services; and Section 22 Road Use Plan)
Utilities	No	No	No	The proposed Project will not draw power from the Yukon power grid or affect the local utilities services.

19.2 ASSESSMENT BOUNDARIES

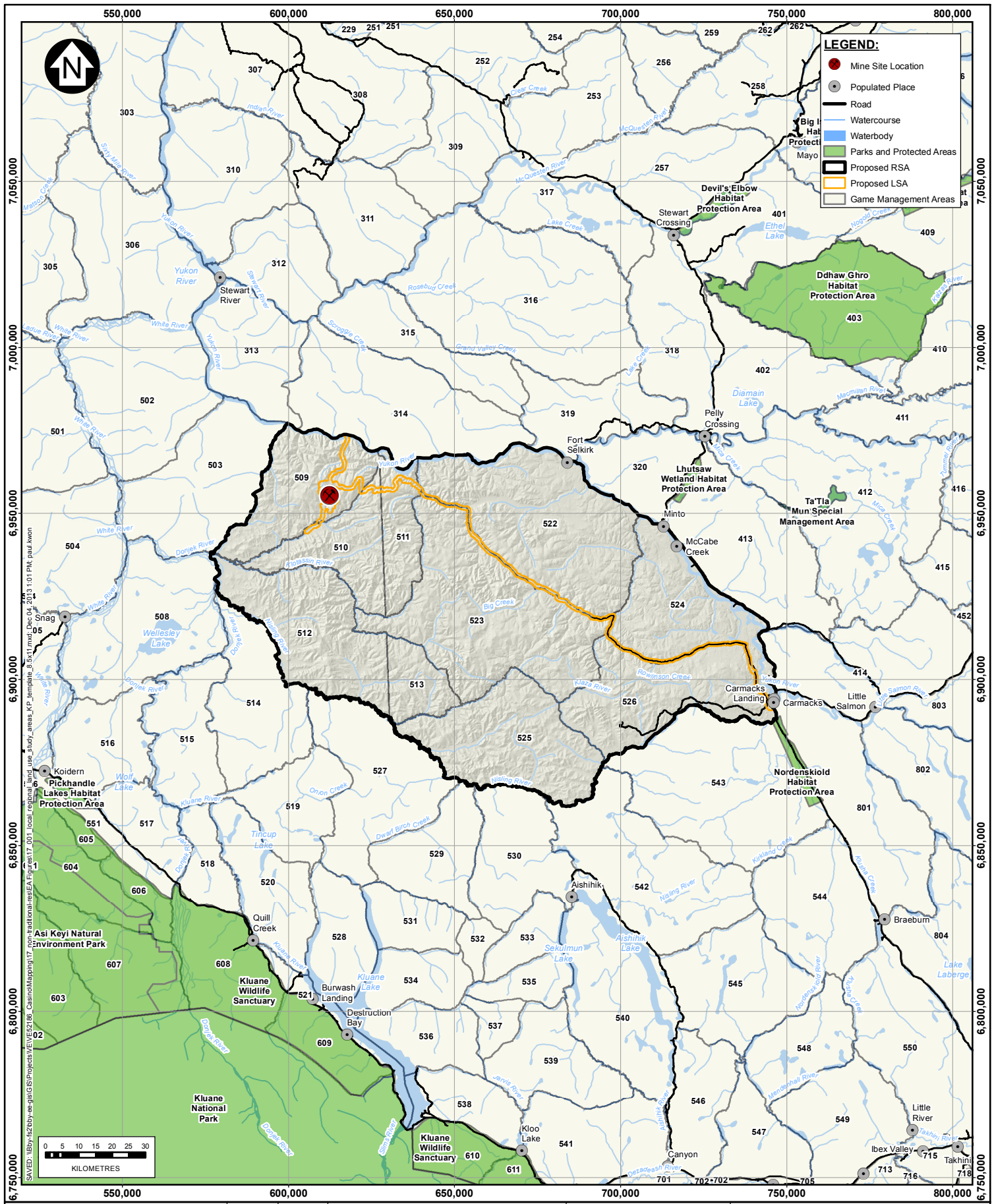
19.2.1 Local Study Area

A 500-m buffer around the entire Project footprint was selected as the Local Study Area (LSA) to ensure potential direct effects of the Project on land use are addressed (Figure 19.2-1). The access road starts at the existing Freegold Road west of Carmacks which will be upgraded as part of the Project. The most western portion of the

Freegold Road will be extended and will terminate at the mine site. The Land Use LSA is based on the following Project components:

- Mine site footprint;
- Water pipeline (and existing access road) from the Yukon River valley;
- Airstrip and associated access road;
- Freegold Road Upgrade; and
- Freegold Road Extension.

For the purpose of this effects assessment the maximum disturbance area incorporates the water pipeline and existing access road as well as the airstrip and access road.



PREPARED BY:

amec

DESIGNED	PK
DRAWN	PK
CHK'D	MY
APP'D	SB
REV	-
DATE	03DEC'13

NOTES:
1. BASE MAP: Atlas of Canada 1:1,000,000, Yukon Geomatics
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: Metres

CASINO COPPER AND GOLD

CASINO PROJECT

Local and Regional Land Use Study Areas

FIGURE 19.2-1

REF REPORT 1

P/A VA101-325/15

19.2.2 Regional Study Area

The Land Use Regional Study Area (RSA), which is based on defined Game Management Areas, provides a representative buffer around the Land Use LSA that overlaps land uses potentially indirectly affected by the Project (Figure 19.2-1). Information collected and summarized for the Land Use RSA is used to develop the list of other projects and activities occurring proximate to the Project that may overlap temporally and spatially with potential Project effects. This information is incorporated into the cumulative effects assessment.

19.2.3 Temporal Boundaries

The temporal boundaries for the effects assessment is defined in Section 5.2 of the Proposal as the life of the Casino Project. Details on activities associated with the construction, operation, closure and decommissioning and post-closure phases of the Project is provided in Section 4.0.

From a land use perspective there are several activities that occur more frequently or are regulated for certain times of the year. The existing Casino Trail is managed as a winter access route and transport of equipment and supplies in support of placer and quartz mining activities and exploration occurs primarily in the winter as this is when access over the trail is most practical. General recreation activities conducted by the local residents occur year round but the Casino Trail is considered relatively inaccessible during the summer months. Although, recreation activities based primarily on tourist participation can occur anytime of the year, it is presumed that they occur more often in the warmer months in areas that would be easily accessible. Hunting regulations specify season dates for various wildlife species (Yukon Environment 2013). Trapping occurs primarily in the winter months between October/November through to February/March.

19.3 BASELINE CONDITIONS

Baseline conditions are provided in the sections below for the following indicators selected to assess potential effects on the Land Use and Tenure VC:

- Traditional and domestic use;
- Hunting, guide outfitting and trapping;
- Recreation and tourism;
- Mining, prospects, exploration and mineral tenures; and
- Transportation and access.

Additional information to supplement the baseline is provided in Appendix 19A.

19.3.1 Traditional and Domestic Use

The Land Use RSA is primarily situated in the SFN and LSCFN Traditional Territory. Both the mine site and the Freegold Road Extension are in the SFN Traditional Territory. The SFN and LSCFN signed Final and Self-Government Agreements with Yukon and Canada in 1997 and 1998, respectively (SFN, Government of Canada and Government of the Yukon 1997; LSCFN, Government of Canada and Government of the Yukon 1998). The LSCFN and SFN are Northern Tutchone, part of the Athapaskan language group. The SFN and LSCFN have historically lived in the Project area. In addition to hunting, trapping and fishing activities SFN and LSCFN in the area participate in a variety of traditional land uses. The collection of plants for food, medicine and construction of baskets, containers, etc., is a traditional and current practice of FN peoples.

The SFN people originally lived in Fort Selkirk where they had a trading relationship with the Coastal Tlingit and would meet to trade during the summer fish camps (SFN 2013; Yukon Bureau of Statistics 2013a). After the fur-trading fort was built, the SFN people settled there on a more permanent basis, continuing to trap, fish, hunt and gather year-round in their traditional areas. With the construction of the Klondike Highway the SFN moved to Minto and later on, settled in Pelly Crossing and other communities. Traditionally, SFN people relied on the land and one another for survival, travelling by foot over long distances for hunting, trading, and celebrations (SFN 2013). Culture, traditions, customs and survival skills were passed to children, who learned by listening and practicing. SFN maintains strong links to hunting with many members obtaining a significant portion of their food supply through this means (SFN 2013)

The LSCFN Traditional Territory is rich in renewable and non-renewable resources. Parts of the year are spent hunting, trapping, fishing and gathering flora for food and medicines in their traditional territory. A wide variety of game, including birds, water fowl, large game, wolf, wolverine, fox and marten, is sought for food, clothing and other uses (Yukon Bureau of Statistics 2013b). The oral history of the LSCFN reveals early contacts and trade relationships with explorers and traders in the area. Since earliest times, the people lived on the land, using the rich supply of game animals, fish, birds and plants, and travelling throughout their traditional territory throughout the year. It is known that LSCFN collect Arctic Raspberry, Labrador Tea, cranberries, blackberries, stone berries and mushrooms in their traditional territory (Nicholson 2002).

19.3.2 Hunting, Guide Outfitting and Trapping

Recreational hunting, guide outfitting and trapping take place within the Land Use LSA and RSA. Licenses are sold by ‘big game’ or ‘small game’ (Environment Yukon 2013a). To harvest big game, hunters are required to have a valid hunting license and big game seal and permit. Those from outside of the Yukon who wish to hunt can only do so with a registered Yukon outfitter or a Yukon resident who holds a special guide license. Big game species include moose, caribou, sheep, goat, bison, bear, deer, elk, wolf, wolverine, coyote, and muskox. It is mandatory that all hunters comply with the regulations outlined in the Wildlife Act (Environment Yukon 2013a).

First Nation hunters who have negotiated a Final Agreement are permitted to hunt within their own traditional territory and are permitted to harvest either gender year round, except for elk and bison. First Nations who are without a Final Agreement are not permitted to hunt on other First Nation’s Traditional Territory without either a current hunting license or written consent from the Territory’s Fist Nation, however, they are permitted to hunt outside of designated Traditional Territory and are permitted to harvest either gender year round, except elk and bison without limit.

Trapping in the Yukon is managed under the *Wildlife Act* as well as the Council of Yukon First Nations Umbrella Final Agreement (including individual First Nation Final Agreements) (Council of Yukon First Nations 1990). In the Yukon, 14 different species of furbearing mammals are trapped. Table 19.3-1 summarizes the 11 registered trapline concessions overlapped by the Land Use LSA (Geomatics Yukon, 2013). For each trapline the percent of trapline area that falls within the Land Use LSA ranges from 0.2 – 18.2%, with the majority (9 traplines) having less than 5% overlapped. Traplines in this region are often remote, and two of the registered trapline holders indicated that access to the traplines can be time-consuming and costly (Registered Trapline Holders, 2012 pers. comm.).

Table 19.3-1: Registered Trapping Concessions Overlapping the Land Use LSA

Registered Trapping Concession	Trapline Area (ha)	% of Trapline that falls within LSA
116	146,462	2.0
121	129,827	4.5
122	113,682	3.6
131	216,996	1.4
146	106,380	4.0
147	77,325	2.5
148	135,364	0.9
149	32,091	2.7
150	21,082	11.2
151	20,943	0.2
408	3,115	18.2

Source: Geomatics Yukon (2013) – Registered Trapping Concessions; Environment Yukon (2013) Harvest Coordinator pers. comm.

A 2011 SFN Newsletter identified development of trapping infrastructure and the traditional economy were identified as priorities that are being incorporated into the 2011/2012 budget (SFN 2011). Similarly the LSCFN Integrated Community Sustainability Plan also identifies subsistence hunting, fishing and trapping as a way of life for their membership (Inukshuk Planning and Development 2007).

Three outfitting concessions (OC) are overlapped by the Land Use LSA: 11; 13; and 14. Outfitter concession 11 is managed by Prophet Muskwa Outfitters; OC 13 is managed by Mervyn's Yukon Outfitting Ltd; and OC 14 is managed by Trophy Stone Outfitting Ltd (summarized in Table 19.3-2). The percent area falling within the Land Use LSA is very small ranging from 0.005% for OC 14 to 1.04% for OC 11.

Table 19.3-2: Registered Outfitting Concessions Overlapping the Land Use LSA.

Registered Outfitting Concession (OC) / Owner	Total Guide Outfitting Concession Area (ha)	% of Guide Outfitting Concession that falls within LSA
OC 11 / Prophet Muskwa Outfitters	903,073	1.04
OC 13 / Mervyn's Yukon Outfitting Ltd	2,330,269	0.75
OC 14 / Trophy Stone Outfitting Ltd	1,018,809	0.005

Source: Yukon Outfitters Association (2013); Geomatics Yukon (2013) – Outfitting Concessions

For the purpose of this assessment, general resident hunting is included as recreational hunting within the recreation and tourism indicator.

19.3.3 Recreation and Tourism

Recreation opportunities in the Yukon are abundant and include boating (rafting, kayaking, canoeing), dog sledding, hiking/backpacking, recreational hunting, cross-country skiing and snowshoeing, horseback riding and mountain bike riding (Yukon Wild 2013a). Popular recreation activities within the area include traveling between

Whitehorse and Dawson City and visiting the historic Fort Selkirk, established during the gold rush (Yukon Wild 2013b). No parks or protected areas, campgrounds or picnic areas are located within the Land Use RSA or overlap the Land Use LSA. However, the general project area is known to be used for a variety of recreational land uses.

19.3.4 Mining, Prospects, Exploration and Mineral Tenures

The Project falls within the Whitehorse Mining District. The four different types of mining activities in the Yukon occur within the Project area and include: placer (gold); quartz (hard rock); coal; and quarries for borrow source material. In most cases mining activities are focussed proximate to the existing Freegold Road and the Freegold Road Extension.

There are 1,421 active quartz claims (registered to 20 different owners) intersected by the Land Use LSA at the time of writing this report. A search of available information indicates that there is no active quartz leases located within the Land Use LSA. There are six active placer prospecting leases and 368 active placer claims (registered to 24 different owners) overlapping the Land Use LSA. There is one active borrow pit and four permitted future (inactive) granular sources and borrow pits en route to the Project site along the existing Freegold Road. One active coal licence overlaps the Land Use RSA and is located approximately 10 km off the eastern end of the Freegold Road.

19.3.5 Transportation and Access

The mine site will be accessed via the Freegold Road, which originates in Carmacks. At present, there is only 70 km of existing Freegold Road, which serves as a corridor for a number of placer mines and exploration in the area, and is also used for accessing hunting, fishing and gathering. Access west of the existing Freegold Road is by the Casino Trail. The Freegold Road will be extended an additional 132 km, following the general path of the Casino Trail corridor, allowing for the transportation of project traffic to and from the mine site. A by-pass, which would see mine-related traffic avoid driving through the community of Carmacks, has been surveyed and approved for building if the Casino mine receives government approval and a decision to build is made.

From km 83, the intention is that the Freegold Road Extension will be a privately owned and operated resource road. There will be no public access. Use of the road will be restricted to support the Casino mine operation. Access will be managed as follows:

- Freegold Road Extension Management and Access agreement and plan will be negotiated between Casino Mining Corporation, Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nations governments;
- The Casino Mining Corporation will have a policy that Project traffic will not be able to hunt, fish or gather while using the Freegold road extension and Freegold road upgrade and while on the mine site;
- No public access (access by permit, as directed and agreed upon by the Management Plan); and
- Controlled, gated, staffed access (with security gates at km 83 and again at the entrance to the mine site)

For the purpose of this assessment potential effects on traffic are discussed in detail in the transportation indicator in Section 17 Community Infrastructure and Services. Potential project effects associated with access are discussed for each of the indicators selected for the Land Use and Tenure VC effects assessment as appropriate.

19.4 PROJECT-SPECIFIC EFFECTS

The following discussion summarises how the Land Use and Tenure VC could be affected by the Project in each of the four development phases: construction; operations, closure and decommissioning; and post closure.

19.4.1 Project Interactions and Potential Effects

19.4.1.1 Project Components / Activities and Potential Interactions with Land Use and Tenures

The following section is broken into development phases and changes to area, access, and ambience.

Potential interactions between the Project components and the indicators selected to identify potential effects to land use and tenures are described below and summarized in Table 19.4-1 below. It is the intent of CMC to negotiate a Freegold Road Extension Access Management Agreement with the Yukon Government and SFN and LSCFN. This agreement will address how a private road and access control could be managed to meet the project requirements with consideration of existing tenure holders and individuals.

Construction

Maximum Disturbance Area (Mine Site Footprint and Ancillary Facilities):

- Change in area due to Project footprint

A direct loss or disturbance of area available for other land uses is expected within the project footprint during construction of the various project facilities. Construction activities will include clearing and preparing the mine site area and building the project components including: accommodations and ancillary buildings; fuel storage; processing facilities; surface water management facilities; topsoil and ore stockpiles; water pipeline; airstrip; and airstrip access road.

- Change in access to area

A staffed security gate will be located at the entrance to the mine site from the Freegold Road. Another staffed security gate will be installed on the existing access road that generally follows the water pipeline.

- Change in local ambience

The local ambiance in the environment surrounding the maximum disturbance area, which includes the airstrip (and associated traffic), will be disturbed by emissions and noise from mine site vehicles and construction equipment, aircraft and the corresponding change in the landscape.

Freegold Road Upgrade:

- Change in area due to Project footprint

The upgrade to the Freegold Road primarily follows the existing Freegold Road. Construction of the Freegold Road Upgrade will include a combination of cut and fill activities and overlanding. Cut and fill construction will involve excavating suitable material and placing it to construct the road embankment. Overlanding will be used through areas of low lying wet lands, and areas of permafrost and will involve the placement of suitable embankment material over organic material. Borrow pits will be required as a source for embankment and road surfacing material. The maximum disturbance area, for both the Freegold Road Upgrade and extension, includes the required borrow pits and laydown areas which will be located along the Freegold Road corridor within the Land Use LSA. Borrow pits will be progressively decommissioned when they are no longer needed by grading restoring natural drainage patterns and re-vegetating. A loss of area available for other land uses will be required

in areas where the upgraded Freegold Road does not follow the existing road in order to achieve regulated design criteria.

- Change in access to area

During construction of the Freegold Road Upgrade it is predicted that access will be limited due to periodic road closures. The schedule and duration of these road closures will be determined as the Project proceeds and whenever possible one lane will remain open.

Freegold Road Extension:

- Change in area due to Project footprint

The Freegold Road Extension will mostly follow the existing Casino Trail that has been used in the past to service the Casino Project site, beginning approximately 83 km northwest of the Village of Carmacks at the western edge of the existing Freegold Road. The Casino Trail, which is used to transport equipment and supplies primarily during the winter, has been the main access route to the mine site area for over 50 years. The existing Casino Trail will initially be used for preconstruction activities during the winter months via winter roads, to move fuel and equipment to the Casino mine site and for road construction support. The existing Casino Trail will be expected to be open for approximately 2-4 months and will be used to mobilize heavy equipment required for the construction of the mine site facilities and by the contractor responsible for the Freegold Road Extension.

The Freegold Road Extension will be a 120 km long, two-lane, gravel resource road designed for all weather use by haul trucks with highway legal loads. The road design criterion satisfies guidelines for a 70 km/h design speed with some short 50 km/h sections where road geometry is limited by the terrain or safety concerns. The road will be 8.2 m wide with maximum grades of 8%. The all-weather access road will be required to support the level of traffic anticipated with year round haulage of materials into and out of the Casino mine site during the operations phase. A new alignment is required along the extension of the Freegold Road in areas where the existing Casino Trail does not support regulated design criteria.

- Change in access to area

Access along the Casino Trail will be limited once construction of the Freegold Road Extension commences. Conflicts with construction traffic may occur and gated access to the mine site at km 83 will be implemented. Traffic allowed past the security gate will primarily be limited to mine site traffic. Any other use of the road would require approval under the Freegold Road Extension Access Management Agreement. Periodic short term road closures may be required. The schedule and duration of these road closures will be determined as the Project proceeds and whenever possible one lane will remain open.

Traffic (Equipment and Materials to/from Site):

- Change in local ambience

Construction along both the existing Freegold Road and Freegold Road Extension will change the local ambiance along the travel corridor with increased vehicle traffic and associated emissions and noise. During construction sections of the upgraded Freegold Road and extension will have traffic limitations. Depending on Project schedule, an increased traffic volume may occur at certain times of the Project along the entire Freegold Road access corridor.

Operations

Maximum Disturbance Area (Mine Site Footprint and Ancillary Facilities):

- Change in area due to Project footprint

A direct loss or disturbance of area available for other land uses is expected within the project footprint during routine operations. Activities at the mine site during operations will include the implementation and advancement of a variety of project components including: open pit mining; crushing and stockpiling; TMF; and waste rock and overburden disposal.

- Change in access to area

Access to the mine site will be monitored by a staffed security gate at the entrance to the mine site. The existing access road that generally follows the water pipeline route will also be monitored by a staffed security gate.

- Change in local ambience

Routine operations, which include the airstrip, will continue 24 hours a day for the life of the mine. The local ambience will be affected by emissions and noise from traffic (ground and aircraft) and equipment during a variety of project operations.

Freegold Road Upgrade:

- Change in access to area

Access along the upgraded all weather Freegold Road will be improved and maintained during operations, though limited at times due to maintenance requirements.

Freegold Road Extension:

- Change in access to area

Access to the mine site will continue to be limited at km 83 along the Freegold Road Extension by a staffed security gate. Individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement.

Traffic (Equipment and Materials to/from Site):

- Change in local ambience

Traffic associated with routine operations along both the existing Freegold Road and Freegold Road Extension will change the local ambiance along the travel corridor with increased vehicle traffic and associated emissions and noise. Conflicts associated with routine project traffic may also be an issue at certain times during operation.

Closure and Decommissioning

Maximum Disturbance Area (Site clearing and de-construction):

- Change in area due to Project footprint

Closure activities would be carried out concurrently with mine operations wherever possible. Mine site facility structures and equipment will be de-constructed and removed from the mine site during closure and decommissioning. Once the site facility structures are removed the mine site will be cleared and prepared for reclamation / revegetation wherever possible.

- Change in local ambience

During closure and decommissioning the local ambience will be affected by emissions and noise from traffic and equipment. Visually the mine site will become less industrialized and the overall landscape be improved with grading and contouring.

Site Reclamation / Re-Vegetation:

- Change in area due to Project footprint

Following de-construction and site preparation disturbed areas will be reclaimed as outlined in the Reclamation and Closure Plan. The landscape will be reclaimed using a variety of methods including revegetation (i.e. heap leach facility and stockpiles); wetlands creation (i.e. TMF); and surface water management (i.e. pit refill and water management pond). Most of the mine site area will be available for a variety of land uses following reclamation. However, some of the reclaimed areas will remain permanently unavailable due to placement of overburden or creation of wetlands and surface water bodies.

- Change in local ambience

During closure and decommissioning activities local ambience will be affected by emissions and noise from traffic and equipment. Once reclamation is complete the local landscape directly affected by mine site operations will visually blend in with the surrounding environment.

Freegold Road Upgrade:

- Change in access to area

Access along the upgraded all weather Freegold Road will be continue to be maintained during closure and decommissioning.

Freegold Road Extension:

- Change in access to area

Traffic will continue to be controlled at the security gate until the closure of the mine site is completed. Access along the Freegold Road Extension will primarily be limited to mine site traffic. Individual road access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. Unless directed otherwise by government, the Freegold Road Extension will be closed and decommissioned once it is no longer required by the Project.

Traffic (Equipment and Materials to/from Site):

- Change in local ambience

Traffic associated with closure and decommissioning along both the existing Freegold Road and Freegold Road Extension will change the local ambiance along the travel corridor with increased vehicle traffic and associated emissions and noise. Conflicts associated with project traffic may also be an issue at certain times during closure and decommissioning. As the closure and decommissioning phase progresses it is presumed that project traffic will decrease to pre-project levels. Following completion of the closure and decommissioning project phase the Freegold Road Extension will be decommissioned.

Post Closure

During the post closure phase, there would be little activity at the mine site. Activities would be limited to monitoring, which would involve only a few aircraft transporting monitoring equipment and monitoring personnel.

The area occupied by several reclaimed site facilities (i.e. TMF and open pit) will be unavailable for future land use activities.

Table 19.4-1 Potential Interactions between the Project and Land Use and Tenures

Project Components and Activities	**Project Phase[1]** (C, O, DC, PC)	**Potential Interaction (Yes/No)**	**Mechanism of Interaction** (or Rationale for No Interaction)
Accommodations (Construction and Mine Staffing)	C, O, CD,	Yes	Included in Maximum Disturbance Area
Aggregate sources / Borrow Sites	C,	Yes	Included in Maximum Disturbance Area
Airstrip and Airstrip Access Road	C, O, CD,	Yes	Change in area due to Project footprint; Change in local ambience
Ancillary Buildings (Explosives Storage, Security Shed, Truck Shop etc.)	C, O,	Yes	Included in Maximum Disturbance Area
Concentrate Transport and Loading	O,	Yes	Included in Maximum Disturbance Area
Concrete Batch Plant Operation	C, O,	Yes	Included in Maximum Disturbance Area
Contracted Employment	C, O, CD,	Yes	Included in Maximum Disturbance Area
Cyclone Sand Plant	C, O,	Yes	Included in Maximum Disturbance Area
Dismantling of Facilities	CD,	Yes	Included in Maximum Disturbance Area
Diversion of Canadian Creek	C, O,	Yes	Included in Maximum Disturbance Area
Drilling and Blasting	C, O,	Yes	Included in Maximum Disturbance Area
Fish Habitat Compensation Construction	C, O,	TBD	To be determined once compensation has been finalized
Freegold Road Extension	C, O, CD,	Yes	Change in area due to Project footprint; Change in access to area;
Freegold Road Upgrade	C, O, CD,	Yes	Change in area due to Project footprint: Change in access to area;
Fuel Storage and Distribution System	C, O,	Yes	Included in Maximum Disturbance Area
Gold Extraction Plant / Oxide Ore Processing	C, O,	Yes	Included in Maximum Disturbance Area
Ground Preparation Activities (e.g. cut, fill, grub, etc.)	C,	Yes	Included in Maximum Disturbance Area
Hazardous Materials Storage, Transport, and Disposal	C, O,	Yes	No interaction expected with implementation of mitigation Addressed in Accidents and Malfunctions Section
Heap Leach Facility	C, O,	Yes	Included in Maximum Disturbance Area
Heap Leach Pad	C, O,	Yes	Included in Maximum Disturbance Area
Laydown Areas	C, O,	Yes	Included in Maximum Disturbance Area
LNG Transport to site	C, O,	Yes	No interaction expected with implementation of mitigation

Project Components and Activities	Project Phase[1] (C, O, DC, PC)	Potential Interaction (Yes/No)	Mechanism of Interaction (or Rationale for No Interaction)
			Addressed in Accidents and Malfunctions Section
Main and Supplemental Power Plant (Gas Turbine and Diesel)	C, O,	Yes	Included in Maximum Disturbance Area
Maximum Disturbance Area	C, O, CD,	Yes	Change in area due to Project footprint
Mine Development	C, O, CD,	Yes	Change in local ambience; Change in local ambience
Mine Staffing	C, O, CD,	Yes	Included in Maximum Disturbance Area
On-site equipment and vehicle use	C, O, CD,	Yes	Included in Maximum Disturbance Area
Open Pit Mining	C, O,	Yes	Included in Maximum Disturbance Area
Ore Conveyors	C, O,	Yes	Included in Maximum Disturbance Area
Ore Crushing	C, O,	Yes	Included in Maximum Disturbance Area
Ore Hauling	C, O,	Yes	Included in Maximum Disturbance Area
Ore Stockpiles	C, O,	Yes	Included in Maximum Disturbance Area
Processing Facilities for Sulphide Ore	O,	Yes	Included in Maximum Disturbance Area
Reagent Storage and Distribution	C, O,	Yes	Included in Maximum Disturbance Area
Site Reclamation / Re-Vegetation	O, CD,	Yes	Change in area due to Project footprint
Site Security and Fencing	C, O, CD,	Yes	Included in Maximum Disturbance Area
Surface Water Management (Contact Water)	C, O, CD,	Yes	Included in Maximum Disturbance Area
Surface Water Management (Non-Contact Water)	C, O, CD,	Yes	Included in Maximum Disturbance Area
Tailings Management Facility	C, O, CD,	Yes	Included in Maximum Disturbance Area
Topsoil Stockpiles	C, O,	Yes	Included in Maximum Disturbance Area
Traffic (Equipment and Materials to Site)	C, O, CD,	Yes	Change in local ambience
Waste management: garbage and sewage waste facilities	C, O,	Yes	Included in Maximum Disturbance Area
Waste rock and Overburden Disposal	C, O,	Yes	Included in Maximum Disturbance Area
Water Supply	C, O, CD, PC	No	No effects on Land Use and Tenures identified

Note:

1. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. Potential mechanism(s) of interaction between the Project components and activities and the valued component are carried forward into the assessment by characterizing the potential effect(s).

19.4.1.2 Summary of Potential Effects

The following discussion summarises the potential effects on the indicators selected for the Land Use and Tenure VC in each of the four development phases for the mine site, Freegold Road Upgrade and Freegold Road Extension using the information summarized in Table 19.4-1 above. Potential Project effects are primarily associated with the following three issues:

- Change in area due to Project footprint;
- Change in access to area; and
- Change in local ambience.

Change in Area Due to Project Footprint

The following indicators were used to assess the potential effects that the Project may have on availability of area for the Land Use and Tenure VC:

- FN Settlement Lands;
- Quartz and Placer Claims; and
- Trapping and Outfitting.

FN Settlement Lands

From a Traditional Land Use perspective, area occupied by FN settlement lands will be affected to varying degrees as the Project progresses through construction, operations, closure and decommissioning and post closure. During construction several sections of the upgrade to the existing Freegold Road and Freegold Road Extension following the Casino Trail will be built on or proximate to SFN and LSCFN settlement lands. The mine site falls within the SFN Traditional Territory. The SFN and LSCFN have historically occupied the project area and are known to participate in a variety of traditional land uses. During operations the area occupied by the Freegold Road access corridor and mine site will be unavailable for traditional land uses. Following closure and decommissioning the area occupied by the Freegold Road Extension and area within the mine site that has not been permanently withdrawn will be available for traditional land uses.

Quartz and Placer Claims

Potential Project effects associated with changing the area available for other land uses due to the mine site footprint, Freegold Road Upgrade and Freegold Road Extension, are primarily associated with placer and quartz tenures and associated exploration activities. Available information indicates that the majority of exploration and mining activities within the Land Use RSA occur along the existing Freegold Road and continue along the Casino Trail to the mine site. Potential project effects include the loss of currently permitted mining tenure and lease areas due to the Freegold Road Upgrade and Freegold Road Extension as well as the mine site footprint. These areas would be directly affected during construction activities and would be unavailable during routine operations. Following closure and decommissioning the Freegold Road Extension will be decommissioned and previously unavailable areas will be reclaimed and opened up for exploration and staking. Areas not permanently withdrawn from staking associated with the reclaimed mine site (i.e. TMF and open pit) and Freegold Road Upgrade will also be available for future exploration activities.

Trapping and Guide Outfitting

Relatively small percentages of several trapping and guide outfitting concessions intersected by Project activities will be affected. During construction and operations 11.2% and 18.2% of trapline concession numbers 150 and

408 will be unavailable. Less than 5% of the remaining nine traplines intersected by the Land Use LSA will be affected during any phase of the Project. The maximum percentage of unavailable area for the three guide outfitter concessions intersected by the Land Use LSA ranges from 0.005 to 1.04% during construction, operations and closure and decommissioning. Potential effects to the trapping tenure (#334164) located within the area proposed as the access road to the airstrip will be specifically assessed as the Project progresses.

Project effects to trapping and guide outfitting concession areas will be addressed during closure and decommissioning. Post closure, most of the trapline and guide outfitter areas will be available, with the exception of permanently withdrawn areas associated with the mine site and Freegold Road Upgrade.

Change in Access to Area

In general improved accessibility to the area due to the Freegold Road Upgrade will benefit existing permitted land user groups (e.g. mining exploration); however, it may also attract additional third party interest and use in the area. Other land use activities may be easier to conduct on the upgraded road with less travel time and effort to access areas.

Traffic along the Freegold Road Extension will be strictly controlled at the km 83 staffed security gate during construction, operations, closure and decommissioning up until the Freegold Road Extension is no longer required and is decommissioned. Access along the Freegold Road Extension is predicted to return to pre-project conditions post closure.

The following indicators were used to assess the potential effects that the Project may have on access in the area for the Land Use and Tenure VC:

- FN Settlement Lands;
- Quartz and Placer Claims;
- Recreational Land Use; and
- Trapping and Outfitting.

<u>FN Settlement Lands</u>

The construction of the Freegold Road Upgrade will provide easier access to areas frequented by FN for traditional land use activities. The upgraded design criteria and year round management of road conditions will facilitate access and make travel safer along the entire Freegold Road corridor. There is the potential, however, for reduced access to traditional territory due to Project activities during construction, operations and closure and decommissioning activities. Conflicts between Project activities and FN traditional land use will vary; with construction activities potentially being the primary issue due to multiple factors (i.e. safety) that will need to be addressed. Once construction of the Freegold Road Upgrade is completed traffic conflicts are expected to be infrequent and short term in duration during operations and closure and decommissioning. Due to the improved design criteria for the Freegold Road Upgrade there is the potential that other land use activities (i.e. recreational hunting) may conflict with FN traditional land use activities.

Access along the Freegold Road Extension will primarily be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement.

Quartz and Placer Claims

There is the potential that Project activities and traffic may adversely affect access to permitted mining tenures along the existing Freegold Road and Casino Trail during construction, operations and closure and decommissioning activities. Conflicts between Project activities and mining activities will vary; with construction activities potentially being the primary issue due to multiple factors (i.e. safety) that will need to be addressed. Once construction of the Freegold Road Upgrade is completed traffic conflicts are expected to be infrequent and short term in duration during operations and closure and decommissioning. Once construction is complete and routine operations commence access to existing tenure areas and new permitted exploration activities along the Freegold Road Upgrade will continue.

Access along the Freegold Road Extension will primarily be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement.

Recreational Land Use

Reduced access to areas used for outdoor recreational activities will occur during the Freegold Road Upgrade during construction, operations and closure and decommissioning. Conflicts between Project traffic and access to recreational activities will vary; with construction activities potentially being the primary issue due to multiple factors (i.e. safety) that will need to be addressed. Once construction of the Freegold Road Upgrade is completed traffic conflicts are expected to be infrequent and short term in duration during operations and closure and decommissioning. The upgrade to the existing portion of the Freegold Road will improve year round access (up until the staffed security gate for the new Freegold Road Extension leading to the mine site) for recreational land uses (i.e. recreational hunting).

Access along the Freegold Road Extension will primarily be limited to mine site traffic. Access for recreational land use (i.e. recreational hunting) on the new Freegold Road Extension will be managed (in most cases stopped unless approval is received) by a controlled, staffed gate at km 83.

Trapping and Outfitting

The upgrade of the existing Freegold Road and extension of the Freegold Road following the Casino Trail will affect access for trappers and guide outfitters. Conflicts between Project activities and access to areas frequented by trappers and guide outfitters will vary; with construction activities potentially being the primary issue due to multiple factors (i.e. safety) that will need to be addressed. Once construction of the Freegold Road Upgrade is completed project conflicts are expected to be infrequent and short term in duration during operations and closure and decommissioning. Once construction is complete and routine operations commence access to trapping and guide outfitting concession areas will be facilitated by the Freegold Road Upgrade. The upgrade to the existing portion of the Freegold Road will improve year round access (up until the staffed security gate at km 83 for the new Freegold Road Extension leading to the mine site). There is the potential that this improved access may increase the presence of others whose activities may conflict with the permitted trappers and guide outfitters operating in the area.

Access along the Freegold Road Extension will primarily be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement.

Change in Local Ambience

In order for a change in local ambience to be considered potential receptors have to be identified that would be adversely affected by the Project. Following a review of the available information it was determined that for the purpose of this assessment the maximum disturbance area of the mine site was considered remote and relatively inaccessible. Therefore, potential receptors were limited to the trapper and guide outfitter concession areas and the Traditional Territory of the SFN that are intersected by the mine site. Although it is possible for recreational enthusiasts to access the mine site area it is very unlikely. Similarly, it has been assumed that due to limited access along the Freegold Road Extension the potential for receptors would be considered relatively minor and is predicted to be limited to the trapper and guide outfitter concession areas and the FN Traditional Territories. The following indicators were used to assess the potential effects that the Project may have on local ambience and wilderness experience associated with the Land Use and Tenure VC:

- FN Settlement Lands;
- Recreational Land Use; and
- Trapping and Outfitting.

FN Settlement Lands

Noise and emissions from construction activities and traffic associated with the upgrade to the Freegold Road and extension along the existing Casino Trail may affect the wilderness experience associated with traditional land use activities. These effects would be reduced substantially once construction is completed. Although the mine site is considered relatively remote there is the potential for activities during all Project phases to adversely affect the local ambience and wilderness experience for FN conducting traditional land use activities proximate to the mine site. Post closure, the local ambience is predicted to be neutralized and return to conditions that blend into the surrounding environment.

Recreational Land Use

During construction of the Freegold Road Upgrade, noise, emissions and traffic will adversely affect the local ambience for recreational land use activities. These effects would be reduced substantially once construction is completed.

Trapping and Outfitting

During construction of the Freegold Road Upgrade and extension along the existing Casino Trail noise, emissions and traffic may adversely affect the local ambience for trapping and guide outfitting activities within their concession areas. These effects would be reduced substantially once construction is completed. During operations and closure and decommissioning there is the potential for an adverse effect on local ambience associated with increased traffic along the Freegold Road Upgrade and extension. The wilderness experience associated with trapping and guide outfitting activities conducted proximate to the mine site will also be affected by noise and emissions during construction, operations and closure and decommissioning. Potential effects on the trapping tenure (#334164) located within the area proposed as the access road to the airstrip will be specifically identified and addressed. Following post closure, the local ambience is predicted to be neutralized and return to conditions that blend into the surrounding environment.

Table 19.4-2 Potential Effects on Land Use and Tenures

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, DC, PC)	Potential Effect	Direction
Change in area due to Project footprint	FN Settlement Lands	C, O, CD,	Loss of area available for FN traditional land use activities or other uses	Adverse
	Quartz and Placer Claims	C, O, CD,	Loss of available area for quartz and placer mining	Adverse
	Hunting, Trapping and Outfitting	C, O, CD,	Loss of area available for trapping and outfitting	Adverse
Change in access to area	FN Settlement Lands	C, O, CD,	Easier access to area for others whose activities may conflict with FN traditional land use activities, (Freegold Road Upgrade)	Adverse
		C, O, CD,	Reduced access to Traditional Territory due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse
		C, O, CD,	Negotiated road access to Traditional Territory (Freegold Road Extension)	Adverse / Neutral/Positive
			Easier access to area for traditional land use activities. (Freegold Road Upgrade)	Beneficial
	Quartz and Placer Claims	C, O, CD,	Reduced access to permitted tenure areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse
		C, O, CD,	Negotiated road access to area for existing mineral tenure holders (Freegold Road Extension)	Adverse / Neutral/Positive
		C, O, CD,	Easier access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade)	Beneficial
	Recreational Land Use	C, O, CD,	No road access to area for recreational activities (Freegold Road Extension)	Adverse/Neutral
		C, O, CD,	Reduced access to recreational areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse

Mechanism of Interaction	Key Indicator(s)	Project Phase (C, O, DC, PC)	Potential Effect	Direction
		C, O, CD,	Easier access to area for recreational activities such as recreational hunting (Freegold Road Upgrade)	Beneficial
	Trapping and Outfitting	C, O, CD,	Negotiated road access to area for existing trappers and guide outfitters (Freegold Road Extension)	Adverse / Neutral
		C, O, CD,	Easier access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade)	Beneficial
		C, O, CD,	Reduced access to trapping and guide outfitting concession areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse
		C, O, CD,	Easier access to area for others whose activities may conflict with trappers and guide outfitters (Freegold Road Upgrade)	Adverse
Change in local ambience	FN Settlement Lands	C, O, CD,	Reduced wilderness experience for FN traditional land use activities	Adverse
	Recreational Land Use	C, O, CD,	Reduced wilderness experience for recreational land use	Adverse
	Trapping and Outfitting	C, O, CD,	Reduced wilderness experience for trappers and guide outfitters	Adverse

Note:

1. Key indicators are defined as measurable parameters or attributes to qualitatively or quantitatively evaluate the potential effect.
2. C (Construction), O (Operation), CD (Closure and Decommissioning) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.

In addition to the potential direct Project effects identified in Table 19.4-2 above, increased wildlife mortality associated with a potential increase in hunting and wildlife accidents involving traffic may contribute to reduced hunting opportunities for guide outfitters, recreational hunters and FN (Section 12).

Several beneficial effects have also been identified for the Land Use and Tenure VC with the upgrade to the existing Freegold Road. Beneficial effects are associated with the improved road conditions and year round maintenance / management of the Freegold Road to the staffed gate at km 83. Freegold Road users will benefit from the upgraded section all year round. Access along the Freegold Road Extension will primarily be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement.

From a land use perspective the following potential beneficial effects have been identified:

- Facilitated access to area for traditional land use activities (Freegold Road Upgrade);

- Facilitated access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade);
- Facilitated access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade); and
- Facilitated access along the existing Freegold Road for all other land uses (Freegold Road Upgrade).

From a temporal perspective, beneficial effects associated with improved access will continue post closure for the Freegold Road Upgrade. Post closure, access along the decommissioned Freegold Road Extension is predicted to return to pre-project conditions.

19.4.2 Identification of Mitigation Measures and Potential Residual Effects

Mitigation measures suggested for minimizing potential effects of the Project on the change in area associated with the project footprint, facilitated access to the area and change in local ambiance include the following:

- Reclamation and Closure Plan;
- Transportation and Access Management Plan (see Road Use Plan); and
- Tenure Holder / Stakeholder Engagement and Communication Plan.

Change in area due to Project footprint

The Reclamation and Closure Plan provides a preliminary outline of mitigation measures addressing the loss of area directly associated with the mine footprint for other land use activities including the following:

- All suitable soil materials in the disturbed areas prior to facility construction and development will be salvaged;
- Salvaged soil will be stockpiled for the duration of the Project and used as reclamation material upon mine areas where mining has been completed; and
- Where appropriate, reclaimed areas will be top dressed with soil and planted with native species selected in consultation with specialists familiar with the specific conditions in the area.

During construction and routine operations the area removed from land use activities for the mine infrastructure will be the greatest. Following closure and decommissioning, with the implementation of the Reclamation and Closure Plan, the area remaining unavailable for other land uses will be decreased significantly.

Placer and quartz tenure areas potentially affected by the upgrade of the existing Freegold Road will be mitigated in consultation with the tenure holders as these areas may be affected beyond the life of the mine (i.e. post closure). Specific mitigation measures will be developed in consultation with the tenure holders to ensure the placer and quartz tenure areas affected by the Freegold Road Extension along the existing Casino Trail, which will be unavailable during the life of the mine, are returned to the tenure holder following mine closure and decommissioning of the Freegold Road Extension.

Potential effects associated with the various phases of the Project on the trapline and guide outfitting concession areas and trapping tenure (#334164) located within the area proposed as the access road to the airstrip will be assessed and mitigation measures identified in consultation with tenure holders.

Change in access to area

An access management strategy will be developed for the mine site in coordination with the trappers and guide outfitters, tenure holders, FN and other affected stakeholders. The purpose of the strategy will be to:

- Manage and limit public access to the mine operating area and site;
- Manage the potential for increased hunting pressures on wildlife;
- Reduce possible wildlife-human conflicts; and
- Protect existing wildlife-dependent land users (e.g. FN, trappers and guide outfitters).

Key elements of the Transportation component of the plan are described in Section 22 Road Use Plan. From an access management perspective, the intention is that the Freegold Road Extension will be a privately owned and operated resource road from km 83. There will be no public access. Use of the road will be restricted to support the Casino mine operation. Some limited use by others may be required; however this is subject to agreement by First Nation governments as well as Yukon Government under the terms of Project specific management plans. (Examples may include pre-existing users, such as trappers, or local placer miners that were already using this route for seasonal access). Important components of the access management strategy will include the following:

- No public access (access by permit, as directed and agreed by the Steering Committee);
- Controlled, gated, staffed access (located at the new bridge over Big Creek (at km 83) – or as otherwise agreed); and
- Develop a tenure holder / stakeholder communication / engagement plan to ensure concerns are identified and addressed.

Access along the restricted portion of the Freegold Road Extension will be in accordance with the Freegold Road Extension Management and Access agreement and appropriate Project-specific management plans. Access along the Freegold Road Extension will be limited to primarily mine traffic. A road access management strategy will be developed in consultation with Yukon Government and SFN and LSCFN that addresses potential interests and concerns with use of the Freegold Road Extension.

Following closure and decommissioning of the Freegold Road Extension, the Freegold Road Upgrade will continue to provide facilitated access. Post closure, the staffed gates at km 83 and the entrance to the mine site will be removed as well as the security fence around the entire mine site. However, following closure a public health and safety assessment will be conducted at the mine site to identify potential risks and develop appropriate long term mitigation and management measures which may include fencing and signage.

In addition to managing access along the Freegold Road Extension, a monitoring program will be implemented that focuses on identifying and reporting any new alternative access points that may be created by local land users (i.e. recreational hunters) along the existing Freegold Road that parallel the gated Freegold Road Extension or provide access to areas that were previously inaccessible. The specific requirements and deliverables for this monitoring program will be developed in consultation with the Yukon government, FN and stakeholders to ensure local interests and concerns are adequately addressed and mitigated.

During construction there is the potential for road closures along the Freegold Road Upgrade. Wherever possible one lane will be kept open to allow travel along the Freegold Road Upgrade however, complete closures may be required periodically. To ensure stakeholders and companies operating in the area are kept informed of the current road status a traffic communication bulletin / update will be circulated in the community on a routine basis. An information line will also be set up to provide answers to questions regarding the Project status.

Potential effects on licenses that may be identified as the Project progresses will be assessed as required throughout the duration of the Project.

Where feasible, enhancement measures will be developed that further support beneficial Project effects throughout the lifetime of the Project.

Change in local ambience

The mine site and ancillary facilities / structures will be planned and constructed to limit the footprint to the maximum extent possible. Accepted best management practices will be incorporated into all phases of the Project with respect to controlling / mitigating traffic, emissions and noise. Reclamation and closure measures will be designed to reduce potential landscape related effects to the maximum extent possible. A stakeholder communication / engagement plan will be implemented to ensure specific concerns identified by the trappers, guide outfitters and FN that may visit the mine site are adequately addressed. Potential effects on the trapping tenure (#334164) located within the area proposed as the access road to the airstrip will be assessed and specific mitigation measures identified.

On-going stakeholder communication / engagement will ensure that potential effects associated with traffic, emissions and noise along the Freegold Road corridor will be identified, documented and addressed. A communication strategy will be developed that will notify local land users of the status of the upgraded Freegold Road to limit potential land use conflicts with Project construction and traffic.

Table 19.4-3 Identification of Mitigation Measures and Potential Residual Effects for the Land Use and Tenure VC

Potential Effect	Project Phase (C, O, DC, PC)	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Loss of available area for FN traditional land use activities	C, O, CD,	Adverse	Limit mine footprint; implement appropriate best management practices and reclamation and closure measures; ensure ongoing communication with FN and local stakeholders.	Moderate	Yes
Loss of available area for quartz and placer mining	C, O, CD,	Adverse		Moderate	Yes
Loss of available area for trapping and outfitting	C, O, CD,	Adverse		Moderate	Yes
Easier access to area for others whose activities may conflict with FN traditional land use activities, (Freegold Road Upgrade)	C, O, CD,	Adverse	Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. Implement access management measures and associated monitoring and	Moderate	Yes
Reduced access to Traditional Territory due to Project traffic during construction, operations and decommissioning / closure (Freegold Road	C, O, CD,	Adverse		High	Yes

Potential Effect	Project Phase (C, O, DC, PC)	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
Upgrade)			communication plans. Ensure ongoing communication with FN and local stakeholders.		
Negotiated road access to Traditional Territory (Freegold Road Extension)	C, O, CD,	Adverse / Neutral/Positive		High	Yes/No
Easier access to area for traditional land use activities. (Freegold Road Upgrade)	C, O, CD,	Beneficial		High	Yes
Reduced access to permitted tenure areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	C, O, CD,	Adverse		High	Yes
Negotiated road access to area for existing mineral tenure holders (Freegold Road Extension)	C, O, CD,	Adverse / Neutral / Positive		High	Yes/No
Easier access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade)	C, O, CD,	Beneficial		High	Yes
No road access to area for recreational activities (Freegold Road Extension)	C, O, CD,	Adverse / Neutral		Moderate	Yes
Reduced access to recreational areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	C, O, CD,	Adverse		High	Yes
Easier access to area for recreational activities (Freegold Road Upgrade)	C, O, CD,	Beneficial		High	Yes
Negotiated road access to area for existing trappers and guide	C, O, CD,	Adverse / Neutral		High	Yes/No

Potential Effect	Project Phase (C, O, DC, PC)	Direction	Proposed Mitigation Measure	Predicted Effectiveness	Residual Effect
outfitters (Freegold Road Extension)					
Easier access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade)	C, O, CD,	Beneficial		High	Yes
Reduced access to trapping and guide outfitting concession areas due to Project traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	C, O, CD,	Adverse		High	Yes
Easier access to area for others whose activities may conflict with trappers and guide outfitters (Freegold Road Upgrade)	C, O, CD,	Adverse		Moderate	Yes
Reduced wilderness experience for FN traditional land use activities	C, O, CD,	Adverse	Limit mine footprint; implement appropriate EMPs (i.e. Air Quality Management Plan) and reclamation and closure measures; ensure ongoing communication with local stakeholders.	Low	No
Reduced wilderness experience for recreational land use activities	C, O, CD,	Adverse		Moderate	Yes
Reduced wilderness experience for trappers and outfitters utilizing the area	C, O, CD,	Adverse		Moderate	Yes

Notes

1. C (Construction), O (Operation), CD (Decommissioning and Closure) and PC (Post-Closure) represent the Project phases when the potential interaction between the Project and valued component is anticipated to occur.
2. For beneficial potential effects, opportunities, where possible, to enhance potential environmental and socio-economic benefits are included as proposed enhancement measures.

19.4.3 Significance of Residual Effects

Table 19.4-4 describes the specific matrices developed for determining the significance of residual effects for the indicators selected to assess the Land Use and Tenure VC. These criteria describe both the characteristics of the effect (e.g., direction, magnitude) and the characteristics of the VC being considered (e.g., context). Quantitative values (i.e. percentage of area removed for local land uses), are used preferentially (when available) over

qualitative criteria. Professional judgement is used in determining if a criterion is given more or less weight in assigning impact significance and the justification for the weighting is provided where necessary for clarification. The level of confidence associated with the assessment is described for each effect.

Table 19.4-4 Determining Significance of Residual Effects for the Land Use and Tenure VC

Criteria	Rating	VC Specific Definitions
Direction	Adverse	Long term trend of the residual effect.
	Beneficial	
Magnitude	Low	Within the range of existing baseline variability; within the normal range of variability for that particular land use.
	Medium	Different from existing baseline conditions but below or equal to threshold/acceptable level; effect is unlikely to pose a serious risk or benefit to land use or to represent a management challenge.
	High	Substantially different from existing baseline, beyond threshold/acceptable level; effect is likely to pose a serious risk or benefit and, if negative, represents a management challenge.
Geographical Extent	Localized	Site-specific or local; effect is confined to the local study area.
	Widespread	Effect extends to the regional study area.
Duration	Short Term	Effect extends throughout the construction phase.
	Long Term	Effect commences during construction and continues throughout operations and closure and decommissioning.
	Permanent	Effects measureable beyond post-closure
Frequency	Infrequent	Occurs occasionally
	Frequent	Occurs often or continuously
Reversibility	Reversible	Pre-Project conditions will return following the cessation of the interaction.
	Irreversible	Pre-Project conditions will not return following the cessation of the interaction.
Context	Low resilience	Low resilience to imposed stresses, or will not easily adapt to the effect.
	High resilience	High resilience to imposed stresses, or will easily adapt to the effect.
Probability of occurrence	Low	Low likelihood that the predicted residual effect will occur.
	Moderate	Moderate likelihood that the predicted residual effect will occur
	High	High likelihood that the predicted residual effect will occur.

In general, to be considered to have potential for a significant effect, the residual effect on the Land Use and Tenure VC must meet one of the following criteria:

- Have a medium magnitude at a regional spatial extent and have a long term or permanent duration;
- Have a high magnitude at a localized spatial extent and be permanent in duration; or
- Have a high magnitude at a regional extent of any duration.

The challenge with assessing potential residual effects for Socioeconomic VCs is that neither guidelines nor predefined thresholds exist, so the assessment often relies on the setting, intensity, public concerns and professional judgement gained from working on similar projects.

19.4.3.1 Change in Area Due to Project Footprint

An adverse residual effect is predicted during construction, operations, closure and decommissioning and post closure associated with the loss of area available for land use activities (Table 19.4-5). This residual effect will be almost completely reversed following reclamation and closure of the mine site and Freegold Road Extension. Residual effects associated with a small area of the mine site, which will be permanently unavailable for other land uses post closure, are rated as irreversible as pre-project conditions will not return following the cessation of the interaction. The area unavailable for traditional land uses, trapping and outfitting activities and quartz and placer mining activities during construction, operations and closure and decommissioning is limited to the Land Use LSA.

Traditional Land Use

The area unavailable for traditional land uses during construction, operations and closure and decommissioning is limited to the Land Use LSA. Post closure the area permanently withdrawn from other land uses is a fraction of the Land Use LSA associated with the mine site; therefore the residual effect is rated as not significant with a low magnitude. The frequency of this potential effect is considered to be infrequent because the area is occupied by various Project components once, but the duration of the effect is long term (lasts throughout the life of the mine).

Placer and Quartz Claims

The tenure areas directly affected by the Freegold Road Upgrade are predicted to be minimal due to the relatively small area that does not follow the existing Freegold Road. Placer and quartz tenure areas potentially affected by the upgrade of the existing Freegold Road may be affected beyond the life of the mine (i.e. irreversible). A magnitude rating of medium was predicted as several of the placer tenures appear to fall within the Freegold Road Extension. Tenure holders will be consulted and a management strategy for affected tenure areas identified. These effects are considered not significant as the area potentially affected is small, and tenure holders will be consulted throughout the process.

Access along the Freegold Road Extension will primarily be limited to mine site traffic. Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. Placer and quartz tenure areas affected by the Freegold Road Extension along the existing Casino Trail, which will be unavailable during the life of the mine, will be returned to the tenure holder following closure and decommissioning of the Freegold Road Extension. The confidence associated with these residual effects are rated as moderate to high as the potential effect is relatively well understood; however, some of the proposed mitigation measures have to be developed in consultation with stakeholders.

19.4.3.2 Change in Access to Area

The upgrade to the Freegold Road and extension of the Freegold Road following the Casino Trail is predicted to have both adverse and beneficial residual effects on the indicators selected to assess the Land Use and Tenure VC. Potential residual effects are described below associated with all phases of the Project for the mine site and Freegold Road corridor.

Traditional Land Use

Residual effects on traditional land use are primarily associated with reduced access to Traditional Territory due to limiting access along the Freegold Road Corridor or to the mine site area during construction, operations and closure and decommissioning. The Freegold Road Upgrade may provide easier access to the area for others whose activities may conflict with FN traditional land use activities. Potential conflicts between construction activities and Project traffic and land users will be managed by monitoring the situation and implementing a First

Nation communication / engagement strategy to ensure concerns are identified and addressed. Adverse residual effects, rated as not significant, are also predicted associated with limiting access within the mine site footprint. The confidence associated with these residual effects are rated as high as the potential effect is relatively well understood and proposed mitigation measures are predicted to be successful.

A beneficial residual effect is predicted for traditional land use activities due to easier access to Traditional Territory along the Freegold Road Upgrade. This beneficial effect is estimated to be localized within the Land Use LSA and to occur through all phases of the Project.

Potential adverse residual effects associated with limiting road access along the Freegold Road Extension are predicted to be negligible with specific mitigation measures negotiated as required to address FN concerns and interests.

Placer and Quartz Claims

Reduced access along the Freegold Road Upgrade associated with road construction and traffic during operations and closure and decommissioning is predicted to have an adverse effect, but was rated as not having a significant residual effect on placer and quartz mining activities. Potential conflicts between construction activities and Project traffic and land users, which are reversible, will be managed by monitoring the situation and implementing a stakeholder communication / engagement strategy to ensure concerns are identified and addressed. The confidence associated with these residual effects are rated as high as the potential effect is relatively well understood and proposed mitigation measures are predicted to be successful.

A beneficial residual effect is predicted for placer and quartz mining activities due to easier access along the Freegold Road Upgrade. This beneficial effect is estimated to be localized within the Land Use LSA and to occur through all phases of the Project.

Potential adverse residual effects associated with limiting access along the Freegold Road Extension are predicted to be negligible with specific mitigation measures negotiated as required to address individual tenure holder's requirements.

Recreational Land Use

Potential residual effects to recreational land use activities are primarily limited to the Freegold Road Upgrade as access to the mine site and Casino Trail are not predicted to change appreciably. It has been assumed that general recreational activities (i.e. recreational hunting) occur primarily along the existing Freegold Road and that accessing the area along the Casino Trail is infrequent. Adverse residual effects on recreational activities are primarily associated with limiting access along the upgraded section of Freegold Road during construction, operations and closure and decommissioning. Reduced access along the upgraded Freegold Road associated with road construction and traffic during operations and closure and decommissioning, which is reversible, is predicted to have an adverse not significant residual effect on recreational activities.

The upgraded Freegold road will provide improved access for recreational activities up until km 83 where the staffed security gate will stop unpermitted access.

Overall the potential adverse residual effects associated with the Freegold Road Extension on recreational activities are predicted to be not significant with a low magnitude and infrequent frequency. After closure of the mine is complete, the Freegold Road Extension will be decommissioned, reducing access to the area to pre-project levels.

There is the potential for new alternative access points created by local land users (i.e. recreational hunters) along the existing Freegold Road that parallel the gated Freegold Road Extension or provide access to areas that

were previously inaccessible. This potential residual effect is also rated as not significant with a low magnitude and low probability due to the remoteness of the area and infrequent use of the area for recreation purposes.

Trapping and Outfitting

Adverse residual effects on trapping and guide outfitting activities are primarily associated with limiting access along the Freegold Road Corridor or to the mine site area during construction, operations and closure and decommissioning. Reduced access along the Freegold Road Upgrade associated with road construction and traffic during operations and closure and decommissioning, which is reversible, is predicted to have an adverse, but not significant residual effect on trapping and guide outfitting activities. Post closure access will return to pre-project conditions for the Freegold Road Extension and most of the mine site. Following closure, the need for restricting access to a small area within the mine site footprint will be assessed. This potential residual adverse effect is considered very minor in relation to the overall area reclaimed and is rated as not significant from a land use perspective. The confidence associated with this significance rating is moderate to high as access post closure will depend on the results of the health and safety assessment following closure and decommissioning and reclamation.

There is also a low to moderate probability that the easier access to the area for others whose activities may conflict with trapping and guide outfitting activities. Potential conflicts between construction activities and Project traffic and land users will be managed by monitoring the situation and implementing a stakeholder communication / engagement strategy to ensure concerns are identified and addressed. Residual adverse effects, rated as not significant, are also predicted associated with limiting access within the mine site facility. The confidence associated with these residual effects are rated as high as the potential effect is relatively well understood and proposed mitigation measures are predicted to be successful.

A beneficial residual effect is predicted for trapping and guide outfitting activities due to easier access to permitted concession areas along the Freegold Road Upgrade. This beneficial effect is estimated to be localized within the Land Use LSA and to occur through all phases of the Project.

Potential adverse residual effects associated with limiting access along the Freegold Road Extension are predicted to be negligible with specific mitigation measures negotiated as required to address existing tenure and individual access arrangements.

19.4.3.3 Change in Local Ambience

A negligible adverse residual effect is predicted during construction, operations, closure and decommissioning and post closure associated with the change in ambiance and wilderness experience for land use activities occurring in the area due to the remoteness of the site (Table 19.4-5). This residual effect will be completely reversed following reclamation and closure.

Traditional Land Use

The reduced wilderness experience for FN traditional land use activities are associated with a variety of Project activities. Although Project effects at the mine site occur continuously during construction, operations and closure and decommissioning the proximity of the receptors (i.e. FN) was predicted to be infrequent. On-going communications with FN will ensure concerns are identified and addressed. The significance of the residual effect was determined to be not significant because effects are predicted to be low in magnitude, local in geographic extent and reversible.

Potential residual effects associated with reduced wilderness experience for FN traditional land use activities along the Freegold Road Upgrade due to Project construction and traffic are predicted to be not significant. This

rating is based on a low magnitude, localized geographic extent and the fact that it is reversible. Potential adverse residual effects associated reduced wilderness experiences along the Freegold Road Extension are predicted to be negligible with specific road access requirements negotiated as appropriate.

Recreational Land Use

There is the potential for reduced wilderness experience for recreational land use activities associated with the Freegold Road Upgrade. This potential adverse residual effect, which is reversible, is rated as not significant and has a low magnitude and localized geographic extent.

Trapping and Outfitting

Mitigation measures implemented to reduce potential Project effects on the trapping and guide outfitting experience associated with changing local ambience due to noise, vibration and decreased visual quality at the mine site are predicted to have a low success rating. However, the proximity of the receptors to the mine site was predicted to be infrequent. On-going communications with these stakeholders will ensure concerns are identified. The significance of the residual effect was determined to be not significant because effects are predicted to be low in magnitude, local in geographic extent and reversible.

Potential residual effects associated with reduced wilderness experience for trapping and guide outfitting activities along the Freegold Road Upgrade are predicted to be not significant due to Project construction and traffic. This rating is based on a low magnitude, localized geographic extent and the fact that it is reversible. Potential adverse residual effects associated reduced wilderness experience along the Freegold Road Extension are predicted to be negligible given the limited traffic under the Freegold Road Extension Access Management Agreement that CMC will negotiate with the Yukon Government and SFN and LSCFN. This agreement will address how a private road and access control could be managed to meet the Project requirements with consideration of existing tenure holders and individuals.

Table 19.4-5 Significance of Residual Effects for Indicators Selected for the Land Use and Tenures VC

Residual Effect	Predicted Degree of Effect After Mitigation (*or Enhancement*) Measures[1]								Significance of Residual Effect
	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Probability of Occurrence	
Change in area due to Project footprint									
Loss of area available for traditional land use activities	Adverse	Low	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant
Loss of available area for quartz and placer mining activities	Adverse	Medium	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant
Loss of area available for trapping and	Adverse	Low	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant

outfitting activities									
Change in access to area									
Easier access to area for others whose activities may conflict with FN traditional land use activities (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	Low / Moderate	Not Significant
Reduced access to Traditional Territory due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Negotiated road access to Traditional Territory (Freegold Road Extension)	Adverse / Neutral / Positive	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Easier access to area for traditional land use activities. (Freegold Road Upgrade)	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Reduced road access to permitted tenure areas due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Negotiated road access to area for existing mineral tenure	Adverse / Neutral / Positive	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant

holders (Freegold Road Extension)									
Easier access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade)	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
No road access to area for recreational activities (Freegold Road Extension)	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	Low	Not Significant
Reduced access to recreational areas due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Easier access to area for recreational activities (Freegold Road Upgrade)	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Negotiated road access to area for existing trappers and guide outfitters (Freegold Road Extension)	Adverse / Neutral	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Easier access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade)	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
Reduced access to trapping and guide outfitting concession areas	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant

due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)									
Easier access to area for others whose activities may conflict with trappers and guide outfitters (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	Low / Moderate	Not Significant
Change in local ambience									
Reduced wilderness experience for FN traditional land use activities (mine site, Freegold Road Upgrade and extension)	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	High	Not Significant
Reduced wilderness experience for trappers and guide outfitters utilizing the area (mine site, Freegold Road Upgrade and extension)	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	Low / Moderate	Not Significant
Reduced wilderness experience for recreational land use activities (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	High	Not Significant

Note: For beneficial potential effects, opportunities, where possible, to enhance potential environmental benefits are included as proposed enhancement measures.

19.4.4 Discussion of Significance

Following a review of the potential Project interactions, applicable mitigation measures and residual effects identified for the indicators selected to assess the potential effects of the Project on the Land Use and Tenure VC

the overall residual effects rating is predicted to be not significant. The rationale for rating the overall residual effects for the Land Use and Tenure VC as not significant is summarized as follows (Table 19.4-6):

- The loss of area directly associated with the project footprint maximum disturbance area for land use is determined to be relatively minor when compared to the total available area. Following closure and decommissioning, the majority of the mine site footprint will be available for various land uses. A very small area (when compared to the SFN Traditional Territory and trapping and guide outfitting concession areas) is predicted to be permanently unavailable for future land uses.
- Potential adverse effects associated with reduced access along the Freegold Road Upgrade are primarily limited to the construction phase due to road closures. These adverse effects are all predicted to be local in geographic extent and reversible. Increased traffic is also identified as another reversible effect which may affect access and local ambiance / wilderness experience during peak Project traffic times. The upgraded all weather Freegold Road will benefit all land users once construction is completed.
- Potential adverse effects associated with limiting access along the Freegold Road Extension following the existing Casino Trail at km 83 are predicted to be not significant, local in geographic extent and reversible with the implementation of specific mitigation measures negotiated as required to address current tenure holder's and individual requirements.
- The proximity of potential land use receptors to the mine site was predicted to be infrequent. The significance of the residual effect was determined to be not significant because effects are predicted to be low in magnitude, local in geographic extent and reversible. Potential residual effects associated with reduced wilderness experience for land use receptors along the Freegold Road Upgrade due to Project construction and traffic was predicted to be not significant. This rating is based on a low magnitude, localized geographic extent and the fact that it is reversible. Potential adverse residual effects associated reduced wilderness experience along the Freegold Road Extension is predicted to be not significant with specific road access requirements negotiated as appropriate.

The high level of confidence associated with the not significant residual effect of loss of area for ongoing land use activities is based on the relatively small footprint within the study area. A high level of confidence is assigned for the Freegold Road Upgrade because the majority of the road already exists and land uses are well understood. The proposed access management agreement between the three governments and the Proponent for the Freegold Road Extension has yet to be negotiated and implemented which results in a moderate level of confidence in the not significant residual rating. A moderate level of confidence is predicted for the not significant residual effect associated with easier access to the area for others whose activities may conflict with trappers and guide outfitters along the Freegold Road Upgrade. The not significant residual rating for change in local ambiance for existing and anticipated future land uses has a high level of confidence because of the relatively small footprint within the available land base and anticipated success of proposed mitigation measures.

Table 19.4-6 Summary of Residual Effects for Land Use and Tenures

Potential Residual Effects	Direction	Significance	Level of Confidence (Low, Moderate, High)
Change in area due to Project footprint			
Loss of area available for traditional land use activities	Adverse	Not Significant	High
Loss of available area for quartz and placer mining activities	Adverse	Not Significant	High
Loss of area available for trapping and outfitting activities	Adverse	Not Significant	High
Change in access to area			
Easier access to area for others whose activities may conflict with FN traditional land use activities (Freegold Road Upgrade)	Adverse	Not Significant	High
Reduced access to Traditional Territory due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Not Significant	High
Negotiated access to Traditional Territory (Freegold Road Extension)	Adverse / Neutral	Not Significant	Moderate
Easier access to area for traditional land use activities. (Freegold Road Upgrade)	Beneficial	Not Significant	High
Reduced access to permitted tenure areas due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Not Significant	High
Negotiated access to area for existing mineral tenure holders (Freegold Road Extension)	Adverse / Neutral	Not Significant	Moderate
Easier access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade)	Beneficial	Not Significant	High
No access to area for recreational activities (Freegold Road Extension)	Adverse	Not Significant	High
Reduced access to recreational areas due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)	Adverse	Not Significant	Moderate
Easier access to area for recreational activities (Freegold Road Upgrade)	Beneficial	Not Significant	High
Negotiated access to area for existing trappers and guide outfitters (Freegold Road Extension)	Adverse / Neutral	Not Significant	Moderate
Easier access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade)	Beneficial	Not Significant	High
Reduced access to trapping and guide outfitting concession areas due to road construction and	Adverse	Not Significant	High

Potential Residual Effects	Direction	Significance	**Level of Confidence** (Low, Moderate, High)
traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade)			
Easier access to area for others whose activities may conflict with trappers and guide outfitters (Freegold Road Upgrade)	Adverse	Not Significant	Moderate
Change in local ambience			
Reduced wilderness experience for FN traditional land use activities (mine site, Freegold Road Upgrade and extension)	Adverse	Not Significant	High
Reduced wilderness experience for trappers and guide outfitters utilizing the area (mine site, Freegold Road Upgrade and extension)	Adverse	Not Significant	High
Reduced wilderness experience for recreational land use activities (Freegold Road Upgrade)	Adverse	Not Significant	High

19.5 CUMULATIVE EFFECTS ASSESSMENT

19.5.1 Introduction

A cumulative effects assessment (CEA) is conducted to identify the potential for cumulative effects to occur and to assess the significance of those effects. The CEA is limited to those residual effects (post-mitigation) on VCs resulting from past, present, or reasonably foreseeable human activities or actions which occur within the time and space where a linkage between the residual effects resulting from the activities related to the Project and the residual effects of other actions occur.

As stated in YESAA (Yukon Environmental and Socio-Economic Effects Assessment 2006), the CEA must consider:

“The significance of any cumulative environmental or socio-economic effects that have occurred or might occur in connection with the Project or existing project in combination with the effects of

(i) Other projects for which proposals have been submitted under subsection 50(1); or

(ii) Other existing or proposed activities in or outside Yukon that are known to the designated office, executive committee or panel of the Board from information provided to it or obtained by it under this Act.”

19.5.2 Identification of other Projects or Activities

Table 19.5-1 provides a description of the projects or activities that may overlap with residual effects identified for the Land Use and Tenure VC and contribute to potential cumulative effects.

Potential residual effects associated with construction, operations and closure and decommissioning of the Project are limited to the Land Use LSA. Following reclamation, residual effects associated with the Project post closure are limited to a very small area of the mine site and Freegold Road Upgrade being permanently removed from future land uses. Due to the remoteness of the mine site, this loss of area, which is considered negligible, is not predicted to overlap spatially or temporally with any other projects or activities and is not carried forward into the CEA. New sections of the Freegold Road Upgrade will be permanently unavailable for other land uses;

however, the old sections of the existing Freegold Road will be reclaimed for future land use. The Freegold Road Extension will be closed, reclaimed and returned to pre-project conditions once it is no longer required.

The baseline for the Land Use and Tenure VC included a description of the other projects and activities occurring within the Land Use LSA and RSA. The corresponding effects assessment described above was conducted taking into consideration the historical and current land uses within the Project area. By examining project residual effects on the Land Use and Tenure VC in the context of the temporal boundaries associated with construction, operations, closure and decommissioning and post closure of the Project the effects assessment is inherently a CEA.

Following a review of the other projects and activities overlapping the Land Use LSA it was determined that very few land uses occurred in the area that would have a measurable residual effect that might combine cumulatively with the Project residual effects summarized in Table 19.4-6 above. Potential residual effects from other projects or activities spatially overlapping the Land Use LSA and temporally overlapping the construction, operations and closure and decommissioning phases of the Project are predicted to be limited to future placer and quartz exploration and mining activities.

Table 19.5-1 Residual Effect Information for Other Projects or Activities – Land Use and Tenure VC

Projects or Activities	Status[1]	Assumed Residual Effect[2]	Spatial Extent of Assumed Residual Effect	Temporal Extent of Assumed Residual Effect
Placer and Quartz mining activities	Potential future	Increase in staking and exploration activity due to improved access along Freegold Road Upgrade	Presumed to continue along the section of upgraded Freegold Road	Presumed to continue into the foreseeable future.
		Increase in staking and exploration activity due to improved access along Freegold Road Extension	Presumed to continue along the Freegold Road Extension	Presumed to continue during Project operations and closure and decommissioning at which time the Freegold Road Extension will be decommissioned, reclaimed and returned to pre-project conditions.

Notes:

1. Status refers to Past, Present or Likely Future project or activity.
2. Assumed residual effects of other projects or activities are derived from professional judgement and focus on the key issues of concern for the VC, thereby ensuring that the CEA remains focussed and the analysis remains manageable and practical.

19.5.3 Interactions and Potential Cumulative Effects

Residual effects of the Project include easier access for currently permitted / active placer and mining activities along the Freegold Road Upgrade with specific access arrangements negotiated with tenures along the Freegold Road Extension. Spatially the residual effects of the Project are predicted to be limited to the Land Use LSA within areas defined in current permits. Increased activity is predicted to occur after construction of the Freegold Road Upgrade is completed, but only permitted traffic will be allowed to use the Freegold Road Extension at km 83. Facilitated access will be provided along the Freegold Road Upgrade for the life of the Project and post closure.

Following closure and decommissioning the Freegold Road Extension will be decommissioned, reclaimed and returned to pre-project conditions. A summary is shown in Table 19.5-2.

Table 19.5-2 Cumulative Effects Assessment Interactions Matrix – Land Use and Tenure VC

Casino Project Residual Effect	Potential Spatial and Temporal Overlap	
	Future Placer and Quartz exploration and mining activity along Freegold Road Upgrade	**Future Placer and Quartz exploration and mining activity along Freegold Road Extension**
	Increased exploration and mining activity is predicted to occur due to improved access along Freegold Road Upgrade for the foreseeable future	Increased exploration and mining activity may occur due to improved access along Freegold Road Extension during construction, operations and closure and decommissioning
Increased activities associated with currently permitted mining tenures along the Freegold Road corridor	Yes	Yes

Notes:

1. YES is used to indicate where a residual effect of the Casino Project has the potential to overlap spatially and temporal with an assumed residual effects of other projects and activities.

Table 19.5-3 summarizes the potential cumulative effects identified for the Land Use and Tenure VC. Residual effects associated with increased exploration and mining activity predicted to occur in the future due to improved access along the Freegold Road corridor are predicted to combine cumulatively with similar Project residual effects. This potential cumulative effect is divided into two scenarios based on the different temporal boundaries identified for the upgraded Freegold Road and the Freegold Road Extension. A greater level of certainty is assumed with the cumulative effects associated with upgrading the existing Freegold Road. Access to the existing permitted exploration and mining activities along the Freegold Road Upgrade will be facilitated for the foreseeable future. Additional new permitted exploration and mining activities are predicted to take advantage of the improved access along the Freegold Road Upgrade.

Potential cumulative effects associated with the improved access along the Freegold Road Extension are less certain as it is unclear whether or not new exploration and mining activities will be allowed past the staffed security gate at km 83. Access management along the Freegold Road Extension has been identified as a concern to FN with traditional territory in the area. Specific issues raised include increased hunting pressure on valued wildlife species and increased wildlife – vehicle incidents. There is also the concern that increased traffic associated with new exploration and mining activity will conflict with project related traffic along the Freegold Road Extension. At this time the access management strategy focuses on the following:

- No public access (access by permit, as directed and agreed by the Steering Committee);
- Controlled, gated, staffed access (located at the new bridge over Big Creek – or as otherwise agreed);
- Develop a stakeholder communication / engagement plan to ensure concerns are identified and addressed; and

- Exploring a cooperative approach to management of access to the Freegold Road Extension involving the Casino Mining Corporation, the Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nation.

Limited use by others may be required; however this is subject to agreement by First Nation governments, Casino Mining Corporation as well as Yukon Government under the terms of Project specific management plans.

Table 19.5-3 Potential Cumulative Effects – Land Use and Tenure VC

Casino Project Residual Effect	Project or Activity	Potential Cumulative Effect
Increased activities associated with currently permitted mining tenures along the Freegold Road corridor	Increased exploration and mining activity is predicted to occur in the future due to improved access along Freegold Road Upgrade	Overall increase in existing and future permitted placer and quartz exploration and mining activities along the Freegold Road Upgrade.
	Increased exploration and mining activity may occur in the future due to improved access along Freegold Road Extension	Unknown. However, cumulative effects would be expected in the event that new placer and quartz tenures are permitted and exploration and mining activities increase along the Freegold Road Extension

19.5.4 Additional Mitigation Measures and Potential Residual Cumulative Effects

The decision to permit and allow access to new placer and quartz claims along the Freegold Road Extension during construction, operations and closure and decommissioning phases of the Project will be made collaboratively with FN, the Yukon Government and other stakeholders with a permitted interest in the area.

Traffic will be monitored along the Freegold Road Upgrade and potentially conflicting land uses will be monitored during the life of the project. An access management strategy will be developed that incorporates controlling access along the Freegold Road Extension and monitoring the success of implemented mitigation measures. The access management strategy will be re-evaluated as necessary to ensure issues / concerns raised by stakeholders are addressed.

19.5.5 Significance of Residual Cumulative Effects

The significance of residual cumulative effects associated with new future exploration and mining activities cannot be quantitatively assessed. The increase in exploration and mining activities along the Freegold Upgrade would be considered a positive effect from an economic perspective. Potential residual cumulative effects associated with new future exploration and mining activities along both the Freegold Road Upgrade and Freegold Road Extension may also include the following:

- Increase in noise levels, emissions and traffic; and
- Change in the disturbed and reclaimed areas.

These residual cumulative effects would be considered not significant as the geographical extent would be rated as having a low magnitude, localized geographic extent and reversible.

19.6 SUMMARY AND CONCLUSIONS

The Project has the potential to have both beneficial and negligible adverse effects on land use and tenure activities within the Land Use SA.

A direct loss or disturbance of area available for other land uses is expected within the project footprint including the mine site, air strip, Freegold Road Upgrade and extension during construction, operations, closure and decommissioning. Following closure and decommissioning the area occupied by the Freegold Road Extension and within the mine site (very small area associated with TMF and open pit) that has not been permanently withdrawn will be available for continued use by a variety of land uses. Potential adverse residual effects on land use access are rated as having a low to medium magnitude, localized geographical extent and are not significant. The confidence associated with these residual effects are rated as high as the potential effect is relatively well understood and proposed mitigation measures are predicted to be successful.

In general, improved accessibility to the area due to the Freegold Road Upgrade will benefit existing permitted land user groups (e.g. mining exploration); however, it may also attract additional third party interest and use in the area. Other land use activities may be easier to conduct on the upgraded road with less travel time and effort to access areas. Traffic along the Freegold Road Extension will be strictly controlled at the km 83 staffed security gate during construction, operations, closure and decommissioning up until the Freegold Road Extension is no longer required and is decommissioned. Individual access arrangements will be negotiated with tenure holders and individuals taking into consideration their specific concerns and requirements. Access along the Freegold Road Extension is predicted to return to pre-project conditions post closure. Potential adverse residual effects on land use access are rated as having a low magnitude, localized geographical extent and are not significant.

A not significant adverse residual effect is predicted during construction, operations, closure and decommissioning and post closure associated with the change in ambiance and wilderness experience for land use activities occurring proximate to the Land Use LSA due to the remoteness of the area. This residual effect is rated as having a low magnitude, localized geographic extent and will be completely reversed following reclamation and closure.

Access to the existing permitted exploration and mining activities along the Freegold Road Upgrade will be facilitated for the foreseeable future. There is the potential for additional new permitted exploration and mining activities due to improved access along the Freegold Road Upgrade. This potential residual cumulative effect can be perceived as both positive (due to economic benefits) and negative (due to increased traffic, noise and associated disturbed area). Potential cumulative effects associated with the Freegold Road Extension are less certain as it is unclear whether or not new exploration and mining activities will be allowed past the staffed security gate at km 83. The Casino Mining Corporation is committed to monitoring potential effects of the Project and ensuring emerging issues are addressed in consultation with the Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nation.

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20 – EFFECTS OF THE ENVIRONMENT ON THE PROJECT

20.1 OVERVIEW

The YESAA requires that every environmental and socio-economic assessment include a characterization of the potential effects of the environment on the project, including the predicted effects of climate change. The YESAB Guidance to Proponents requires the prediction of potential effects of extreme environmental conditions such as terrain hazards, landslides, flood events, slope stability, and earthquakes on the project to be included as part of the Proposal (YESAB 2005). In addition, the proponent is required to identify and describe the predicted effects of climate change on the project including changes in hydrology patterns, climatic patterns and permafrost regimes for project components and activities that are potentially affected by such changes (YESAB 2005).

This section of the Proposal characterizes the likely extreme environmental conditions and long-term climate change scenarios that have the potential to affect the Casino Project and the predicted effects of those conditions and likely scenarios on the Project's components and activities. The potential effects to the Project take into consideration the probability of occurrence as well as the potential consequences to the Project from occurrence of the event. In addition, potential sensitivities of the Project's components or activities, including the timing of operations and critical site conditions are discussed.

20.2 APPROACH

Environmental conditions with the potential to adversely affect the Project components and activities were identified through the professional experience of CMC, its engineers and environmental consultants. In addition, consultations conducted with First Nations, the public, and Yukon Government helped to inform the scope of the assessment. The range of environmental events that have a potential to affect the Project components and activities during the construction, operations, decommissioning and closure, and post-closure phases include:

- Seismic Activity;
- Terrain Instability (landslides, avalanches, and permafrost disturbance);
- Extreme Weather Events;
- Wildfires; and
- Climate change.

The overall risk of an environmental event on the Project is a combination of both the likelihood of the potential event to occur and the consequences of the potential effect.

Existing information was used to determine a probability of occurrence for an environmental event, if available. Conversely, where existing information was not available, professional judgement was used to characterize the likelihood of occurrence.

A rigorous approach requires consideration of "worst-case" scenarios, which are presented below. It is important to note that the project design standards are conservative with the intention of eliminating the possibility a these scenarios arising as described in this section.

Table 20.2-1 lists the categories of likelihood for a potential extreme environmental event to occur over the life of the Project.

Table 20.2-1 Categories of Likelihood for Potential Extreme Environmental Events

Likelihood Categories	Life of Project Likelihood	Description of Effect Likelihood
Negligible	<1%	Doubt it could happen
Low	5 to 25%	Unlikely to happen
Moderate	25% to 50%	It could happen
High	75 to 99%	Has or probably will happen
Extreme	<99%	Happens regularly

Notes:
1. Life of the Project is defined as construction through to post closure phases.

Potential effects of the environmental event on the Project components and activities were described in terms of a range of potential effects which represents the likely predicted scenario and the unlikely worst case scenario. Even though the unlikely worst case scenario was presented, the likelihood of it occurring is considered to be negligible.

The severity of the potential effect on the Project was rated by selecting the category which best describes the likely consequences. The selection was informed by best available information including design-based mitigation measures, proposed management plans, proposed monitoring plans and response measures, as well as professional judgement. Four general categories of severity were used to rank the potential effects of the environment on the Project (Table 20.2-2).

Table 20.2-2 Categories of Severity of Potential Effects of the Environment on the Project

Severity of Potential Effect	Description of the Potential Effect on the Project
Negligible	Project components, activities and critical services do not shut down.
Low	Complete shutdown of Project components, activities and critical services for more than 24 hours
Moderate	Complete shutdown of Project components, activities and critical services for more than one week
High	Complete shutdown of Project components, activities and critical services for more than one month
Extreme	Complete shutdown of Project components, activities and critical services indefinitely

Notes:
1. The four categories of severity are selected by CMC based on the ability of the Project to continue operations uninterrupted.

Mitigation measures were proposed by CMC to eliminate, reduce or control adverse potential effects of the environment on the Project. The majority of mitigation measures for potential adverse environmental effects were identified early in the Project planning process and have been integrated into the design of the Project. These types of design-based mitigation measures are informed by industry's code of good practice, standards and environmental policies.

The findings of the Proposal and consultations with government reviewers, First Nations and the public will help to refine the mitigation measures proposed. According to YESAA, mitigation measures include measures for the elimination, reduction, or control of adverse environmental or socio-economic effects (YESAA 2005). These

measures may include restitution for adverse effects, including replacement, restoration, compensation, or other appropriate means (YESAB 2005).

20.3 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

20.3.1 Seismic Activity

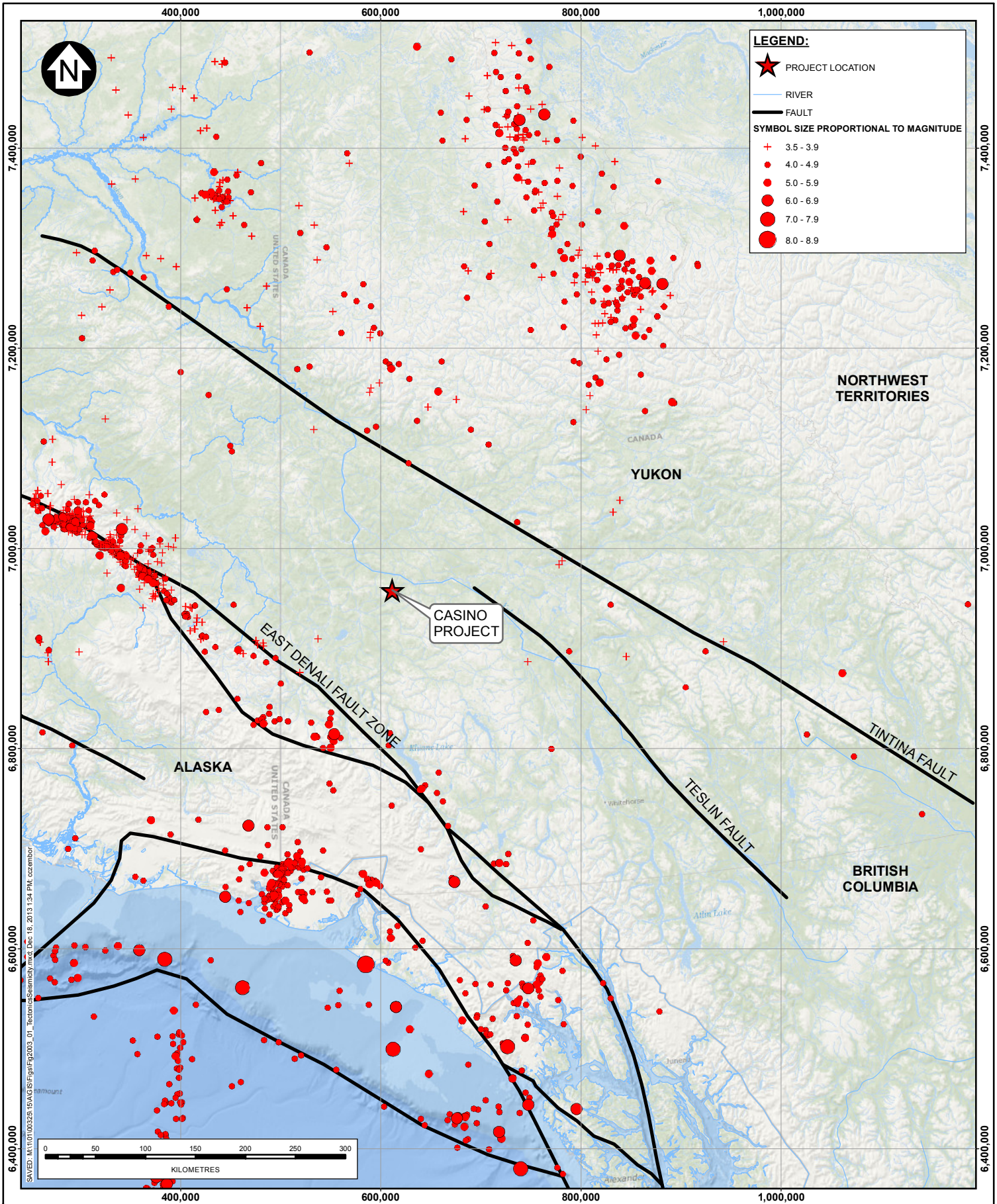
A review of the regional tectonics and historical seismicity was carried out to enable selection of appropriate design earthquake events for key Project components such as the TMF (Knight Piésold Ltd. 2012c). Figure 20.3.1 from Natural Resources Canada shows the regional tectonics and historical seismicity of the Yukon Territory, surrounding regions, and for the location of the Project.

The Project is located in an area of minor seismicity between the Denali and Tintina fault systems. Review of historical earthquake records indicates that the Project is situated in a region that can be generally described as having low seismicity. The seismic hazard for the Casino mine site is predominantly from shallow crustal earthquakes (with magnitudes up to 7.0 on the Richter Scale, or M7.0) that may occur in the region south of the Project. In addition, seismic hazard is also influenced by the potential for larger magnitude earthquakes (of approximately M7.5 to 8.0) occurring farther from the Project site on the East Denali fault zone.

20.3.1.1 Likelihood of Occurrence

The seismic hazard for the Project was defined using probabilistic methods of analysis and design ground motion parameters have been determined for the Project site using information provided by the probabilistic seismic hazard database of Natural Resources Canada (Knight Piésold Ltd. 2012c, NRCan 2012). The results are summarized in Table 20.3.1 in terms of earthquake return period, probability of exceedance (for a 22 year design operating life of the Project) and the corresponding peak ground acceleration (median and mean hazard values).

The Operating Basis Earthquake (OBE) for the Project is a 1 in 500 year return earthquake and was selected from the results of a probabilistic hazard evaluation. The OBE is defined as an earthquake that produces ground motions at the site that can reasonably be expected to occur within the service life of a project; the associated performance requirement is that the project functions with little or no damage, and without interruption of function (FEMA 2005). There are no fixed criteria for selecting the OBE. The hazard level selected for the OBE is often chosen as the earthquake with a 10% probability of exceedance in 50 years (with a corresponding return period of about 500 years). For a return period of 1 in 500 years the corresponding median peak ground acceleration is 0.07g indicating a low to moderate seismic hazard for the Casino mine site.



PREPARED BY:

Knight Piésold CONSULTING

DESIGNED	GRG
DRAWN	AMD
CHK'D	CAH
APP'D	KJB
REV	0
DATE	16DEC'13

NOTES:
1. BASE MAP: CANVEC.
2. PROJECTION: NAD 1983 UTM ZONE 7N
3. COORDINATE GRID: METRES.
4. HISTORICAL EARTHQUAKE DATA FROM NRCAN, USGS, AND NGDC DATABASES.
5. INCLUDES RECORDED EARTHQUAKES FROM 1600 TO 1973 (MAGNITUDE > 6.0) AND FROM 1973 TO SEPTEMBER 2012 (MAGNITUDE > 3.5).

CASINO COPPER AND GOLD

CASINO PROJECT

REGIONAL TECTONICS AND HISTORICAL SEISMICITY

FIGURE 20.3-1

REF 1

P/A VA101-325/15

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Table 20.3-1 Summary of Probabilistic Seismic Hazard Analysis

Return Period (Years)	Probability of Exceedance[1] (%)	Peak Ground Acceleration (PGA)[2]	
		Median PGA[3,4] (*g*)	Estimate Mean PGA[5] (*g*)
100	20	0.04	0.05
500	4	0.07	0.08
1,000	2	0.08	0.10
2,500	1	0.11	0.13
5,000[6]	0.4	0.14	0.17
10,000[6]	0.2	0.18	0.22

Notes:

1. Probability of exceedance calculated for a design life of 22 years q = 1-(-L/T) where: q = probability of exceedance L = design life in years T = return period in years
2. Peak ground accelerations are for soft rock/very dense soil (Vs30 = 360 - 760 m/sec)
3. Median peak ground accelerations for return period up to 2,500 years obtained from the seismic hazard database of Natural Resources Canada
4. Median peak ground accelerations for return periods of 5,000 and 10,000 years obtained for site-specific analysis using EZ-FRISK
5. Mean PGA values estimated as 1.2 x median values
6. Predicted values are derived from EZ-FRISK seismic hazard analysis module

The NRCan database only provides ground motion parameters for an earthquake up to a return period of 2,500 years. Therefore, a probabilistic seismic hazard analysis was conducted for the Project to provide ground motion parameters beyond 2,500 years, specifically for return periods of 5,000 and 10,000 years (Knight Piésold Ltd. 2012a).

The computer program EZ-FRISK was used to develop a seismic hazard model for the Yukon and the surrounding regions (Risk Engineering, Inc. 2008). The seismic hazard analysis module available with EZ-FRISK includes a database provided by Risk Engineering Inc. of faults and areal seismic sources for the pertinent regions of western Canada. Seismic sources defined in the seismic hazard model include the regions of the southern Yukon Territory, southeastern Alaska, and the Denali and Fairweather fault systems. The seismic hazard model was used to determine the relationship between peak ground acceleration and annual frequency of occurrence for the Project site. Predicted values for the Project site are included in Table 20.3.1 for earthquake return periods of 5,000 and 10,000 years. Predicted values for lower return periods were very similar to those provided by the NRCan seismic hazard database.

The OBE for the Project was selected as the 1 in 500 year return period earthquake event. The probability of exceedance for this event is approximately 4% for a 22 year mine life operating period. Based on the categories of likelihood for potential effects on the Project (Table 20.2.1) for the OBE, the overall likelihood of occurrence of a 1 in 500 year return period seismic event during the life of the Project is LOW and is unlikely to happen.

20.3.1.2 Potential Effects

If an earthquake were to occur and affect the Project, the damage potential of the earthquake would depend largely on the proximity of the Project to the epicentre of the earthquake. Damage to Project infrastructure can occur directly through ground shaking and indirectly as a result of induced landslides or other falling objects. All Project components could be affected by seismic activity, though the level of damage depends on the nature of the seismic event. Of particular interest is how the TMF embankments, the Casino pit wall, the heap leach facility and pad, main power plant and the stockpiles are predicted to respond to seismic activity.

Table 20.3.2 outlines a range of potential effects from seismic activity to represent the likely predicted scenario and the unlikely worst case scenario.

Table 20.3-2 Potential Effects on the Project from Seismic Events

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Likely Predicted Scenario	Unlikely Worst Case Scenario
TMF (main and west) embankments	O, CD, PC	TMF embankments will not fail and both short term (operational) and long term (post-closure) stability is maintained. Any embankment deformations caused by earthquake shaking will be minor and will not have a significant impact on embankment freeboard or result in any loss of embankment integrity. Project components, activities and critical services will not shut down.	Catastrophic failure of the TMF embankments leading to release of water, tailings, and waste rock from the TMF into Casino Creek. Complete shutdown of the Project for an extended period of time.
Temporary ore and topsoil stockpiles	O	The consequences will be negligible and restricted to minor displacement of the surface of the ore and topsoil stockpile slopes (or ravelling). The integrity of the stockpile is maintained and there will be no damage to other mine site infrastructure. Project components, activities and critical services will not shut down.	Complete failure of the stockpiles will occur due to compromised structural integrity from shaking. Failed stockpiles will damage haul roads and other Project facilities such as the Plant site. A complete shutdown of Project components, activities and critical services will occur temporarily for more than one week while Project facilities and critical services are restored.
Heap Leach Facility	O, DC, PC	Heap leach pad deformations will be negligible, if any, and will not impact operations at the HLF. Structural slope stability of the HLF will be maintained. Project components, activities and critical services will not shut down.	Displacement of the heap leach pad slopes and compromised stability of the heap leach pad will occur due to decreased interface shear strength between the various components of the liner system. A complete shutdown of Project components, activities and critical services will occur for more than one week.
Casino Pit	C, O	Small shallow slides and rock falls in the Casino Pit will occur but none on a scale sufficient to disrupt operations or pose a safety concern to personnel. Project components, activities and critical services will not shut down.	A catastrophic failure of the Casino pit wall could be hazardous to personnel and equipment, result in lost production and/or sterilization of resources. A complete shutdown of Project components, activities and critical services will occur for more than one week while Project facilities and critical services are restored.
Ancillary facilities and support buildings at the Casino mine site.	C, O	Buildings and facilities will not fail. Project components, activities and critical services will not shut down.	Structural damage to buildings and facilities will pose a hazard to personnel and critical equipment. A complete shutdown of Project components, activities and critical

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Likely Predicted Scenario	Unlikely Worst Case Scenario
			services will occur for more than one week while Project facilities and critical services are restored.

Notes:
Construction (C), Operations (O), Closure and Decommissioning (CD), and Post-Closure (PC)
A range of potential effects are described to represent the most likely predicted scenario and the unlikely worst case scenario.

Based on the consequence categories established in Table 20.2.2 and the potential effects of the likely predicted scenario, the consequence of a seismic event on the Project is considered to be LOW. This rating is due largely to the fact that all critical Project components are designed to perform at earthquake exposure levels meeting or exceeding the 1 in 500 year return period earthquake. For example, the TMF embankments for the Project are designed to perform at earthquake exposure levels meeting the 1 in 10,000 year return period earthquake.

The consequence of seismic activity on the Project as a result of earthquake shaking is anticipated to be minimal and restricted to minor displacement of the surface facilities. The TMF, stockpiles and heap leach facility and pads are expected to function in a normal manner after the OBE. There would be a negligible effect on the integrity of the Project components and little, if any, effect on critical activities and timing of operations. All Project activities and components have been designed to withstand seismic activity and it is very unlikely that a complete shutdown of the Project and critical services will last more than 24 hours.

20.3.1.3 Mitigation Measures

The Project has been designed to ensure that components and activities will perform at earthquake exposure up to the expectations and in compliance with current standards in Canada.

All buildings on site including the accommodations camp, maintenance shops, explosives storage facility and the plant site are designed according to the National Building Code (NBC) of Canada. The NBC incorporates technical requirements to ensure that buildings are protected against earthquakes based on local seismic conditions.

According to the Canadian Dam Association (CDA) guidelines, each dam structure, such as the Project's TMF embankments, is assigned a "Dam Class" based on the incremental losses that would result from a catastrophic failure of the dam with respect to loss of life, environmental and cultural values, as well as infrastructure and economic losses.

Table 20.3.3 outlines the CDA dam classes and corresponding criteria for incremental losses. The CDA Guidelines require that the Project TMF be designed for a High dam classification. The CDA Dam Class also determines the required Earthquake Design Ground Motion (EDGM) and Inflow Design Flood (IDF) and for the design of the dam structure and water management systems.

Table 20.3-3 CDA Dam Classification

Dam Class	Population at Risk1	Incremental Losses		
		Loss of Life[2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	Zero	Minimal short-term loss. No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration or compensation in kind highly possible	Losses to recreational facilities; seasonal workplaces, and infrequently used for transportation services.
High	Permanent	10 or fewer	Significant loss or deterioration of important fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or fewer	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances.
Extreme	Permanent	More than 100	Major loss of critical fish or wildlife habitat. Restoration or compensation in kind impossible.	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

Notes:

1. Definitions for population risk

None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure

Temporary – People are only temporarily in the dam breach inundation zone (e.g. seasonal cottage use, passing through on transportation routes, participating in recreational activities

Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g. as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out.

2. Implications for loss of life:

Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during flood season.

Consistent with the current design practice for geotechnical structures such as dams, two levels of design earthquakes have been considered: the OBE for normal operations, and the Maximum Design Earthquake (MDE) for extreme conditions (ICOLD 1995). Values of Peak Ground Acceleration (PGA) and design earthquake magnitude have been determined for both the OBE and MDE for the Project.

For the design of the TMF, the OBE has been taken as the 1 in 500 year return period event. The corresponding median PGA for this event is 0.07g. However, for geotechnical structures it is recommended that the mean average PGA value be used for design (CDA 2007). The mean PGA is likely to be approximately 15 to 20 percent greater than the median value, giving an estimated value of 0.08g. A design earthquake magnitude of 8.0 has been selected for the OBE, based on a review of regional tectonics and historical seismicity.

An appropriate MDE for embankment design has been selected, based on the High dam classification defined for the TMF and the criteria for design earthquakes provided by the Canadian Dam Association's (CDA) "Dam Safety Guidelines" (2007), and presented in Table 20.3.4.

Table 20.3-4 Suggested Design Flood and Earthquake Levels

Dam Class	Annual Exceedance Probability (AEP)	
	Inflow Design Flood (IDF)[1]	Earthquake Design Ground Motion (EDGM)[3]
Low	1/100	1/500
Significant	Between 1/100 and 1/1,000[4]	1/1,000
High	1/3 between 1/1,000 and Probable Maximum Flood[5]	1/2,500[6]
Very High	2/3 between 1/1,000 and Probable Maximum Flood[5]	1/5,000[6]
Extreme	Probable Maximum Flood (PMF)[6]	1/10,000

Notes:

1. As defined in Table 5.2 – Dam Classification
2. Extrapolation of flood statistics beyond 1/1,000 year flood (10-3 AEP) is discouraged
3. AEP levels for EDGM are to be used for mean rather than median estimates for the hazard.
4. Selected on the basis of incremental flood analysis, exposure, and consequence of failure.
5. PMF has no associated AEP. The flood defined as 1/3 between 1/1,000 year and PMF or 2/3 between 1/1,000 year and PMF has no defined AEP.
6. The EDGM value must be justified to demonstrate conformance to societal norms of acceptable risk. Justification can be provided with the help of failure modes analysis focused on the particular modes that can contribute to failure initiated by a seismic event. If the justification cannot be provided, the EDGM should be 1/10,000.

The CDA Guidelines require that a "High" dam classification be designed for a probabilistically derived event (defined as the Earthquake Design Ground Motion) having an annual exceedance probability (AEP) of 1/2,500. Accordingly, the MDE selected for the TMF is the 1 in 2,500 year earthquake. The median PGA is 0.11g for the 1 in 2,500 year earthquake. The corresponding mean average PGA used for design is estimated to be 0.13g. A design earthquake magnitude of 8.0 has been selected for the MDE, based on a review of regional tectonics and historical seismicity. Limited deformation of the TMF embankment is considered to be acceptable under seismic loading from the MDE, provided that the overall stability and integrity of the TMF is maintained and that there is no release of stored tailings or water (ICOLD 1995).

Table 20.3-5 Earthquake Design Basis for Project Components

Design Basis	Heap Leach Facility	Stockpiles	TMF
Operational Basis Earthquake (OBE)	1 in 500 year return period with a maximum firm ground acceleration of 0.08g	1 in 500 year return period with a maximum firm ground acceleration of 0.08g	1 in 500 year return period with a maximum firm ground acceleration of 0.08g
CDA Classification	-	-	High dam classification
Maximum Design Earthquake (MDE)	1 in 500 year earthquake	1 in 500 year earthquake	1 in 2,500 year earthquake
Design Earthquake Magnitude	8.0	8.0	8.0
Median Peak Ground Acceleration (PGA)	0.08g	0.08g	0.11g
Mean Peak Ground Acceleration (PGA)	0.13g	0.13g	0.13 g

The open pit slope angles of the Casino Pit are designed to limit the potential for failures which could lead to hazards to personnel and equipment, lost production, or sterilization of resources (Knight Piésold Ltd. 2012b). There are few, if any, recorded instances in which earthquakes have been shown to produce significant slope instabilities in hard rock conditions, a statement supported by evidence from a number of mines in highly active seismic zones (Read 2009). According to Read, earthquakes are more likely to produce small shallow slides and rockfalls in open pits but none on a scale sufficient to disrupt mining operations. After closure, site drainage will be altered to allow the Casino Pit to be filled with water to create Pit Lake.

A stability assessment has been carried out for the temporary stockpiles proposed for the mine site (Knight Piésold Ltd. 2012d). The design earthquake for the ore and overburden stockpiles have been taken as the 1 in 500 year return period event, consistent with the OBE defined for the TMF. The corresponding mean peak ground acceleration is 0.08g. A design earthquake magnitude of 8.0 has been selected based on a review of regional tectonics, potential seismic source zones in the region and historical seismicity.

The slopes of the topsoil stockpiles have been designed to be low and flat, with gently sloped faces and an overall slope angle of about 14 degrees (4H:1V) to provide stability. The ore stockpiles have been designed with overall slopes of 2H:1V. The temporary stockpiles have been designed to remain stable under both static and seismic loading conditions and have a minimum acceptable factor of safety under static conditions of 1.3 for short-term operating conditions and 1.5 after closure and reclamation. All stockpiles will be removed before or at closure of the Project.

Stability of the HLF during earthquake loading has been assessed by performing a pseudo-static analysis, where a horizontal force (seismic coefficient) is applied to the heap to simulate earthquake loading to determine the critical acceleration required to reduce the factor of safety to 1.0. Deformation is predicted to occur if the critical acceleration is lower than the predicted average maximum ground acceleration along the potential slope surface from the design earthquake. Potential deformations under earthquake loading have been estimated using the semi-empirical simplified methods of Newmark (1965), Makdisi-Seed (1977) and Bray (2007). These methods estimate displacement of the potential sliding mass based on the average maximum ground acceleration and the yield acceleration. The yield acceleration corresponds to the seismic coefficient required to initiate movement of the sliding mass. The yield acceleration was determined by iterative stability analyses. For the final heap leach pad configuration, the estimated yield acceleration is 0.12g. To account for the possible amplification of ground accelerations as seismic waves propagate through the heap leach pad, an amplification factor of 1.5 was

assumed, resulting in an estimated average maximum acceleration of 0.12g. Predicted heap leach pad deformations calculated for the design earthquake are negligible, if any, and would not impact operations at the HLF.

The consequences of failure of the HLF during an earthquake event will likely be minimal and restricted to some displacement of the heap leach pad slopes. There would be negligible impact on the integrity of the HLF and little, if any, impact on other mine site facilities. However, for design of the HLF a conservative design earthquake corresponding to the 1 in 500 year return period event has been adopted, consistent with the Operating Basis Earthquake (OBE) defined for the TMF. The corresponding mean peak ground acceleration is 0.08g. A design earthquake magnitude of 8.0 has been selected based on a review of regional tectonics, potential seismic source zones in the region and historical seismicity. The seismic stability assessment of the heap leach pad has included estimation of seismically induced deformations of the pad from the design earthquake.

Table 20.3.6 is a summary of the mitigation measures proposed by CMC for the potential adverse effects of seismic activity on the Project components and activities.

Table 20.3-6 Seismic Events - Mitigation Measures

Project Components/ Activities	Mitigation Measures	
	Design Considerations	**Prevention, Response and Remedial Actions**
TMF Embankments	The TMF has been designed to meet the CDA Guidelines for a “High” consequence dam. An MDE mean PGA value of 0.13 g was used for the design of the TMF embankments based on a 1 in 2,500 year return earthquake event of a design magnitude of 8.0.	Remedial action will be taken for small indications of potential failure modes. Internal erosion and piping will be detected through routine monitoring and inspection by mine site personnel and by qualified geotechnical engineers.
Temporary Ore and Topsoil Stockpiles	The slopes of temporary stockpiles have been designed to be low and flat, with gently sloped faces and an overall slope angle of about 14 degrees (4H:1V). Temporary ore stockpiles have been designed have a 2H:1V slope angle.	Remedial action will be taken for small indications of potential displacement through regular monitoring and inspection by mine site personnel.
Heap Leach Facility	The HLF has been designed to correspond with the 1 in 500 year return period event consistent with the OBE defined for the TMF.	Routine monitoring of the heap leach facility will occur and remedial actions will be taken for small indications of potential displacement.
Casino Pit	The Casino Pit was designed to an acceptable level of risk and incorporate this acceptable level of risk into the stability analyses as a Factor of Safety (FOS) and/or Probability of Failure (POF).	The Casino Pit drainage and dewatering system will maintain pit wall stability via horizontal depressurization holes and drain water and prevent water pressures from building up behind the pit walls during operations.
Ancillary facilities and support buildings at the Casino mine site.	All buildings and structures on site have been designed according to the 2010 National Building Code of Canada	A detailed emergency response plan will be developed and put in place prior to the construction phase of the Project. The emergency response plan will include training and guidance for responding to

Project Components/ Activities	Mitigation Measures	
	Design Considerations	Prevention, Response and Remedial Actions
		earthquakes.

20.3.1.4 Summary Statement

The overall potential effects of seismic activity on the Project is not considered significant because the overall likelihood of occurrence has been determined to be LOW and the consequence of the most likely event has been determined to be LOW. Furthermore, in order to eliminate any reasonable possibility of a negative effect (failure), design considerations for the TMF involved designing the embankments to withstand a 1/10,000 year seismic event.

20.3.2 Terrain Instability

A terrain hazards assessment was carried out for the Casino mine site, Freegold Road Extension, and the Casino Airstrip (Knight Piésold Ltd. 2012f and Appendix 6B). The terrain hazards assessment incorporated terrain mapping, terrain stability mapping and a preliminary assessment of potentially hazardous permafrost-related features. The potential likelihoods for landslides, snow avalanches and permafrost disturbances are described below.

20.3.2.1 Likelihood of Occurrence

Terrain stability mapping was undertaken in 2012 to analyse the terrain stability in relation to the proposed locations of the Project components and activities. Terrain stability refers to the likelihood of a landslide initiating in a terrain polygon following construction activities and timber harvesting and was evaluated based on the slope angle, the slope aspect, the surficial geology, the permafrost conditions and the presence of gullied terrain. Three terrain stability classes were used for the terrain mapping study:

- Stable – Identified as terrain with a ‘negligible’ to ‘low’ likelihood of landslide initiation following road construction
- Potentially Unstable – Expected to contain areas with a ‘moderate’ likelihood of landslide initiation following road construction
- Unstable – Expected to contain areas where there is a ‘high’ likelihood of landslide initiation following road construction.

Terrain stability maps were produced for the Casino mine site, Freegold Road Extension and Casino Airstrip and Airstrip Access Road, to show areas of stable, potentially unstable and unstable terrain (Appendix 6B, 6D). The areas of potentially unstable and unstable terrain are based on the inferred presence of ice-rich soils. Table 20.3.7 summarizes the potential likelihoods of occurrences of terrain instability based on the terrain stability mapping exercise for the Project.

Table 20.3-7 Potential Likelihoods of Occurrences of Terrain Instability

Locations	Stable Terrain (%)	Potentially Unstable Terrain (%)	Unstable Terrain (%)	Occurrence Type	Likelihood
Casino Mine Site	86.5	13	0.5	Landslides and Avalanches	NEGLIGIBLE
				Permafrost Degradation	HIGH
Casino Airstrip and Airstrip Access Road	95	5	0	Landslides and Avalanches	NEGLIGIBLE
				Permafrost Degradation	HIGH
Freegold Road Extension	88	9	3	Landslides and Avalanches	LOW
				Permafrost Degradation	HIGH

Casino Mine Site

The terrain stability mapping indicates that approximately 13% of the Casino mine site is considered to be 'potentially unstable' terrain and approximately 0.5% is considered to be 'unstable' terrain (Appendix 6D). The terrain stability mapping identified areas of potentially unstable terrain and unstable terrain at the TMF location. Additional areas of potentially unstable terrain were also identified at the temporary stockpile sites and the HLF.

Field studies did not observe any recent debris slides, debris flows or rockfalls within the Casino mine site. A possible solifluction lobe was identified in the footprint area of the proposed location of the Open Pit and discussed in further detail in the terrain hazards assessment report (Appendix 6B).

Snow avalanches and landslides generally occur on terrain with slope angles of approximately 27 to 40 degrees. The predominant slope angle classes within the Casino mine site are gentle slopes (of 4 to 15 degrees) and moderately inclined slopes (of 16 to 26 degrees). Therefore, the likelihood of avalanches and landslides were thought to be negligible.

The Casino mine site is located within a zone of widespread discontinuous permafrost and there is regional evidence of permafrost degradation as well as visually observed evidence (Appendix 6B). Permafrost is 'most prevalent on north-facing slopes and in valley bottoms where thick fine-grained slope toe complexes (interbedded loess, colluvium and peat) and alluvial sediments have accumulated' (Bond and Lipovsky 2011). Terrain mapping work at the Casino mine site confirmed that permafrost is present close to ground surface within the majority of summits and ridgelines. Pingos were also identified through field observations in the northeast part of the Casino mine site.

Casino Airstrip and Airstrip Access Road

The terrain stability mapping indicates approximately 5% of the proposed Airstrip and Airstrip Access Road alignment to be 'potentially unstable' terrain (Knight Piésold Ltd. 2012f). The existing variable ground conditions along the Casino Airstrip alignment can result in an increased likelihood of differential settlement of the proposed embankment if not mitigated.

The terrain hazards study identified local evidence of permafrost degradation in the area of the proposed Casino Airstrip and Airstrip Access Road. It was believed that the extent of permafrost degradation has been exacerbated, by anthropogenic effects, in particular the construction of access tracks and winter roads.

Freegold Road Extension

The terrain stability mapping indicates approximately 9% of the proposed Freegold Road Extension alignment to be within 'potentially unstable' terrain and approximately 3% within 'unstable' terrain (Knight Piésold Ltd. 2012f).

Along the Freegold Road Extension, the road sections considered least susceptible to instability are generally those in areas of bedrock exposure. The road sections considered most susceptible to landslides are those in areas of ice-rich, north-facing colluvial slopes, where permafrost degradation can result in slope instability. Gullied terrain is particularly susceptible to landslides because there tends to be concentrations of both surface and sub-surface water.

Snow avalanches generally occur on terrain with slope angles of approximately 27 to 40 degrees. The predominant slope angle classes within the area are gentle slopes (of 6 to 26% or 4° to 15°) and moderate slopes (of 27% to 49%, or 16° to 26°). Overall, a significant proportion of the annual precipitation falls as snow, and the proposed Freegold Road Extension route will pass through some areas of moderately steep terrain that could be susceptible to snow avalanches.

The proposed Freegold Road Extension alignment will traverse extensive areas of permafrost terrain, a significant proportion of which was interpreted in the terrain hazard study to have a shallow (within approximately 1 m of the ground surface) permafrost table and ice-rich soils.

20.3.2.2 Potential Effects

The dominant terrain instability hazard for the Project is permafrost degradation because landslides and snow avalanches are less likely to occur. The baseline rate of permafrost degradation and the extent to which permafrost degradation is anticipated to be affected by anthropogenic processes (including construction activities) is difficult to predict (Appendix 6B). Table 20.3.8 outlines a range of potential effects from terrain instability occurrences to represent the most likely predicted scenario and the most unlikely worst case scenario.

Table 20.3-8 Potential Effects on the Project from Terrain Instability

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Predicted Likely Scenario	Unlikely Worst Case Scenario
Casino mine site	C, O, CD	Terrain instability occurrences do not occur or are minor when they occur, detected by monitoring and mitigated. Occurrences do not compromise the short term or long term stability of infrastructure at the Casino mine site. Project components, activities and critical services are not interrupted.	Unstable terrain has the potential to damage Project infrastructure at the Casino mine site, cause adverse environmental effects, and pose a threat to health and safety. The Project would be completely shut down for more than one month.
Casino Airstrip, Airstrip Access Road, and Freegold Road Extension	C, O, CD	Minor slope instability and erosion of embankments which are monitored and mitigated quickly to prevent sediment delivery to watercourses. Project components, activities and critical services are not interrupted.	Differential settlement of air strip embankments, road embankments and bridge foundations. Slope instability and enhanced erosion and sediment delivery to watercourses. Complete shutdown of Project components, activities and critical services for more than one week.

Notes:
Construction (C), Operations (O), Closure and Decommissioning (CD), and Post-Closure (PC)
A range of potential effects are described to represent the most likely predicted scenario and the unlikely worst case scenario

The Casino mine site, Casino airstrip, and Freegold Road Extension are located within a zone of widespread by discontinuous permafrost. Additionally, there is currently regional evidence of permafrost degradation and visually observed evidence with the Casino mine site. Permafrost degradation can occur both during and after construction, resulting in the possibility of differential settlement of infrastructure embankments and foundations, slope instability and enhanced erosion and sediment delivery to watercourses.

20.3.2.3 Mitigation Measures

Given the uncertainty in predicting the extent to which permafrost degradation will occur, CMC has adopted design based mitigation measures for potentially sensitive structures and will establish and monitoring and response measures prior to the construction of the Project (Table 20.3.9). Site selections for potentially sensitive structures including the HLF, TMF embankments and stockpiles were based on engineering assessments that considered geotechnical conditions informed by completing geotechnical investigations and stability analysis for the proposed locations of the embankments and foundations.

Table 20.3-9 Terrain Instability - Mitigation Measures

Project Components/ Activities	Mitigation Measures	
	Design Considerations	**Actions**
Potentially sensitive structures such as embankments and foundations (TMF, HLF, stockpiles, bridges, airstrip, access roads, etc.)	Potential areas of instability were avoided where possible. Where avoidance is not possible, instability will be mitigated through design considerations and actions.	During construction, permafrost zones and potentially unstable foundation materials within the proposed footprint of sensitive structures will be removed to encourage thawing and drainage and to ensure stability before placement of foundations or embankments.
	The design of sensitive structures accommodates for the removal of permafrost zones prior to construction. A safety margin has been built in to the design of sensitive structures to account for potential reduction in stability due to removal of frozen layers.	Sensitive structures will be monitored for their performance throughout life of the Project through regular inspections to identify areas of potential instability. Mitigative measures will be carried out to decrease the likelihood of failure.
	Sensitive structures will be instrumented (as appropriate) to allow for monitoring of temperature, settlement and slope displacement throughout the life of the Project. For example, vibrating wire piezometers can be installed prior to the construction of the starter TMF embankment.	A program can be established to monitor permafrost conditions adjacent to cleared areas within the Project footprint after the construction phase. This program can monitor for downslope movement and soil moisture in sufficient frequency to assess the effects conditions that may affect terrain stability.

20.3.2.4 Summary Statement

The overall potential effects of terrain instability, in particular permafrost degradation, on the Project is not considered significant. Even though the overall likelihood of occurrence has been determined to be HIGH and is likely to occur over the life of the Project, the consequence of the most likely event is considered to be LOW because Project components, activities and critical services are not anticipated to be interrupted for more than 24 hours with the implementation of proposed mitigation measures.

20.3.3 Extreme Weather Events

Extreme weather events are unusual, severe or unseasonal weather at the extremes of the historical distribution. The following provides a brief overview of extreme weather events that may affect the Project and characterizes the likelihood of occurrence and the severity of the potential effects on the Project. An overview of mitigation measures proposed to prevent and minimize potential adverse effects on the Project is provided. This section includes a discussion of:

- Extreme precipitation (including rain and snow); and
- Extreme temperatures.

20.3.3.1 Likelihood of Occurrence

In general, the climate of the Project area is characterized by long, cold, dry winters and short, warm, wet summers, with conditions varying according to altitude and aspect (Knight Piesold 2012). Climatic data was

collected on-site at the Project's climate station located in the upper Casino Creek sub-watershed at an elevation of 1,200 m. Climatic data was collected from 1993 to 1994 and from 2008 to present and was used in conjunction with climatic data from regional sites to calculate potential extreme weather conditions.

Annual extreme 24-hour rainfall values were calculated using the Rainfall Frequency Atlas of Canada (Hogg and Carr, 1985) methodology and the return period values were estimated using a Gumbel distribution. The 24-hour rainfall depths range from 29 mm for a 2-year return period, to 56 mm for a 200-year return period. For comparison, the maximum daily rainfall recorded at the Casino mine site from 2009 to 2011 was 31.6 mm, which corresponds to a return period between 2 and 5 years according to the Rainfall Frequency Atlas. The maximum daily rainfall recorded at the Pelly Ranch Regional Climate Station, according to Environment Canada's 1971-2000 climate normal, is 34.8 mm. Scaled to the Casino mine site (according to the regression relationship for monthly precipitation), the calculated extreme 24-hour rainfall value is 57 mm as presented in Table 20.3-10.

The maximum and minimum temperatures recorded at the Project climate station between 2008 and 2011 are 26 C and -40 C, respectively. The extreme maximum and minimum recorded temperatures at Pelly Ranch according to Environment Canada's 1971-2000 climate normals are 35 C and -60 C, respectively. Scaled to the Casino mine site (according to the regression relationship for temperature), the calculated maximum temperature at the Casino mine site is approximately 30 C. The calculated minimum temperature at the Casino mine site is more challenging to calculate due to the weaker correlation in winter temperature but is approximately -50 C.

Table 20.3-10 Weather Extremes

Weather Extremes	Pelly Ranch Weather Station	Project Station (Measured)	Project (Calculated)	Likelihood
24-hour Rainfall	34.8 mm	31.6 mm	57.0 mm	Negligible
Annual Snowfall Depth	180 mm	-	179 mm	Moderate
Temperature - Maximum	35^{o}c	26^{o}c	30^{o}c	Moderate
Temperature - Minimum	-60^{o}c	-40^{o}c	-50^{o}c	Moderate

20.3.3.2 Potential Effects

Extreme weather events have the potential to affect the Project components and activities if not mitigated. For example, extreme precipitation can cause unwanted releases of water from water management components such as the TMF, collection ponds and HLF events pond. Extreme precipitation can also instigate erosion of material from stockpiles and flooding of structures and access and haul roads or increased maximum snow loading on mine site buildings. Prolonged periods of extreme snow fall can decrease visibility and become a major issue that impedes mine and transportation operations. A summary of the potential effects of the extreme weather events on the Project components and activities is presented in Table 20.3-11.

Table 20.3-11 Potential Effects on the Project from Extreme Weather Events

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Predicted Likely Scenario	Unlikely Worst Case Scenario
Water management structures (including the TMF, collection ponds and HLF events pond)	C, O, CD	Extreme precipitation will increase water levels within the TMF, collection ponds and HLF events ponds but is within maximum capacity. Project components, activities and critical services are not interrupted.	Extreme precipitation will increase water beyond the capacity of the water management structures and will lead to overtopping of mine contact water into the environment prior to meeting discharge requirements for water quality.
TMF, HLF, and stockpiles	C, O	Minor erosion of embankments, from extreme wind gusts or precipitation events will be monitored and mitigated quickly to prevent sediment delivery into watercourses or short and long term instability. Project components, activities and critical services are not interrupted.	Extreme wind gusts and precipitation events can lead to weathering and erosion of materials that will result in run-off of mine contact water from the TMF or instability of embankments and stockpiles.
Access road and haul roads	C, O	Temporarily (short-term) impassable sections of roads due to flooding from extreme precipitation or visibility issues related to extreme snow are mitigated quickly so that Project activities and critical services are not interrupted for more than 24 hrs.	Large sections of roads are impassable due to extreme precipitation or snow for an extended period of time, so that Project activities and critical services are interrupted for more than one week.
Casino airstrip	C, O	Extreme snowfall, low temperatures and wind gusts may cause short term delays and cancelled flights at the Casino airstrip for less than 24 hrs.	Extended extreme snowfall, low temperatures and wind gusts can cause the Casino airstrip to shut down and cancel all flights for Casino staff for more than a week.
Mine operations including HLF ore stacking, open pit development and ore processing	C, O	Short term visibility issues from extreme snowfall may interrupt mine operations. The majority of Project activities and critical services are not interrupted for more than 24 hrs.	Extended visibility issues from extreme snowfall may affect Project activities and critical services for more than a week.
Camp office, maintenance shops, thickened tailings plant, explosives storage magazine, mill	C, O	Localized flooding, and increased snow loading on structures at the Casino mine site will be monitored and mitigated quickly so that Project activities and critical services are not interrupted.	Extreme and extended snow fall and precipitation events could potentially cause generalized flooding at the Casino mine site. Extreme snow fall could cause the collapse of some structures due to snow loading.

Notes:

Construction (C), Operations (O), Closure and Decommissioning (CD), and Post-Closure (PC)

A range of potential effects are described to represent the most likely predicted scenario and the unlikely worst case scenario

20.3.3.3 Mitigation Measures

The Project has incorporated design-based mitigation measures into the design of Project components and activities to prevent and minimize the potential effects of extreme weather events on critical Project components and activities. The calculated extreme weather conditions for the Project (presented in Table 20.3-10) were used

as the design values for engineering the Project's key mine site components, water management structures and access components. For example, the capacity of the collection pond for the TMF has been sized to provide sufficient storage for water taking into consideration extreme precipitation events including the Probable Maximum Flood (PMF) event. The PMF, as defined by the Canadian Dam Safety Association, is a flood event which results from the most severe and reasonably possible combination of rainstorm, snow accumulation, melt rate and antecedent moisture conditions (CDSA 1995). The design based mitigation measures listed in Table 20.3-12 are expected to prevent any possible overtopping and accidental release of mine contact water that does not meet water quality objectives during extreme precipitation events.

During the life of the Project, the Emergency Response Plan and other associated environmental management and monitoring plans will define actions and procedures to ensure that human and environmental health and safety is considered in relation to potential effects on the Project from extreme weather events.

Table 20.3-12 Extreme Weather Events - Mitigation Measures

Project Components/ Activities	Mitigation Measures	
	Design Considerations	**Actions**
Water management structures (including collection ponds, events pond, diversion ditches)	The crest elevations of water management ponds have been designed to provide sufficient storage capacity to safely contain the probable maximum precipitation event. The 1 in 100 year 24-hour storm event is defined as the design storm event for the sizing of surface runoff and diversion ditches. Temporary collection ditches for construction will be sized to convey the runoff from the 1 in 10 year 24-hour storm event. The HLF Fresh Water Supply Pond will be designed with an overflow spillway sized to pass the design storm event commensurate with the dam safety rating.	Throughout the life of the Project, water management objectives will be guided by the Water Management Plan for the Project. During operations, dewatering systems will include ditches, pipes, sumps, pumps and booster pumps. After decommissioning and closure, any mine-contact water that does not meet discharge requirements for water quality will be routed to the Open Pit (anticipated for approximately 10 years).
TMF	A safety assessment of the TMF was conducted to determine the storm storage requirements. The TMF has been designed using a 72-hour 1:1,000 and the Probable Mean Flood (PMF) events. The Inflow Design Flood (IDF) selected for the TMF has a volume of 7.0 million m3 during the construction phase, 9.0 million m3 during operations, and 6.1 million m3 at closure, once the spillway is operational. TMF ditches will be sized to convey the 1 in 10 year peak flow.	During operations, selective handling and placement of materials (including waste rock, tailings, topsoil and overburden) combined with management strategies to avoid or minimize weathering and erosion of materials into run-off will be implemented and monitored.
Stockpiles	The diversion ditching system along the upslope side of the stockpiles have been designed to meet the criteria for a 1 in 100 year 24-hour duration storm event. Where possible soil stockpiles will be oriented to reduce wind erosion and located to reduce wind exposure.	Sediment control fencing will be placed around the down-gradient perimeter sections of the stockpiles to prevent sediment discharge from the stockpiles. All ore and topsoil stockpiles will be removed before or at closure of the mine. The topsoil from the stockpiles will be

Project Components/ Activities	Mitigation Measures	
	Design Considerations	Actions
		used in reclamation activities for the Project.
Access road and haul roads	Any areas in close proximity to flood plains, watercourses and unstable terrain, have been avoided where possible. Road culverts on haul roads and access roads have been designed to account for a 1 in 100 year flood event. Bridges along the Freegold Road have been designed with 2m of freeboard above the 1 in 100 year flow elevation to allow for clearance of debris during a flood event.	The Transportation Management Plan will include snow clearing strategies on haul roads and access roads to ensure continuous operations. Regular road maintenance will include ensuring proper drainage off the road surface, and monitoring for erosion of bridge abutments, approaches, and drainage ditches following heavy rainstorms. In addition, culverts along the Freegold Road Extension and Freegold Road Upgrade will be inspected and cleared to ensure they operate and drain effectively.
Casino airstrip	Any areas in close proximity to flood plains, watercourses and unstable terrain, have been avoided where possible. The airstrip design includes a drainage system to divert subsurface flow and runoff from the airstrip surface.	Special vehicles at the Casino airstrip will clear the snow as fast as possible from the airstrip. Additional mitigation, if required, can include localised slope flatting or air convection embankments to reduce snow accumulation and allow cold air to propagate into the embankment during the winter.
Heap Leach Facility	A number of considerations have been planned for the Heap Leach Facility including In-Heap Storm Storage for the 1 in 25 year storm event, a HLF embankment spillway for conveying the 1 in 200 year storm event, a HLF Events pond designed for the 1 in 100 year storm event with a spillway for the 1 in 200 year storm event and diversion ditches. In addition, in consideration of low visibility months, the Casino mine plan does not propose to carry out ore stacking at the HLF during the worst winter months.	The Emergency Response Plan will define actions and procedures to ensure that human and environmental health and safety is considered during extreme weather events. Staged stacking of the ore at the facility will also take place.
Mine operations including open pit development and ore processing	Information on design mitigation measures adopted for the Project is provided in Section 4.0 of the Proposal.	The Emergency Response Plan will define actions and procedures to ensure that human and environmental health and safety is considered during extreme weather events.
Camp office, maintenance shops, thickened tailings plant, explosives storage magazine, mill	Flood control design based mitigation measures for a 1 in 100 year wet event has been incorporated into the design for all on-site structures including the mill. Snow loading design based mitigation measures have been incorporated into the design of all on-site structures for a 1 in 100 year storm event. As appropriate, building designs will follow Part 4 of the	Sensitive structures and buildings will be monitored for their performance throughout life of the Project, especially during and after extreme weather events, through regular inspections to identify areas of potential failure. Mitigative measures will be carried out to decrease the likelihood of short or long term failure.

Project Components/ Activities	Mitigation Measures	
	Design Considerations	Actions
	Canada Building Code.	

20.3.3.4 Summary Statement

The overall potential effect of extreme weather events on the Project components and activities is not considered to be significant. Given the semi-arid climate of the Project location, the likelihood of occurrence for an extreme weather event during the life of the Project is categorized as negligible to moderate. Even though extreme weather events have a low potential of occurring during the life of the Project, the Project has incorporated design-based measures to mitigate for potential effects and the severity and consequence of potential effects to the Project from extreme weather events are considered to be low. Based on the design considerations employed, it is anticipated that extreme weather events will not cause the Project's critical components and activities to shut down for more than 24 hours.

20.3.4 Wildfires

Wildfires have the potential to cause widespread damage to ecosystems and property if not contained. Wildfire behavior is a function of forest moisture levels, precipitation, wind speed, humidity, and air temperature. The amount of fuel onsite determines the heat and the potential damage that can be caused by a fire. Generally, areas that have a high fire frequency tend to have lower fuel loading and will burn through the understory quickly and with less destructive force. Forests with a lower fire frequency (common in areas where fire suppression is active), have higher fuel loading, and consequently in the event of a wildfire, burn hotter and more destructively.

The following provides a brief overview of wildfire history in the Yukon Territory and characterizes the likelihood of occurrence and the severity of the potential effects on the Project's critical components and activities. An overview of mitigation measures proposed to prevent and minimize potential adverse effects on the Project is provided.

20.3.4.1 Likelihood of Occurrence

Wildfires can originate from lightning strikes, accidents, malfunctions, careless human activity and deliberate criminal acts. As well environmental factors such as dry summer weather, high winds, and lightening will increase the fire risk and risk of accidental fire. According to the Yukon Government, the Yukon has an average of 150 wildfires per year and approximately half of which are caused by people (Government of Yukon 2013). Wildfire statistics for the Yukon Territory between 2000 and 2006 are provided in Table 20.3.13 from statistics available on the Yukon Government Wildland Fire Management Program.

Table 20.3-13 Wildfire Statistics from 2000 to 2006

Year	Lightning Caused	Human Caused	Total Fires	Hectares Burned
2006	53	26	79	95,033
2005	57	26	83	129,472
2004	249	33	282	1,714,875
2003	28	49	77	49,037
2002	30	39	69	36,336
2001	50	18	68	17,334
2000	23	31	54	7,653

Given that half of all wildfires in the Yukon are caused by anthropogenic sources, it is difficult to determine the probability of a wildfire occurring in the Project area. Based on the categories of likelihood and taking into consideration the wildfire data provided by the Yukon Government, the overall likelihood of a wildfire event that has the potential to affect the Project during the life of the Project is moderate and it could happen.

20.3.4.2 Potential Effects

The potential effects of wildfires on the Project include damage to onsite buildings and structures within the Casino mine site, the Casino Airstrip, Yukon River water pipeline and the access road. Primary Project components at risk from wildfire include mine supply traffic along the Freegold Road Upgrade and Freegold Road Extension. Within the Casino mine site, of particular concern is the ability for critical Project components, such as the HLF, to continue to operate safely if the main or supplementary power plants fails to generate power. This potential effect is discussed in detail in Section 21 as part of the assessment of accidents and malfunctions.

Table 20.3-14 lists a range of potential effects to the Project components or activities, from the most likely scenario to the worst case scenario.

Table 20.3-14 Potential Effects on the Project from Wildfires

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Predicted Most Likely Scenario	Worst Case Scenario
Freegold Road (Extension and Upgrade)	C, O	Minor damage to bridges and culverts are repaired and Project activities and critical services are not interrupted.	Multiple bridges and culverts along the access road are destroyed by wildfire causing Project activities and critical services to be interrupted for more than one month while repairs are completed.
Casino airstrip	C, O, DC	Minor damage to the Casino airstrip facilities and infrastructure are repaired and Project activities and critical services are not interrupted.	The Casino airstrip infrastructure and facilities are destroyed and regularly scheduled flights in and out of the Casino mine site are disrupted for more than one month while repairs are completed.
On site buildings and structures including the accommodations camp, offices, maintenance shops, plant site, and haul roads	C, O	Minor damage or no damage to buildings and structures at the Casino mine site and activities and critical services are not interrupted.	Buildings and structures at the Casino mine site are destroyed and there is a complete shutdown of Project components, activities and critical services for more than one month.
Explosive facility	C, O	Unintended explosion and fire is within the buffer established and does not affect other buildings at the Casino mine site. The Project activities are not interrupted.	Unintended explosion and fire will destroy other buildings at the Casino mine site. There is a complete shutdown of Project components and activities and critical services for more than one week.
Power plants (Supplementary and Main)	C, O	Minor damage if any to the Main Power Plant or Supplementary Power Plant but not both. Backup generators are available and the Project activities and critical services are not interrupted for more than 24 hrs.	Wide spread power outage at the Casino mine site due to damage to both power plants. Backup generators are insufficient, and Project activities and critical services are interrupted for more than a week until additional generators are brought to the Casino mine site.

Notes:
Construction (C), Operations (O), Closure and Decommissioning (CD), and Post-Closure (PC)
A range of potential effects are described to represent the most likely predicted scenario and the unlikely worst case scenario

20.3.4.3 Mitigation Measures

The Project is located in the Mayo sub-district of the Northern Tutchone fire management district. The closest fire department is located in the Village of Mayo, and is staffed by 15 to 20 volunteers. The Casino mine site will be mainly cleared of vegetation, reducing the risk of a wildfire damaging onsite Project components. Mitigation measures proposed to minimize potential effects to the Project associated with wildfires are listed in Table 20.3-15.

Table 20.3-15 Wildfires - Mitigation Measures

Project Components/ Activities	Mitigation Measures	
	Design Considerations	**Actions**
Freegold Road (Extension and Upgrade)	The Freegold Road Extension will operate as a resource road with controlled and limited access.	Brushing and clearing along the Freegold Road Extension and Freegold Road Upgrade right-of-ways will help minimize the risk of wildfires. CMC will develop a transportation management plan that will include measures to limit the risk of anthropogenic fires as a result of mine generated traffic on the Freegold Road Extension and Upgrade.
Casino airstrip	Firefighting equipment will be located at the Casino airstrip.	Vegetation that could provide fuel for fire will be removed from around the airstrip infrastructure.
On site buildings and structures including the accommodations camp, offices, maintenance shops, plant site, and haul roads	Firefighting equipment will be located throughout the mine site. The process offices, laboratory and shop/warehouse will be fitted with sprinkler systems. Vegetation that could provide fuel for fire will be removed from around mine infrastructure. The HLF will be designed to ensure safe operation and/or shutdown in the event of a site evacuation and/or power failure.	A fire and explosion response process will be developed as part of the Emergency Response Plan for the Project that will include procedures for dealing with wildfire hazards and site evacuations.
Explosive facility	Fire risk is always kept in mind when considering explosives storage and the placement of the explosives magazine at the mine site. Vegetation that could provide fuel for fire will be removed from around mine infrastructure.	Explosives magazines will be located and designed within embankments to prevent damage to other facilities.
Power plants (Supplementary and Main)	Water for firefighting is available at the Casino mine site. Emergency generators are also available on site.	Vegetation that could provide fuel for fire will be removed from around mine infrastructure.

20.3.4.4 Summary Statement

The overall potential effect of wildfires on the Project components and activities is not considered to be significant. The likelihood of occurrence for a wildfire event during the life of the Project is categorized as moderate because approximately half of all recorded wildfires in the Yukon Territory are caused by people. Given the likelihood of occurrence, the Project has incorporated design-based measures to avoid wildfires and minimize the potential severity and consequence to the Project. The overall impact of wildfires to the Project is considered to be low. CMC anticipates that wildfire events will not cause the Project's critical components and activities to shut down for more than 24 hours.

20.3.5 Climate Change

Climate change is defined by the Intergovernmental Panel on Climate Change as "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties that persists for an extended period, typically decades or longer" (IPCC 2007). Climate change reflects abnormal variations to the

expected climate, and is currently most commonly associated with increasing temperatures, although related changes in other parameters such as atmospheric water vapour content; precipitation patterns; snow and ice cover; soil moisture; and runoff, also qualify as abnormal variations to the expected climate.

A preliminary assessment of potential climate change effects was conducted for the Project to verify whether or not the climate scenario used to assess the potential effects on valued components reasonably represents conditions that might be expected over the life of the Project and into post closure. This assessment included a review of relevant literature and examination of historical trends of annual temperature, precipitation, and discharge for the Project. Historical trends were compared to downscaled predictions established from global climate models developed for the Intergovernmental Panel for Climate Change in order to assess a full range of possible climate change scenarios for the Project. The comprehensive findings of this assessment are available in the Climate Change Report (Appendix 20A) and a summary of the key finding is provided below.

Section 8.0 of the Proposal describes air quality as an indicator of both environmental and human health due to the atmosphere's role in transporting air emissions to humans, freshwater, and terrestrial receptors. In the context of climate change, air quality can also be a key indicator of increase greenhouse gasses (GHG) in the atmosphere and its contribution to climate change.

Concerns about the potential effects of GHG related climate change have resulted in national and local policy and regulatory initiatives that apply to developments in the Yukon. At the federal level, legislation and GHG emissions targets are still being developed based on the approach set out in Canada's 2007 Action Plan, the *Turning the Corner Plan*, which was supplemented by the development of a regulatory framework in 2008 (Environment Canada 2008). In addition, a number of provinces and territories have developed their own climate change legislation to reduce local contributions to GHGs. The Government of Yukon's Climate Change Strategy (YGCCS) was published in 2006 (Government of Yukon 2006a).

The Yukon strategy's four goals call for:

- Enhancing public awareness;
- Reducing greenhouse gas emissions;
- Building environmental, social, and economic systems to adapt to changes and take advantage of climate change opportunities; and
- Establishing Yukon as a northern leader in climate change research and innovation.

Environment Yukon has focused on meeting these goals through the development of the Yukon Climate Change Action Plan, which was finalized in 2009 (Government of Yukon 2009a). The Action Plan identifies 33 specific actions that advance the goals set out in the 2006 YGCCS. Currently, though, there are no regulations related to release of GHG emissions within Yukon.

20.3.5.1 Likelihood of Occurrence

Climate change predictions are particularly relevant for development projects in the Yukon because the greatest temperature increases have been noted in northern latitudes (Werner *et al.* 2009). According to the Yukon Government's report "Yukon Water: An Assessment of Climate Change Vulnerabilities" (Goulding 2011), temperature and precipitation generally increased across the Yukon for the period of 1950 to 1998, annual temperatures were generally increasing across the territory, in the order of 2 °C (Lemmen *et al*. 2008), and daily minimum temperatures were found to be increasing faster than daily maximum temperatures (Werner *et al.* 2009). All regions showed slightly increasing winter precipitation, while summer precipitation decreased in the northern

Yukon but increased in the southern Yukon. According to a Pacific Climate Impacts Consortium (PCIC) report "Climate Change in Dawson City, YT: Summary of Past Trends and Future Projections", winter temperatures are projected to increase 2.1°C to 3.5°C by 2050 over baseline climate normal values for 1961 to 1990, and annual precipitation is projected to increase by 10% to 40%, with a 30% to 50% increase expected in the winter and a 10% to 30% increase expected in the summer (Werner *et al*. 2009). Estimates of climate changes predicted for the Dawson Region for 2050 using the PCIC Regional Analysis Tool, based on an ensemble of future emission scenarios, are summarized in Table 20.3-16, and indicate a median temperature increase of 2.6°C and a median annual precipitation increase of 15%.

Table 20.3-16 Climate Change Predictions for the Dawson Region by 2050 and Likelihood of Occurrence

Climate Variable	Season	Projected Change in 2050 relative to 1961-1990			Likelihood of Occurrence
		Ensemble Median	10th Percentile	90th Percentile	
Mean Temperature (°C)	Annual	+2.6	+1.6	+4.4	Moderate
Precipitation (%)	Annual	15%	4%	24%	Moderate
	Summer	12%	2%	28%	
	Winter	17%	3%	37%	
Snowfall (%)	Winter	16%	0%	36%	Moderate
	Spring	6%	-7%	23%	Low

Notes:
1. Source: Pacific Climate Impacts Consortium Regional Analysis Tool, 2013
2. Median and percentile calculations are based on results for emission scenarios used in the IPCC Fourth Assessment Report (AR4)

20.3.5.2 Potential Effect

Equivalent carbon dioxide (CO_{2e}) was estimated for the Project using the US Environmental Protection Agency (US EPA) AP42 emission factors, approved emission limits, manufacturer specifications, NONROAD2008 software, and MOVES 2010a software. CO_{2e} is a measure that describes, for a given mixture and amount of GHG, the amount of CO_2 that would have the same global warming potential, when measured over a specified timescale (generally, 100 years). Project generated CO_{2e} is summarised in Table 20.3-17.

Table 20.3-17 Casino CO_{2e} Emission Estimates

Project Phase	Greenhouse Gas Source	CO_{2e} (kt)
Construction Phase	Mine Fleet (average per year)	140
	Power Generation (average kt per year)	75
	Other Sources (average kt per year)	3.7
	Construction Phase Total (average kt per year)	**216**
	Construction Phase Total Emissions (3 year period)	**648**
Operation Phase	Mine Fleet (average kt per year)	399
	Power Generation (average kt per year)	202
	Other Sources (average kt per year)	3.96
	Operation Phase Total (average kt per year)	**604**
	Operation Phase Total Emissions (22 year period)	**13,297**

Notes:

1. Equipment speeds (other than haul trucks) are based on general mining practices.
2. It was assumes that all vehicles will use diesel fuel and generators will use diesel and LNG.
3. The fuel rates for all vehicles were taken from Caterpillar's Performance Handbook Edition 29.
4. Fuel consumption for vehicles are averages and a load factor of 1 was applied. This assumes that equipment will not be overloaded and will be used on adverse grades and experience some high rolling resistance.
5. Working time was calculated as the productive time, which includes loading, unloading, and transporting.
6. The Main Power Plant will be active for the entire operation phase with 90% efficiency.

Information on Yukon and Canadian CO_{2e} emissions from 1990 to 2011 are presented in Section 8 of this Proposal. Existing levels of annual CO_{2e} emissions from the Yukon in 2011 contributed to approximately 0.05% of the total Canadian emissions. Taking into account the potential CO_{2e} emissions generated by the Project during the construction phase, the Yukon Territory with the Casino Project would only contribute 0.15% of the total annual Canadian emissions (using 2011 rates). In general, the Yukon generates relatively very low CO_{2e} emissions nationally and does not provide a measurable contribution to global emission levels.

According to Nelson and Schuchard (2011), the temperature and precipitation shifts and more frequent and severe extreme weather events associated with climate change will affect the mining sector. Climate models predict a general increase in winter precipitation and rapid warming in the north, which can lead to degradation of permafrost (ICF Marbek 2012). Potential effects to the Project from climate change are outlined in Table 20.3-18.

Table 20.3-18 Potential Effects on the Project from Climate Change

Project Component or Activity	Project Phase[1]	Range of Potential Effects[2]	
		Predicted Most Likely Scenario	Worst Case Scenario
All infrastructure and components	C, O, CD, PC	Minor occurrences of terrain instability will not compromise the short term or long term stability of infrastructure. Project activities and critical services are not interrupted.	Increased heavy rain and increased erosion will affect slope stability of sensitive infrastructure and components. Terrain instability along the transport corridors could temporarily disrupt delivery of process materials to site or of concentrate off site. Project activities and critical services will be temporarily interrupted while repairs are completed.
All infrastructure and components	C, O	Hotter and drier conditions are monitored and responded to appropriately so that wildfires do not threaten facilities and activities. Minor damage is expected to cause only short term interruption to Casino mine site activities and components.	Hotter and drier conditions will cause larger wildfires that could result in damage of infrastructure or medium or long term of disruption of activities.
Water management structures	C, O, CD	Extreme precipitation will increase water levels within the TMF, collection ponds and HLF events pond but water management structures will not overtop.	Flooding from increased rainfall could exceed the capacity of water management structures, resulting in the unintentional release of water into the environment.
Closure and Reclamation Practices	CD, PC	Hotter temperatures will make it more difficult to re-establish native vegetative cover, however increased CO_2 and longer growing seasons could conversely benefit re-vegetation efforts.	Increased erosion resulting from inability of re-vegetated areas to become self-sustaining. PC monitoring will inform adaptive management.

Notes:
Construction (C), Operations (O), Closure and Decommissioning (CD), and Post-Closure (PC)
A range of potential effects are described to represent the most likely predicted scenario and the unlikely worst case scenario

20.3.5.3 Mitigation Measures

Design considerations for the potential effects of climate change on the Project have been incorporated into the design of potentially sensitive components and activities. For example, the designs of the HLF and TMF have incorporated predefined synthetic modelled peak flow assumptions for extreme precipitation events. The design specifications of all key structures have taken into account the potential for climate change and other extreme events and effects of the environment.

Table 20.3-19 outlines the sections of the Proposal that provide design considerations and prevention, response and remedial actions to mitigate for the potential effects of climate change on the Project. Additional measures, outlined in Section 8.0, will be implemented by CMC to minimize potential CO_{2e} emissions from the Project.

Table 20.3-19 Climate Change - Mitigation Measures

Project Components/ Activities	Mitigation Measures	
	Design Considerations	**Prevention, Response and Remedial Actions**
All infrastructure and components	Terrain instability – described in Section 20.3.2	Described in Section 20.3.2
Water Management Structures	Extreme Weather Events – described in Section 20.3.3	Described in Section 20.3.3
All infrastructure and components	Wildfires – described in Section 20.3.4	Described in Section 20.3.4
Closure and Reclamation Practices	A Closure and Reclamation Plan will be developed in the context of future climate, with considerations for future biodiversity, vegetation and other climate change considerations,	Reclamation refinement during mine operations will help select native vegetation that will adapt to the changing climate.

20.3.5.4 Summary Statement

The overall potential effect of climate change on the Project is not considered to be significant. The likelihood of occurrence for climate change during the life of the Project is categorized as moderate, since it is widely recognized that warming of the climate is evident, though the magnitude of the climate change generated effects is uncertain (ICF Marbek 2012). Given the likelihood of occurrence, the Project has taken into consideration potential climate change effects in the design of key and potentially sensitive components and activities to avoid or minimize any potential effects to the Project.

20.4 CONCLUSION

The design considerations for the Project and proposed prevention, response and remedial actions have taken into account the potential for extreme environmental events, including those associated with climate change; therefore, no significant effects to the Project are anticipated due to effects of the environment.

Table 20.4-1 Summary of Potential Effects to the Project from the Environment

Environmental Events	Potential Effect (based on Likelihood and Consequence)
Seismic Activity	Not Significant
Terrain Instability (landslides, avalanches, and permafrost disturbance)	Not Significant
Extreme Weather Events	Not Significant
Wildfires	Not Significant
Climate Change	Not Significant

Notes:
Severity of the potential effect is based on the potential effects described to represent the most likely predicted scenario

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21 – ACCIDENTS AND MALFUNCTIONS

21.1 INTRODUCTION

In accordance with Section 42 of YESAA, the assessment of a project must include determination of the significance of any environmental or socio-economic effects resulting from accidents or malfunctions. Additional federal and territorial legislation pertaining to accidents and malfunctions are discussed in Appendix 21-A. Environmental risk assessment is a systematic review of the potential for failure of engineered systems and their effects, and incorporates design and contingency planning (Pelletier and Dushnisky 1993). The primary purpose of a risk assessment is to identify hazards associated with a project, assess the associated risks, and bring the risks to tolerable level on a continuous basis (Paithankar 2011). The general approach to risk assessment involves the identification and analysis of information in terms of risk to environmental and socio-economic values; the outcome of the risk assessment is used to identify risk reduction strategies (Ministry of Environment, Lands and Parks 2000).

Credible hazard scenarios with potentially moderate to major impacts or consequences are assessed in this section of the Casino Project Proposal; the analysis of risk includes the evaluation of the likelihood of occurrence of an incident, and the consequences of an incident should one occur. A qualitative risk assessment was used: qualitative approaches to risk assessment are the most commonly applied and use descriptive terms to identify broad likelihoods and consequences of events (Paithankar 2011). Qualitative methods often illustrate the ranking of risks using a risk matrix (Paithankar 2011). Section 21.3 provides the methodology used to assess the risks associated with accidents and malfunctions.

The assessment was completed by examining Project components or activities to develop an understanding of accidents and malfunctions that could occur for all phases of the Project, and all potential hazard scenarios associated with the accident or malfunction. Accidents and malfunctions are unplanned events that may be caused by design failure, equipment malfunction, or human error. The accidents and malfunctions assessment includes discussion of hazard scenarios; their potential causes; design measures implemented to reduce the likelihood and consequence of any incident; the potential effects of any incident on Valued Components (VCs); and mitigation and management measures that will be implemented to further reduce the risk of occurrence. The effect of natural events, such as earthquakes or floods, that could affect the Project are discussed elsewhere in this Proposal.

The scope of the risk assessment considers accidents and malfunctions associated with the following Project components:

- Site preparation;
- Mining;
- HLF and processing;
- Mine waste management (tailings and waste rock);
- Water supply and management;
- Liquefied Natural Gas (LNG) and diesel use;
- Transport of equipment, personnel, materials, and product to and from site utilizing trucks and aircraft;
- Hazardous material storage and use; and

- Waste disposal.

Potential accidents or malfunctions associated with the Project components were assessed for all Project phases. The effects of accidents and malfunctions on employee health and safety or on the economics of the Project will be addressed as part of the Project health and safety program and in the operations management manual, respectively, and are not addressed in this section of the Proposal. A set of credible incident scenarios was selected for assessment, based on the Project design. Typical risks associated with mining developments include transportation accidents resulting in fuel or chemical spills; tailings line rupture or release; and tailings impoundment or spillway failure (Pelletier and Dushnisky 1993). The credible hazard scenarios assessed for the Casino Project were:

- Embankment failures;
- Slope failures;
- Spills or leaks;
- Transportation accidents;
- Water conveyance and storage systems failure;
- Fires and explosions; and
- Failure of erosion and sediment control measures.

Interactions between the hazard scenarios associated with the accidents and malfunctions and the Project VCs are discussed. The hazard scenarios, design measures, potential effects of any incident on VCs; and mitigation and management measures to address each high level risk are recorded in a Risk Register. The completed Risk Register for the Casino Project can be found in Appendix 21B.

21.2 METHODOLOGY

The method used to assess the significance of potential accidents and malfunctions follows the general approach and framework of a Failure Modes and Effects Analysis (FMEA). The purpose of a FMEA is to assess the risk of failure in a process and identify the most important areas for improvement; it is a step-by-step process to identify the ways in which a component or process may fail (the “failure modes”) and assess the consequences of those failures (“effects analysis”). For this assessment, the “failure modes” are the accidents and malfunctions. The “effects analysis” is the determination of risk.

Risk assessment involves risk identification (what could happen, how, when, and why) followed by risk analysis (Purdy 2010). Risk analysis involves developing an understanding of the risk in terms of consequences and likelihood, and making a decision about an acceptable level of risk and the need for additional treatment (Purdy 2010). Options to “treat” the level of risk include avoiding the risk by not initiating the activity; removing the source of risk; or implementing measures to alter the likelihood or consequences (Purdy 2010). Risk assessments can follow quantitative, semi-quantitative, or qualitative approaches. Quantitative analyses use numerical measurements to describe conditions, while qualitative analyses are based on existing research, professional experience, and judgement (Ministry of Environment, Lands and Parks 2000). Most risk assessments are neither purely quantitative nor qualitative, since qualitative analyses rely to some extent on numerical background information, and quantitative analyses are based on assumptions and expert opinion; both require professional judgement when dealing with uncertainty (Ministry of Environment, Lands and Parks 2000).

A qualitative risk assessment was conducted for the Casino Project in order to identify all components or activities and potential hazard scenarios that could pose a risk to the Project VCs. Qualitative approaches use descriptive terms to identify likelihoods and consequences of events (Paithankar 2011). The ranking of risks for each hazard scenario are illustrated on a risk matrix. The general approach followed in the assessment is presented Figure 21.2-1 and discussed in the following paragraphs.

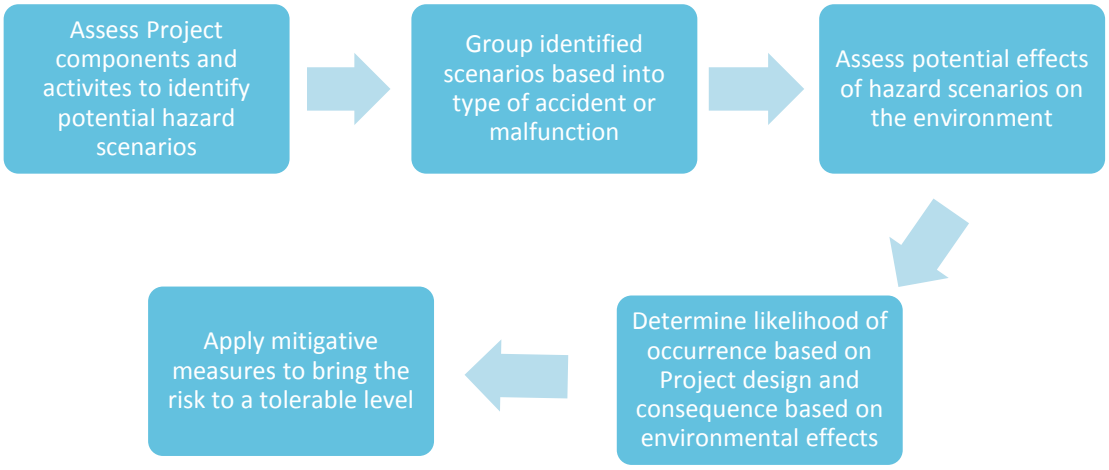


Figure 21.2-1 Accidents and Malfunctions Risk Assessment Methodology

21.2.1 Risk Identification and Analysis

Professional judgment was used to identify potential accidents and malfunctions associated with each of the major Project components and activities and resulting hazards that were determined to be credible. For this assessment, the Project description provided in Section 4 of this Proposal was reviewed to identify the major components of the Project, which comprise:

- Site preparation activities (borrow pits, clearing and grubbing, mass excavation and fill, topsoil and overburden stockpiles);
- Mining (open pit drilling and blasting, crushing and conveying of ore and waste);
- Heap leach facility (heap leach pad, events pond, operation and cyanide destruction plant, constructed wetland at closure);
- Processing (gold extraction plant, sulphide ore processing, concentrate handling);
- Tailings Management Facility (TMF) (embankment, cyclone plant, tailings distribution pipelines, potentially reactive waste rock and overburden);
- Water supply and management (riverbank caisson and radial well system, temporary and permanent storage ponds, collection and diversion ditches);
- LNG and diesel facility;

- Transport of equipment, materials, personnel to/from site (including the Freegold Road construction and use);
- Hazardous materials storage and use; and
- Waste disposal.

A Risk Register was developed to document the major components or activities and potential accidents or malfunctions associated with each. A Risk Register is a tool used to record details of all risks identified for a component or activity. The Risk Register includes a description of each risk; when it could occur; factors that could affect the likelihood or consequence of a risk; the likelihood and consequence of a failure; actions and controls that would be implemented to mitigate the risks; and an assessed risk grade.

Each "risk" was assigned an alphanumeric code to reflect the Project component and the hazard scenario and carried forward in the assessment.

Risk is typically defined as the product of the likelihood and the consequence of an event. Likelihood is assigned based on the level of design information available for the Project, review of historic or current mining accidents and malfunctions, and professional judgement. Consequence is assigned based on the spatial and temporal context of the Project. Qualitative descriptors for the four likelihood categories are provided in Table 21.2-1. Qualitative descriptors for the four consequence categories are provided in Table 21.2-2.

Table 21.2-1 Likelihood Rating Criteria

Unlikely	Event is not expected to occur during the life of the Project
Rare	Low probability of occurrence during the life of the Project
Possible	Event may occur during the life of the Project
Likely	Event is expected to happen at least once during the life of the Project

Table 21.2-2 Consequence Rating

Very Low	Effects occur near the source, are contained, and are immediately reversible
Low	Effects extend beyond event site but are confined, and persist over the short-term but are reversible through mitigation
Moderate	Effects extend beyond event site, have medium-term recovery but are reversible through mitigation, with no residual impacts
High	Effect is widespread, requires long-term recovery with mitigation, leaves a residual impact

Confidence in the likelihood and consequence ratings is provided in the Risk Register; low confidence in the ratings would be a result of insufficient information regarding details of the Project component or activity, or incomplete knowledge of the site-specific setting (or a combination of the two); high confidence would be assigned where information is available on design and failure modes for similar components or activities.

21.2.2 Risk Evaluation and Ranking

The primary objective of a risk assessment is to provide context in making decisions, ideally decisions that result in acceptable levels of risk to environmental, social and economic values (Ministry of Environment, Lands and Parks 2000). The likelihood and consequence of the hazard scenarios identified in the previous steps was therefore discussed subsequently in terms of the Project VCs. The assessment of potential effects to VCs from

the accident and malfunction hazard scenarios is based on an initial screening of interactions. A three-point scale was used to rank potential interactions, ranging from '0' where no interaction is anticipated to '2', denoting a higher risk interaction; the criteria for each rank are defined in Table 21.2-3.

Table 21.2-3 VC Interaction Code

Code	Anticipated level of interaction
0	No interaction
1	Interaction is not anticipated to result in an environmental or socio-economic effect with implementation of mitigation and management measures.
2	Interaction could result in an environmental or socio-economic effect of concern, even with implementation of mitigation measures.

Interactions between potential accidents and malfunctions and the Project VCs are provided on Figure 21.2-2; all VCs potentially affected by each hazard scenario are indicated in the Risk Register (Appendix 21B).

	Valued Components													
Accidents and Malfunctions	**Surficial Geology, Terrain, and Soils**	**Water and Sediment Quality**	**Air Quality**	**Noise**	**Fish and Fish Habitat**	**Rare Plants and Vegetation Health**	**Wildlife**	**Community Vitality**	**Community Infrastructure and Services**	**Sustainable Livelihood**	**Employability**	**Economic Development and Business Sector**	**Cultural Continuity**	**Land Use and Tenure**
Embankment Failure	2	2	0	0	2	2	2	0	0	0	0	0	0	0
Slope Failure	2	2	0	0	2	2	2	0	0	1	0	0	0	1
Spills/Leaks	2	2	0	0	2	0	2	0	1	2	0	0	0	0
Water Management Failure	2	2	0	0	2	2	1	0	0	0	0	0	0	0
Fire/Explosion	0	0	2	2	0	2	1	0	1	1	0	0	0	2
Transportation Accident	0	0	0	0	0	0	1	0	2	0	0	0	0	0
Erosion and Sediment Control Measures Failure	1	2	0	0	2	1	1	0	0	0	0	0	0	0

Figure 21.2-2 Accidents and Malfunctions VC Interaction

The next step in the risk assessment is to identify additional management or monitoring strategies for all hazard scenarios. Management measures could include additional mitigation for moderate or higher risk scenarios, and monitoring and adaptive management for lower risk activities.

Using the likelihood and consequence ratings for each hazard scenario, a risk grade is assigned based on a risk matrix, as illustrated on Figure 21.2-3.

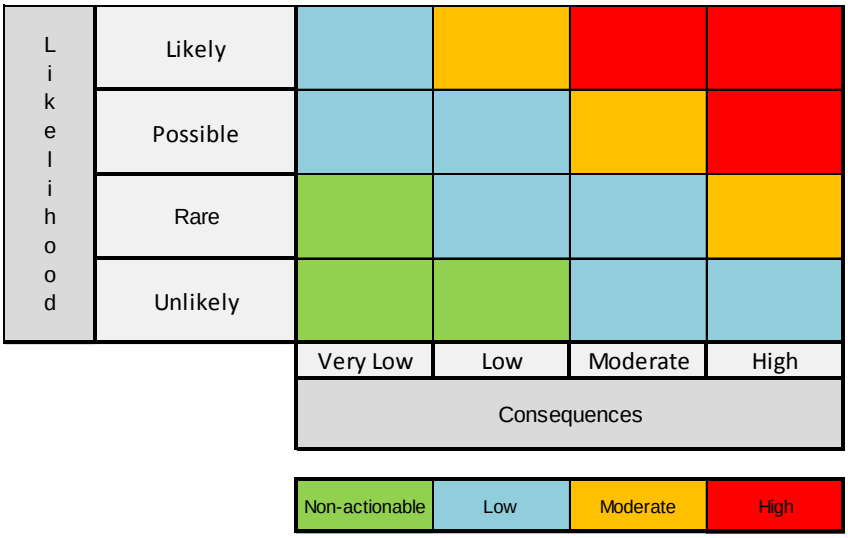


Figure 21.2-3 Risk Matrix Template

Risk grades range from Non-actionable (negligible risk; no additional mitigation or re-design required) to High (serious risk; re-design or operational changes required). Hazard scenarios ranked as 'Non-actionable' risk to 'Moderate' risk are considered Not Significant; those rated as 'High' are considered to constitute a potentially significant impact on Project VCs. Risk grades are used to assist management and decision making in determining where focus will be needed at the design detail stage or during operations to minimize the risk of failure of a component or activity.

21.3 RISK IDENTIFICATION

The Casino Project is primarily a copper and gold mine that is anticipated to process approximately 120,000 t/d or 43.8 million t/y of material over 22 years of full production. The Casino Project will produce gold and silver doré and copper and molybdenum concentrates from both heap leach and conventional flotation recovery processes. A detailed description of the Project is provided in Section 4.

21.3.1 Site Preparation and Construction

Site preparation activities for the Casino Project include:

- Clearing and grubbing of vegetation;
- Topsoil salvage for future use in reclamation
- Construction of sediment and erosion control structures;
- Development of site staging and laydown areas;
- Large mass excavations and fills;
- Excavation of borrow sites for aggregates; and
- Foundation preparation for infrastructure.

Potential accidents and malfunctions and hazards assessed with site preparation activities were identified as:

- Slope or wall failure in borrow sites, resulting in slope failure or instability in surrounding terrain;

- Failure of sediment and erosion control structures during clearing and grubbing, development of site staging and laydown areas, or foundation preparation, resulting in discharge of deleterious substances (sediment) to the environment;
- Failure of sediment and erosion control structures during topsoil salvage and stockpiling;
- Spills or leaks from heavy equipment and machinery used for site preparation, resulting in release of deleterious substances (fuels, lubricants, etc.);
- Vehicle collisions (trucks, track and wheel dozers, graders, water trucks, etc.) resulting in spills or leaks of deleterious substances (fuels, lubricants, etc.); and
- Accident or equipment failure relating to the Concrete Batch Plant, resulting in the discharge of deleterious substances (uncured concrete or concrete leachate) to the environment.

Site preparation activities will be conducted primarily in the construction phase, but will extend into the Operation Phase for components such as the TMF, HLF, and waste rock and topsoil stockpiles, which will be developed over the life of the mine as the Open Pit expands.

21.3.2 Mining

21.3.2.1 Open Pit

The Casino Project Open Pit, located between the headwaters of Casino Creek and Canadian Creek, will occupy an area of approximately 300 ha at its greatest extent. The Open Pit will be developed using standard drill and blast techniques. Activities associated with Open Pit operation include:

- Drilling and Blasting:
  - Blast holes will be drilled and explosives (ammonium nitrate and fuel oil (ANFO)) dispensed into the blast holes; and
  - Blasting trials are implemented when there are observed changes in the characteristics of the rock during excavation.
- Open Pit development:
  - Overburden will be cleared at the Open Pit edge at a 2H:1V slope;
  - Benches 8 m wide and 15 m tall with a face angle of 65º will be used for the majority of the Open Pit;
  - Inter-ramp angles of 45º will be used for the majority of the Open Pit, angles of 42º will be used to minimize wedge failures as necessary.
- Water management:
  - Diversion ditches will be constructed to collect surface runoff, snowmelt and seepage along the pit crest and the base of the weathered bedrock materials and divert it away from the pit;
  - Horizontal drains will be drilled in pit walls to drain groundwater;
  - Vertical wells will be drilled to reduce water pressure in the pit walls; and
  - Pumps and collection systems will transfer water from the pit excavation to a surface sump.

At closure the Open Pit will be partially backfilled with low grade ore and lime will be added to increase the pH. Water from the tailings pond will be pumped and stored in the Open Pit until the TMF wetlands are active, and diversion ditches will be removed to allow the Open Pit to passively fill with water; once the Open Pit fills to the point of overflow (estimated to occur within 50 to 100 years), pit drainage will enter the TSF wetland via decant control valve.

Potential accidents and malfunctions and hazards assessed for Open Pit activities are:

- Fuel spill in Open Pit during refueling or resulting from vehicle collisions;
- Pit wall failure resulting in adjacent slope instability;
- Fly rock and air overpressure wildlife injury or mortality and damage to public infrastructure from blasting accidents; and
- Open pit flooding and overtopping during operations.

21.3.2.2 Ore Crushing, Conveying, Hauling, Stockpiling

Ore materials from the Open Pit will be hauled to the ore stockpiles or the crusher system for crushing to reduce ore size to required specifications. The following stockpiles will be used during the course of construction and operations:

- Gold ore intended for the heap leach will be stockpiled starting in Year -3 and continuing up to Year 15;
- Low-grade ore will be stored in several temporary stockpiles adjacent to the plant site and crusher up to Year 17 and milled during the last four years of mine operations;
- Supergene oxide (SO_X) ore will be stockpiled during the construction phase and in Year 1 of operations for processing during Years 4 to 12; and
- Sulphide coarse ore reclaim: primary crushed sulphide ore will be stockpiled on the ground in a covered coarse ore reclaim stockpile until it will be fed to the semi-autogenous (SAG) mill circuit.

Potential accidents and malfunctions and hazards assessed for ore handling activities are:

- Ore stockpiles slope failure resulting in deposit of material into surrounding terrain (sediment); and
- Blockage of water collection or diversion ditches at toe of stockpiles, resulting in discharge of deleterious substances to environment (contact water).

21.3.3 Processing

The sulphide ore processing facility produces mineral concentrates of copper and molybdenum using conventional flotation technology. The oxide ore processing facility produces gold and silver doré bars via heap leaching and carbon adsorption technology.

21.3.3.1 Sulphide Ore Processing Facility

Sulphide ore processing will be comprised of primary crushing, a conventional single-line SAG mill circuit, and conventional copper-molybdenum flotation to produce concentrates of molybdenum and copper. Copper concentrates will flow by gravity from the flotation circuit to a copper concentrate thickener. Thickened copper concentrate will be filtered in three tower-type copper concentrate pressure filters into filter cakes. The filter cakes will be discharged on to a conveyor belt that transfers them to a covered copper concentrate stockpile until shipment. Copper concentrate from the concentrate stockpile will be moved by front-end loaders onto highway haul trucks.

Molybdenum concentrates from the flotation circuit flow by gravity to an agitated filter feed tank. Molybdenum concentrate slurries will be filtered to create filter cakes, which will travel through dryer before discharging to the

molybdenum concentrate storage bin. Molybdenum concentrate will be bagged in super-sacks for shipment by highway haul trucks.

The sulphide ore processing facility also includes:

- Tailings thickener;
- Potential Acid Generating (PAG) Tailings distribution pipeline to the TMF;
- Tailings distribution launder (for bulk Non-PAG tailings) to the Cyclone Plant; and
- Tailings distribution pipeline (for bulk, underflow, and overflow Non-PAG tailings) from the Cyclone Plant.

Potential accidents and malfunctions and hazards assessed as part of the sulphide ore processing facility are:

- Failure of containment vessels, mechanical equipment or control system resulting in on-site reagent spill to or in sulphide ore processing facility;
- Failure of mechanical equipment or control system resulting in on-site concentrate spill;
- Failure of the thickeners, pipes, and pumps from sulphide ore processing facility to the TMF and release of PAG tailings; and
- Reagent fire or spill in sulphide ore plant site.

21.3.3.2 Oxide Ore Processing Facility

The oxide ore processing facility produces gold and silver doré bars via heap leaching and carbon adsorption technology. Copper contained in the oxide ore will be recovered as a copper sulphide precipitate using the Sulphidization, Acidification, Recycling and Thickening (SART) process. Crushed oxide ore will be placed on the heap leach in stages over a period of approximately 18 years. The oxide ore processing facility includes:

- Heap leach facility:
  - Heap leach pad
  - Earthen embankment
  - Composite liner system
  - Leak detection and recovery system (LDRS)
  - Insulated drip-type irrigation system
  - Leachate collection system (solution collection pipes and pumps to facilitate recovery of enriched (pregnant) leach solution.
- Events pond and embankments; constructed to full size prior to commencing operations of the HLF
- Pipeline from the in-heap collection area of the heap leach facility discharges the pregnant solution to the gold recovery building; and
- Gold recovery building housing the carbon adsorption facility (ADR plant) and SART facilities.

Preliminary closure plans for the oxide ore processing facility include:

- Rinsing and drain-down of the ore and cyanide destruction;
- Removal of the geosynthetic liners from the overflow spill way and the events pond;
- Decommissioning of the pregnant solution recovery system; and

- Removal of pregnant solution, events pond pumps and pipeworks.

Potential accidents and malfunctions and hazards assessed for the oxide ore processing facility are:

- Failure of tanks, pipes, pumps between HLF and gold recovery building, resulting in release of pregnant solution;
- Heap leach pad embankment or slope failure or Events Pond overflow or embankment failure resulting in discharge of deleterious substances to environment (sediment, barren solution, pregnant solution); and
- Fire or spill involving processing reagents.

21.3.4 Mine Waste Management

All waste rock, tailings and water from the mine and process operations will be stored in the Casino Project TMF, located southeast of the Open Pit within the Casino Creek headwater valley. The TMF is designed to retain tailings, potentially reactive waste rock and overburden materials, and acidic supergene waste.

21.3.4.1 Tailings Management Facility

The TMF will be comprised of:

- Two earth-rockfill-cyclone sand, zoned embankments constructed by a centerline raise construction method, with upstream and downstream shells constructed from dozer compacted cyclone sand and other suitable borrow materials;
- Cyclone plant to generate clean sand from the bulk Non-PAG (Non-Potentially Acid Generating) tailings for embankment construction and tailings distribution pipelines (bulk non-PAG tailings, PAG tailings, cyclone sand, cyclone overflow);
- Mill and cyclone plant reclaim water systems;
- Waste storage area in the upstream portion of the TMF impoundment for potentially reactive waste rock and overburden;
- Supernatant (surface water) pond;
- Water management system (seepage collection ditches and pond, and seepage recycle system); drainage piping added to embankments in Years 1, 4, 10, and 22;
- A closure spillway and downstream channel near the right abutment of the West Saddle Embankment terminating at an erosion protected plunge pool at the confluence of Brynelson Creek; spillway will pass a 24-hr probable maximum flood event; and
- Wetland treatment for the removal of copper at closure.

The TMF will be developed starting in the construction phase in Year -4 and will be utilized throughout the mine life. Potential accidents and malfunctions and hazards assessed for the TMF are:

- TMF embankment failure or overtopping;
- Tailings distribution pipelines failure (bulk non-PAG tailings, PAG tailings, cyclone sand, cyclone overflow); and
- Reclaim water line rupture resulting in release of contact water and causing erosion and sedimentation.

21.3.4.2 Topsoil, Overburden and Non-PAG Waste Rock Management

Non-PAG waste rock will be produced as part of the Open Pit pre-stripping activities during the construction phase and will be used in construction of the TMF starter embankment. The Non-PAG waste rock that is either unsuitable for use as construction material or in excess of construction material requirements will be placed in the waste storage area of TMF or an adjacent surface dump. During general site preparation, overburden will be salvaged and placed in temporary stockpiles located around the mine site for use in reclamation activities.

Potential accidents and malfunctions and hazards assessed for waste rock and overburden management are:

- Stockpile erosion and sedimentation; and
- Slope failure in stockpiles or waste rock dumps.

21.3.5 Water Supply and Management

21.3.5.1 Water Supply and Distribution

During construction (Year -3 to Year -1) a Temporary Freshwater Supply Pond located within the TMF catchment area will be developed by retaining flows in an upper Casino Creek headwater tributary behind a cofferdam. During operations, freshwater will be sourced from the Yukon River by a riverbank caisson and radial well system. Freshwater will be piped to site via the Yukon River Fresh Water Pipeline, which will be an aboveground insulated pipeline with four booster stations. Water will be stored on site in a Freshwater Pond located northeast of the Open Pit and adjacent to the Yukon River Access Road. The Yukon River Fresh Water Pipeline will follow an existing road that leads northward from the Casino mine site to the Yukon River along Britannia Creek.

The hazard scenario assessed for the water supply and distribution system was equipment or design failure (cofferdam failure, pipeline rupture, etc.) resulting in discharge of water with the potential to cause erosion and sedimentation.

21.3.5.2 Site Wide Water Management

The objectives of water management at the Casino Project are to keep contact water and non-contact water separate, to minimize erosion in disturbed areas, and to mitigate the release of sediment laden waters to the receiving environment. This will be achieved through sediment control ponds, cofferdams, pumping systems, runoff collection ditches, diversion channels, and stabilizing disturbed land surfaces to minimize erosion. During operations the following measures will be used to meet the water management objectives:

- Diversion ditches will divert runoff around TMF embankments, ore stockpiles, and Open Pit during operations;
- Sediment control fencing placed around the down-gradient perimeter of mine components;
- Water management ponds to collect and store surface runoff and seepage;
- Open Pit horizontal drains to drain groundwater and vertical wells to reduce water pressure; and
- Upslope catchment runoff diverted to the TMF during Closure and Post Closure;
- During Closure water management structures not required for monitoring in Post-Closure will be decommissioned and reclaimed and water will be directed to the Open Pit for filling.

The hazard scenario assessed for the water management component is equipment or design failure (cofferdam failure, pipeline rupture, pump failure, etc.) resulting in discharge of contact or non-contact water, resulting in erosion and sedimentation or discharge of other deleterious substances to the environment.

21.3.6 Fuel Storage and Distribution

The Project will utilize an on-site power plant to generate its own electrical power using LNG to fuel generator drivers. Power will be supplied throughout the site by two power plants: the Supplementary Power Plant will be established near the accommodations camp during the construction phase and the Main Power Plant will be located at the plant site for operations.

During Year -4 diesel fuel will be used at the Supplementary Power Plant; diesel will be transported to the Casino mine site using a fleet of tanker trucks capable of self-loading and discharging. Diesel fuel will be stored in a diesel fuel storage tank installed next to the plant.

Beginning in Year -3, the LNG receiving, storage, and distribution facility will be constructed at the plant site. The LNG will be transported to the Casino mine site from Fort Nelson, British Columbia via double wall vacuum tanker trucks for and transferred to site-fabricated storage tank(s) tanks at -162°C and 1+ atmospheric pressure. A vaporization facility will convert the LNG into natural gas form at an appropriate pressure for use at the power plants.

Potential accidents and malfunctions and hazards assessed for the bulk delivery and fuel storage of the LNG are (Drube et al 2012):

- Tank or piping failure due to collision, impact or overpressure;
- Tank failure due to loss of strength from fire exposure;
- Material failure due to corrosion or brittle fracture;
- Piping failure due to vibration and/or thermal fatigue;
- Operator error (e.g., leaving a valve open);
- Accident, operator error, or equipment malfunction during fuel delivery and unloading; and
- Mechanical failure in tank, tanker offloading pumps, or refueling equipment leading to vapor leak or LNG spill.

Drube et al (2012) note that “Refueling stations perform a similar function regardless of fuel. Variations relate to the location, nature and volume of fuel stored and the risks around fuel dispensing. LNG is viewed as more hazardous due to the large volumes stored above ground and the relative volatility of the fuel itself compared to … diesel.” Therefore, the hazards for storage and transfer of diesel are similar to those of LNG.

21.3.7 Transport of Equipment, Materials and Personnel

Throughout the both the Construction and Operation phases of the Casino Project trucking will be the primary inbound and outbound transport from the Casino mine site. Aircraft will be used for transporting personnel.

21.3.7.1 Trucking

Material will be transported to site by truck along the Freegold Road from Carmacks. The Freegold Road Extension will be a two-lane, all-weather gravel road designed to accommodate double-trailer and Tridem trucks, and will have 18 major bridge crossings and 71 major culvert or short span bridge crossings. The Freegold Road

Extension has been designed to meet the BC Ministry of Forests and Range Forest Road Engineering Guidebook (2nd Edition, 2002) for a 70 km/h design speed with some 50 km/h sections where road geometry is limited by the terrain.

Predicted traffic volume during construction will vary from 870 vehicles in Year -4 to 9,512 vehicles in Year-2; these numbers include transport trucks supplying mining equipment, camp, fuel and supplies, as well as light vehicles. During the Operation Phase transport traffic is anticipated for shipping of copper and molybdenum concentrate and copper sulphide precipitate; LNG and diesel tanker trucks; ancillary supplies and equipment; and waste removal.

During closure and decommissioning it is anticipated that diesel will be delivered to the site.

Traffic accidents or traffic-related incidents could result due to one or more of the following reasons:

- Operator error (including driver impairment);
- Equipment failure;
- Road conditions;
- Weather conditions;
- Improper road maintenance (grading, snow removal); and
- Wildlife crossings.

As noted by Drube et al (2012), transport of fuel using public roads raises a number of safety concerns because of the large volumes involved; the primary concern is either a high-impact crash or mechanical failure leading to the release of fuel into the environment. In the case of LNG, a cryogenic LNG spill could lead to injuries, property damage, or fire. Potential causes of loss of containment for LNG noted by Drube et al (2012) are:

- Tank or piping failure due to impact or overpressure;
- Material failure due to corrosion or brittle fracture;
- Piping failure due to vibration and/or thermal fatigue; and
- Operator error.

The following hazard scenarios associated with traffic accidents or incidents are assessed:

- Hazardous materials spill;
- Injury, mortality to wildlife;
- Fire/explosion causing injury, mortality, use of essential services RCMP, fire department, ambulance service; and
- Motor vehicle collision resulting in damage to public facilities.

21.3.7.2 Aircraft

Aircraft will be used for employee transport to and from the Casino mine site. The airstrip design has been developed to conform to Transport Canada's Aerodrome Standards and Recommendations Practices (TP312) and is designated a Code 3C Non-instrument runway. The projected average number of flights per year in the construction and Operations Phase for personnel rotations is 359 and 152, respectively.

Aircraft accidents could result due to one or more of the following reasons:

- Operator error (including pilot impairment);
- Equipment failure;
- Airstrip conditions; and
- Weather conditions.

The following hazard scenarios associated with aircraft accidents or incidents on landing or takeoff at the Casino airstrip are assessed:

- Injury, mortality to wildlife;
- Hazardous materials spill; and
- Fire/explosion.

21.3.8 Hazardous Material Storage and Use

Hazardous materials (other than LNG and diesel previously discussed) that will be required for mine operation include explosives, lubricants, and processing reagents. This section discusses the potential accidents and malfunctions that could be associated with the handling, storage and use of explosives materials and processing reagents.

21.3.8.1 Explosives Manufacture and Storage

The Casino Project requires the use of explosives during construction of the infrastructure site pads, construction of access roads, and production of the Open Pit. Blasting will be carried out using ANFO manufactured at the Casino mine site. Fixed emulsion and ammonium nitrate will be stored on site. Facilities associated with explosives manufacture and storage area consist of:

- Bulk ammonium nitrate outdoor storage area (silos);
- Bulk fuel area;
- Magazine for storage of detonators, detonating cord, boosters ;
- Emulsion manufacturing facility;
- Wash bay;
- Maintenance facility; and
- Trucks.

The explosives facility will be located at the north end of the Casino mine site, taking into consideration Natural Resources Canada (NRCan) requirements for siting. All materials will be stored in accordance with applicable regulations and standards and will be managed by a NRCan licensed explosives contractor.

The accidents and malfunctions assessed related to explosives storage are fires, explosions, and spills.

21.3.8.2 Processing Reagents

Reagent storage, mixing, and distribution will be conducted for the reagents used in the sulphide ore and oxide ore processing circuits. The reagent storage and mixing facilities for the flotation circuits will be located within a

structurally independent building adjacent to the flotation building. An 8,000 t pebble lime silo will be located apart from the flotation building. Chemicals used in the sulphide ore (flotation) process and a brief description of their use are provided in Table 21.3-1. Chemicals used in the Heap Leaching Circuit process and a brief description of their use are provided in Table 21.3-2.

Table 21.3-1 Sulphide Ore Process Reagents

Chemical	Description/Typical Material Safety Data Sheet Information
Sodium-diisobutyl dithiophosphinate (Aerophine 3418A Promoter)	Colorless to light yellow, odorless, mobile liquid; slightly alkaline; auto-ignition temperature 437°C; completely soluble in water; LC50 Bluegill, 96-hour: 375 mg/l Daphnia, 48-hour: 149 mg/L
Sodium diethyl dithiophosphate/sodium di-secondary butyl dithiophosphate (Aerofloat 208 Promoter)	Slight fire hazard when exposed to heat or flame; acid may react with metals to produce hydrogen, a highly flammable and explosive gas; heating may cause expansion or decomposition leading to violent rupture of rigid containers; may emit acrid smoke and corrosive fumes.
Methyl Isobutyl Carbinol (MIBC, frother)	Clear liquid with a “sweet” odour; Flammable liquid and vapour. Vapours are heavier than air and may travel across the ground and reach remote ignition sources causing a flashback fire danger. Low toxicity: LD50 >2000 mg/kg for rat and rabbit
Pebble Lime (CaO, pH modifier)	White or gray, odorless lumps, granules, or powder. Not combustible or flammable but reacts with water to form calcium hydroxide while generating heat, which could ignite combustible materials. Not explosive but reaction with water or other incompatible materials causes material to swell and may rupture containers. High pH therefore toxic to aquatic organisms and aquatic systems.
Fuel Oil (#2 Diesel fuel, moly collector)	Colourless to straw or red oily liquid with kerosene like odour. Combustion may produce CO, CO_2 and reactive hydrocarbons.
Sodium Hydrosulfide (NaHS, copper mineral depressant)	High pH therefore toxic to aquatic organisms and aquatic systems (pH 11). Auto-ignition temperature 120°C; releases highly toxic and highly flammable hydrogen sulfide gas if mixed with an acid or if exposed to excessive heat. Toxic to terrestrial vertebrates.
Flomin D-910 (Sodium dithiophosphate)	Prepared by the reaction of phosphorus pentasulfide with sodium hydroxide; commonly called “Nokes reagent”
Flocculant	Typical flocculant like Anionic Polyacrylamide is a colourless of white granular powder with a pH of 6.0. Flammable, dust explosions may occur if material is dispersed in air. Flammability may be enhanced by presence of strong oxidizers.
Potassium amyl xanthate (PAX – pyrite flotation)	May spontaneously ignite on exposure to moist air; flammable gas (carbon disulfide) when wet; highly toxic gases (carbon disulfide,

Chemical	Description/Typical Material Safety Data Sheet Information
	hydrogen sulfide) if heated to decomposition. If discharged to waterways, xanthates may persist for several days; highly toxic to aquatic life - may form complexes with heavy metals.

Table 21.3-2 Oxide Ore Process

Chemical	Description/Typical Material Safety Data Sheet Information
Sodium Cyanide (NaCN)	Solid white substance with a faint “bitter almond” odour; soluble in water. Decomposes on heating, emitting toxic fumes, including those of hydrogen cyanide, and ammonia; toxic to animals in comparatively low concentrations. Known to cause bird kills in tailings dams.
Caustic Soda (sodium hydroxide, NaOH)	Odourless white solid; highly reactive with metals; reactive with oxidizing agents, reducing agents, acids, alkalis, moisture.
Pebble Lime (CaO)	White or gray, odorless lumps, granules, or powder. Not combustible or flammable but reacts with water to form calcium hydroxide while generating heat, which could ignite combustible materials. Not explosive but reaction with water or other incompatible materials causes material to swell and may rupture containers. High pH - toxic to aquatic organisms and aquatic systems.
Hydrochloric Acid (HCl)	Liquid with a pungent odour; colourless to light yellow. Reacts violently with water, especially when water is added to the product; absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent at 125°C; sodium reacts very violently with gaseous hydrogen chloride; reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates; reacts with most metals to produce flammable hydrogen gas.
Sodium Hydrosulphide (NaHS)	High pH therefore toxic to aquatic organisms and aquatic systems (pH 11). Auto-ignition temperature 120°C; releases highly toxic and highly flammable hydrogen sulfide gas if mixed with an acid or if exposed to excessive heat. Toxic to terrestrial vertebrates.
Sulphuric acid (H_2SO_4)	Clear, colourless to dark brown, odourless; dense, oily liquid; hygroscopic. Will not burn but can decompose at high temperatures, forming toxic gases such as sulphur oxides. Contact with combustible materials may cause fire; highly reactive. Contact with many organic and inorganic chemicals may cause fire or explosion; contact with metals liberates flammable hydrogen gas; reacts violently with water; reacts with most metals, especially

Chemical	Description/Typical Material Safety Data Sheet Information
	when diluted with water; this reaction produces highly flammable hydrogen gas that may explode if ignited.
Activated Carbon	Black, odourless, pelletized powder; insoluble in water;
Antiscalant	Typical antiscalants such as -1,1 Diphosphonic Acid 1-hydroxyethane may produce Co_x, PO_x and phosphine on combustion.
Flocculant	Typical flocculant like Anionic Polyacrylamide is a colourless white granular powder with a pH of 6.0. Flammable, dust explosions may occur if material is dispersed in air. Flammability may be enhanced by presence of strong oxidizers.

The accidents and malfunctions assessed related to processing reagent storage are fires, explosions, and spills.

21.3.9 Solid and Hazardous Waste Management

21.3.9.1 Solid Waste

Non-Hazardous Solid Wastes produced as part of Casino mine construction, operations and closure will include woody debris, domestic camp wastes (food, plastics, paper), and inert bulk wastes (rubber belts, drywall, etc.). Woody debris from clearing and grubbing will be stockpiled for local use, mulched, or burned in slash piles. The waste will be sorted by material and depending on the material, hauled-offsite by truck to an approved disposal area, disposed of on site in a landfill, or incinerated on site before being disposed of in a landfill. Open air controlled burning of inert combustible materials will be conducted on an as-needed basis to eliminate large quantities of construction related wood waste and cardboard that would otherwise use up landfill capacity.

The main disposal method for combustible non-hazardous wastes will be incineration using a variable flow dual chamber incinerator. Incineration will divert putrescible waste from the landfill and prevent problems associated with odours, which may attract wildlife. Inert solid waste and ashes from the incinerator will be disposed of in landfills. Regular cover will be applied over the landfill sites and a cap of native overburden will be placed on top of the landfill before decommissioning.

The accidents and malfunctions assessed related to solid waste management are:

- Fire or explosion from incinerators, woody debris slash piles;
- Leaks from storage or disposal drums; and
- Leaching from landfill

21.3.9.2 Hazardous Waste

Hazardous wastes (used batteries, used paint, reagent containers, waste petroleum products and oils, etc.) will be temporarily stored in special containers and/or at designated locations on site and will be shipped to registered hazardous waste disposal facilities, burned on site, or returned to manufacturers or to recycling depots. Manifests will be prepared for all materials shipped off-site and the receivers will be required to maintain chain of custody records. Estimated volumes of hazardous and recyclable wastes will be developed during detailed engineering design.

The accidents and malfunctions assessed related to hazardous waste management are leaks and spills.

21.3.9.3 Sewage Management

A pre-engineered and pre-fabricated sewage treatment plant system accepts and treats all sanitary wastewater with an aerobic process that allows for bio-oxidation of the sanitary wastes to suitable levels for discharge into the environment. Wastewater will be either pumped from the mine buildings to the wastewater treatment plant, or collected in holding tanks and delivered via truck to the wastewater treatment plant. Treated effluent will be disposed of in a rock drain, designed to the standards of the Yukon Government.

The accidents and malfunctions assessed related to sewage management are leaks and spills.

21.3.10 Reclamation

Typical and proposed mine reclamation activities include:

- Grading, covering, and revegetation of final slopes (overburden stockpiles, waste management dumps, HLF) to provide adequate drainage and erosion protection from surface runoff;
- Placement of soil cover material containing adequate growth media (fines) to sustain re-vegetation and prescribing a vegetative cover that is capable of self-regeneration without continued dependence on fertilizer or re-seeding;
- Constructed wetlands within the TMF to treat any residual low levels of cyanide and trace metals resulting from precipitation infiltrating through the HLF closure cap.

Further details on the reclamation measures are provided in Section 4.

21.4 RISK ANALYSIS AND EVALUATION

A Risk Register was developed to document the major components or activities and potential accidents or malfunctions associated with each. A Risk Register is a tool used to record details of all risks identified for a component or activity. The Risk Register includes a description of each risk; the phase in which the component or activity would occur; the design or management measures to reduce the likelihood or magnitude of a failure; the likelihood and consequence ratings; mitigation measures; and the assessed risk grade. The following seven credible hazard scenarios associated with one or more of the Project components or activities were assessed, and are discussed in detail in the following paragraphs:

- Embankment failures;
- Slope failures;
- Spills or leaks;
- Transportation accidents;
- Water conveyance and storage systems failure;
- Fires and explosions; and
- Failure of erosion and sediment control measures.

The Risk Register is provided in Appendix 21B.

21.4.1 Embankment failure

Potential embankment failure associated with each of the following Project components is assessed in this section:

- TMF;
- Heap Leach Pad;
- Heap Leach Pad Events Pond;
- Freshwater Ponds;
- Process Water Pond; and
- Water Management Pond.

21.4.1.1 Tailings Management Facility Embankment Failure

Azam and Qi (2010) attempted to statistically analyze available data on tailings dam failures; failure modes were attributed to unusual weather events, seepage, poor management (inappropriate dam construction procedures, improper maintenance of drainage structures, and inadequate long-term monitoring programs), slope instability, structural defect, and overtopping. Overtopping can be attributed to inadequate spillway design, spillway debris blockage, or settlement of the dam crest, while seepage occurs around pipes and spillways, through animal burrows and through cracks in the dam or dam foundations (International Commission on Large Dams (ICOLD) 2013). Improved engineering practices, construction technology, and more stringent safety criteria have significantly reduced dam failures since the 1990s (Azam and Qi 2010). The decrease over the several decades in the failure rate of dams has been attributed to, among other things, improvements in investigation techniques and dissemination of knowledge on risks (ICOLD 2013).

The likelihood of a TMF embankment failure is difficult to predict. Azam and Qi (2010) note that the failure rate over the last 100 years, based on a world inventory of 18,401 mine sites, is estimated as 1.2%; however, Haile and Brouwer (2012) note that “it is incorrect to imply that any particular proposed or actual dam structure is more or less likely to fail based solely on the extrapolation of general dam failure statistics”, and that the assessment of the integrity and stability of any dam is more correctly based on site-specific conditions and facility details.

The TMF Main and West Saddle Embankments have been designed in accordance with the CDA Dam Safety Guidelines, and based on site geotechnical, hydrogeological, hydrometeorological, and seismic information (Knight Piésold 2012a). The embankments will be constructed as water-retaining zoned structures with a low permeability core zone and appropriate filter and transition zones to prevent downstream migration of fines. The core zone will include a seepage cut-off key into competent rock in the foundation. Foundation preparation for the TMF embankments will involve the stripping of topsoil and vegetation and excavation of underlying frozen soils to competent, stable bedrock or non-frost susceptible overburden foundation. The removed material will be replaced with core, filter or shell zone material. The design basis for the embankments includes a Hazard Classification Consequence Category of “High”, as defined by the CDA Dam Safety Guidelines. The Main Embankment will be constructed in several stages over the operating life of the mine using the centreline method of construction. Development of sufficient tailings beach area is required between the supernatant pond and the embankment to provide a stable upstream construction surface for the centreline embankment raises.

Two levels of design earthquake are considered in the design of the Casino Project’s TMF: the Operating Basis Earthquake (OBE) for normal operations, and the Maximum Design Earthquake (MDE) for extreme conditions, as described in Section 4.3. A design earthquake of magnitude 8.0 has been selected as the MDE, based on a

review of regional tectonics and historical seismicity. Based on the CDA Guidelines classification for a “High” consequence dam, the Casino Project TMF is designed for a probabilistically derived event having an annual exceedance probability of 1/2,500.

The centerline raise construction method is a widely used construction technique that “affords superior seismic and static stability as compared to upstream construction methods and results in an inherently stable structure that does not rely on the strength of the deposited tailings solids … there are relatively few instances of catastrophic failure for tailings dams constructed using the centerline and downstream methods” (Haile and Brouwer 2012). The results of the stability analyses conducted for the Project indicate that the design satisfies the minimum requirements for factors of safety for short term (operational) and long term (post-closure) stability (1.3 and 1.5, respectively) (Knight Piésold 2012a). The seismic analysis for the TMF embankment indicates that any embankment deformations during OBE or MDE earthquake loading would be minor, and would not have any significant impact on embankment freeboard or result in any loss of embankment integrity (Knight Piésold 2012a).

Based on these design measures using the site specific geotechnical, hydrogeological, hydrometeorological, and seismic information, the likelihood of failure has been rated as Unlikely. In the event of a TMF embankment failure the consequences would be High if tailings and supernatant water were released into the environment, depending on the magnitude of the release.

Failure of the Main Embankment could result in release of tailings and supernatant into the Casino Creek valley, and potentially into the Dip Creek watershed. This section describes the potential effects of a TMF embankment failure on the following VCs:

- Surficial Geology, Terrain, and Soils;
- Water and Sediment Quality;
- Fish and Fish Habitat;
- Rare Plants and Vegetation Health; and
- Wildlife.

Release of tailings and supernatant water could result in an increase in metals concentration in soil, water, and sediment; alteration or loss of fish habitat; direct fish mortality; destruction of rare plants or loss of rare ecological land types; and loss of wildlife habitat downstream of the embankments.

The extent of any effect would depend on the type of embankment failure (partial to catastrophic) and on the amount of tailings released. Partial failure, or total embankment failure during the construction or early operations period would result in localized effects, due to the relatively smaller volume of tailings released, while a catastrophic failure of the embankment during the final years of operation or during closure could inundate the Casino Creek watershed. The Project Emergency Response Plan (Appendix 22B) will outline the containment and cleanup measures to be implemented in the unlikely event of any TMF embankment failure, methods for the disposal of contaminants and debris, and post-incident evaluations.

21.4.1.2 Heap Leach Pad Embankment and Events Pond Embankment Failure

The heap leach pad and events pond will be located upstream and within the same catchment area as the TMF thereby minimizing potential environmental impact (Knight Piésold 2012b). The heap leach pad embankment constructed at the toe of the proposed pad will provide stability to the heap leach pad and provide in-heap storage for solution. The heap leach pad is designed to be operated predominantly as a ‘dry’ pad with minimal solution storage occurring in the in-heap storage during normal operating conditions. The embankment will be constructed

with an upstream slope of 3H:1V and downstream slope of 2H:1V to ensure embankment stability. Storage of leachate during operations is not expected to occur during the course of normal operations; however, during significant rainfall events or during a process shut-down, in-heap storage will be used. The heap leach pad liner system is designed to be operated as a dry operation, with pregnant leachate solution being pumped out as soon as it collects in the sump; this will reduce the hydraulic head on the liner system. If required however, solution storage in the ore-pore volume behind the confining embankment is possible up to elevation 1096 m (approximately two days irrigation volume) before discharging over the confining embankment spillway.

The Events Pond will be situated immediately down gradient of the HLF embankment and pond flows will be conveyed via the HLF spillway. The Events Pond is designed to meet the following design criteria:

- Storage capacity to contain the excess heap leach pad leachate and surface runoff from the 1 in 100 year 24-hour storm event without discharge to the TMF; and
- Spillway designed to discharge the 1 in 200 year 24-hour storm event with a minimum embankment crest freeboard of 0.3 metres.

Solution stored in the events pond will be pumped back to the heap leach pad using the events pond pump station, designed to empty the 1 in 10 year storm runoff volume over ten days, and the 1 in 100 year volume over 12.5 days (Knight Piésold 2012b). During storm events greater than the 1 in 200 year 24-hour, water volumes exceeding the events pond storage capacity will be conveyed to the TMF pond via the events pond spillway.

The heap leach pad and events pond feasibility design were based on site geotechnical investigations, hydrogeological conditions, and a probabilistic seismic hazard assessment. Construction of the embankment will involve stripping the topsoil and excavating the underlying frozen colluvial and residual soils down to competent, stable bedrock (Knight Piésold 2012b). Failure modes for the embankments will be similar to those for the TMF embankments (unusual weather events, seepage, poor management, slope instability, structural defect, and overtopping).

Based on the design measures using the site specific geotechnical, hydrogeological, and seismic information, the likelihood of heap leach embankment failure has been rated as Unlikely. In the event of a HLF embankment failure the consequences would be Very Low, since the Events Pond immediately downstream of the heap leach pad embankment is designed for sufficient storage capacity to contain the excess leachate and surface runoff from the 1 in 100 year 24-hour storm event without discharge to the environment.

The likelihood of an events pond embankment failure is rated as Unlikely, based on the design and construction methods. The consequences for an Events Pond embankment failure are rated as Very Low since water volumes exceeding the events pond storage capacity will be conveyed to the TMF pond via the events pond spillway and not be discharged to the environment.

Failure of the Events Pond embankment simultaneously or as a result of a heap leach pad embankment failure could result in release of barren and pregnant solution; however, this would be contained within the TMF and not be discharged into the environment. No effects on VCs are therefore predicted. The Project Emergency Response Plan (Appendix 22B) will outline the containment and cleanup measures to be implemented in the event of any heap leach pad or Events Pond embankment failure, methods for the disposal of contaminants and debris, and post-incident evaluations. Special handling methods for cyanide may be required; this will be outlined in the Emergency Response Plan.

21.4.1.3 Freshwater Pond Embankment Failure

The Temporary Freshwater Supply Pond required during construction will be located within the TMF footprint, while the permanent Freshwater Pond for operations will be located northeast of the Open Pit. Failure modes for the cofferdam and permanent Freshwater Pond embankment will again be similar to those for the TMF embankments (unusual weather events, seepage, poor management, slope instability, structural defect, and overtopping). The likelihood for both is rated as Rare. Consequence of a failure for the Temporary Freshwater Supply Pond cofferdam are rated as Very Low, since the pond will be located in the headwaters of Casino Creek and will be upstream of the TMF Main Started Embankment, which will capture any flows that result. Consequence of a failure for the operations Freshwater Pond embankment are rated as Moderate, since failure could result in discharge of sediment-laden water into Britannia Creek, and possibly into the Yukon River downstream. Catastrophic failure of the embankment could result in the release of the entire contents of the Freshwater Pond. Detail design of the embankments will consider CDA guidelines and site-specific geotechnical information.

Release of water from the Freshwater Pond could affect the following VCs:

- Water and Sediment Quality
- Fish and Fish Habitat

Discharge of sediment-laden water into Britannia Creek could alter water quality by increasing the turbidity. Effects of high suspended sediments on fish and fish habitat include changes in fish physiology, altered behaviour patterns, and in-filling of stream substrate, altering the quantity and quality of rearing, spawning and incubation habitat. The spatial extent of the effect would depend on the volume of water released and the flow within the receiving water body. If a breach were to occur during high stream flows, the sediment would remain in suspension and be transported a greater distance than if a breach occurred during low stream flows. In the event of an embankment failure of the operational Freshwater Pond, the Water Management Plan and an erosion and sediment control plan would be implemented to limit the extent of impact, and to remediate any impacted areas.

21.4.1.4 Process Water Pond and Water Management Pond Embankments Failure

Process water reclaimed from the tailings pond and from the plant will be collected in a 63,700 m^3 process water pond. Process water will be comprised of combined thickener overflow, reclaim water from the tailings pond, and fresh water. Overflow solution from the bulk concentrate, and copper concentrate thickeners will also be pumped to the process water pond. The Water Management Pond will be located downstream of the TMF main embankment, in the Casino Creek valley. The Water Management Pond is designed to collect embankment seepage and runoff.

The likelihood of failure of the Process Water Pond is rated as Rare and consequence is rated as Very Low, since any material released would be ultimately captured within the TMF located down-gradient of the site. The likelihood of failure of the Water Management Pond is rated as Rare and consequence is rated as Moderate.

Embankment failure of Process Water Pond and Water Management Pond could affect the following VCs:

- Surficial Geology, Terrain, and Soils;
- Water and Sediment Quality;
- Fish and Fish Habitat;
- Rare Plants and Vegetation; and

- Wildlife.

Soil contamination could result in areas down-gradient of the Process Water Pond in the event of an embankment failure. It is expected that released process water could be fully contained upon implementation of measures outlined in the Emergency Response Plan, since the area will be adjacent to other Project components such as the Sulphide Ore Processing Facility and the Low Grade Ore Stockpile.

The Water Management Pond will have measureable concentrations of tailings, reagent residues, and potentially metals. Environmental effects of an embankment failure and release of process water into Casino Creek could include altered water quality; direct mortality of fish and other aquatic biota and wildlife; and disturbance of rare plants and vegetation. Effects could extend several kilometres downstream in Casino Creek and potentially into Dip Creek. The extent of any effect would depend on the type of embankment failure (partial to catastrophic) and on the amount of process water released. Partial failure, or total embankment failure during the construction or early operations period could result in localized effects, due to the relatively smaller volume of water released. A catastrophic failure of the embankment during the final years of operation or during closure could affect the Casino Creek watershed.

Water quality concerns include TMF seepage water quality. The PAG tailings from milled ore are assumed to require complete subaqueous disposal in the TMF in order to maintain a saturated state and inhibit oxidation and potential reactivity. The PAG tailings will be isolated in a centrally located region in the TMF to reduce potential mixing and contact with the embankments and to decrease overall seepage potential. Supergene material produced during construction and early operations will be placed in an upstream area of the TMF, where the predicted seepage rate is low.

The Project Emergency Response Plan (Appendix 22B) will outline the containment and cleanup measures to be implemented in the event of any TMF embankment failure, methods for the disposal of contaminants and debris, and post-incident evaluations.

21.4.2 Slope failure

Potential slope failure associated with each of the following Project components is assessed in this section:

- Pit wall;
- Ore stockpiles;
- Heap Leach Pad (during operation and closure); and
- Topsoil and Non-PAG Waste Rock and Overburden stockpiles.

21.4.2.1 Pit Wall Slope Failure

Pit wall slope failures can range from minor bench raveling to massive slope failures; failure modes include unknown geologic structures, abnormal weather patterns, or seismic shock (Girard 2001). Minor slope failures within the Open Pit are anticipated as part of the development process due to ongoing drill and blast activities and the potential to encounter areas of instability. The Open Pit slope design for the Casino Project is based on kinematic and rock mass stability analysis and site-specific geotechnical and hydrogeological information. Design factors considered in selecting the final Open Pit wall angle include slope height, rock mass strength, ground water pressure, blasting, and inter-ramp angles. Slope monitoring will be conducted during all stages of Open Pit development; monitoring will include geotechnical analysis of the pit walls including geotechnical mapping, tension crack mapping, surface prism monitoring, piezometer installation, and automated monitoring systems.

Open Pit perimeter well and horizontal bench wells, as well as pumping wells, will be used to extract groundwater and depressurize pit slopes to increase pit wall stability as required. Incorrect blasting activities may lead the progressive deterioration of the wall face and instability; therefore, blasting trials will be implemented when there are observed changes in the characteristics of the rock during excavation. Regular inspections will identify areas of potential instability and result in mitigative measures to decrease the likelihood of failure.

Despite the design and proposed monitoring measures, some level of instability can still be expected in any surface operation, and "even slopes with conservative slope designs may experience unexpected failure" (Girard 2001); therefore, the likelihood of an Open Pit wall failure at the Casino Project has been rated as Possible. In the event of an Open Pit slope failure the consequences would be Low, since the material will remain within the pit.

Slope failure near the northwest side of the Open Pit in Year 10 of operations, as the pit wall intersects Canadian Creek, could result in an adverse impact on Surface Water and Sediment Quality. With the implementation of erosion and sediment control measures, it is anticipated that any effects would be localized and easily remediated, with no residual impacts. Monitoring will be conducted to detect instability at an early, noncritical stage to allow for the implementation of mitigation measures, as noted by Girard (2001), and the Emergency Response Plan will outline measures for containment and remediation, if required.

21.4.2.2 Ore Stockpiles Slope Failure

During operations, mined ore to be processed at the HLF during Years -3 to 15 will be stored in a temporary stockpile near the crusher on the valley slope east of the Open Pit. The Supergene Oxide (SOX) ore and Low Grade ore will also be stored in temporary stockpiles (Knight Piésold 2012c). The SOX ore will be stockpiled between the Open Pit and main plant site during pre-production and in Year 1 of operations for milling during Years 4 to 12. Low Grade ore will be stockpiled east and south of the main plant site, on valley slopes above the TMF, as well as at the same locations used for the SOX ore south of the Open Pit after Year 12. Low Grade Ore will be milled during Years 19 to 22 of operation. Ore stockpiles will be generally situated on south to east facing slopes between the TMF and the Open Pit; the east facing slopes are generally better drained and have frost-susceptible soils (Knight Piésold 2012c).

Factors that affect slope failure include slope angle, the presence of water, and physical properties of the slope material. Slope failures can range in magnitude from small slumps to mass wasting events. Hazards associated with slope failure of the ore stockpiles were identified as deposit of ore onto surrounding terrain; and blockage of surface runoff or diversion ditches at the toe, resulting in discharge of sediment-laden water into nearby waterways. Slope erosion and slope failure likelihood and consequence were both assessed.

Design measures to minimize the risk of ore stockpile slope failures include (Knight Piésold 2012c):

- Geological information and geotechnical conditions for the ore stockpiles were derived from site investigations which have included test pitting, geotechnical drilling, laboratory testing of recovered rock core and bulk soil samples, in situ permeability testing and geophysical surveys;
- A probabilistic seismic hazard assessment has been carried out for the Casino project site to provide seismic parameters for design of project facilities; the Casino Project site will be situated in a region of low seismicity and moderate seismic hazard;
- All temporary stockpiles will be designed to remain stable under both static and seismic loading conditions; the minimum acceptable factor of safety for ore stockpiles under static conditions is 1.3 for short-term operating conditions and 1.5 after closure and reclamation;

- The design earthquake defined for seismic stability assessment of the stockpile slopes is the 1 in 500 year earthquake and earthquake magnitude of 8.0; and
- Sediment control fencing will be placed around the down-gradient perimeter sections of the ore stockpiles to prevent sediment discharge from the stockpiles.

Pre-production and operational activities that will ensure stockpile stability include clearing vegetated areas and removing the organic layer to initiate melting of permafrost; removal of unsuitable material in the foundation prior to loading; loading the stockpile in lifts, with each lift developed at the angle of repose (1.3H:1V); retaining 20 m benches along the toe of each lift to establish a maximum overall slope angle of 2H:1V; and loading and developing the lifts parallel to the slope (where possible) to avoid stress concentrations (Knight Piésold 2012c).

The surface and diversion ditching system along the upslope side of the ore stockpiles will divert surface flow around the stockpiles to minimize contact with the water; water will be discharged to the TMF. The diversion ditching system includes the following design criteria:

- Design storm conveyance 1 in 100 year 24-hour duration storm event;
- Maximum design storm flow depth of 0.5 m and minimum freeboard of 0.3 m; and
- Minimum channel side slope of 2H:1V

The likelihood and consequence of ore stockpile erosion were rated as Possible and Very Low, respectively. Any material from localized erosion would be captured on the 20 m wide benches at the toe of each lift.

Based on the ore stockpile design measures using the site specific geotechnical, hydrogeological, hydrometeorological, and seismic information, the likelihood of stockpile slope failure has been rated as Rare. In the event of a slope failure the consequence was rated as Very Low, since the stockpiles will be all located on valley slopes above the TMF. The seismic stability assessment of the ore stockpiles concluded that “the consequences of a stockpile slope failure due to earthquake shaking will be minimal and restricted to minor displacement of the surface of the stockpile slopes (ravelling). There would be a negligible impact on the integrity of the stockpile and little, if any, impact on other mine site facilities” (Knight Piésold 2012c).

Erosion or failure of the ore stockpile slope could result in release of small amounts of ore material onto the surrounding terrain or into the diversion or runoff ditches. This section discusses the potential effects of this scenario on the following VCs:

- Surficial Geology, Terrain, and Soils; and
- Water and Sediment Quality.

Soil and water contamination from metal leaching could result from deposition of ore if the site was not remediated in a timely manner. The stockpiles will be developed at the angle of repose of 1.3H:1V with 20 m benches along the toe of each lift to establish a maximum overall slope angle of 2H:1V. Contact water will report to the TMF and not be discharged to the environment. Material is not anticipated to travel far from the toe of the slope should a slope failure occur; in the event of a failure the Emergency Response Plan would be implemented. The Plan will outline containment and cleanup and site restoration and remediation measures.

21.4.2.3 Heap Leach Pad Slope Failure

The heap leach pad will consist of a confining embankment, pad liner system, irrigation system, and leachate collection system to collect and convey the leachate solution to the gold extraction plant (Knight Piésold 2012b). The pad will be located on a uniformly sloping sidehill with an approximate slope of 5H:1V. The heap leach pad

will be constructed in five pad development stages with successive bench lift heights of approximately 8 m, commencing in Year -3. The benches will have repose bench face angles of 1.4H:1V; benches approximately 9 m wide will be left at the toe of each lift to establish a final overall slope angle of approximately 2.5H:1V to provide stability of the heap and allow for on-going reclamation during operations. The pad foundation preparation, liner installation, and leachate collection piping will be developed as the footprint of the leach pad expands upslope to accommodate additional ore lifts. The confining embankment, events pond, and perimeter diversion ditches will be developed prior to commencing ore stacking and leaching. The heap leach pad embankment constructed at the toe of the pad will provide stability and provide in-heap storage for solution. The leaching process will involve the irrigation of weak cyanide solution over successive lifts of heaped ore.

The critical aspects of heap leach design are the depth of the ore, presence of water and local terrain; Thiel and Smith (2003) have noted that “Heap leaching presents a combination of extreme base pressures and high moisture conditions not present in any other containment application”. Key geotechnical concerns of heap leach facilities as summarized by Thiel and Smith (2003) include:

- Slope Stability: extreme heights and base pressures resulting in global failures; sliding block stability along geomembrane interfaces; elevated degrees of saturation; chemical and biological degradation of ore; first-lift stability affected by lift thickness and stacking direction;
- Liquefaction: earthquake induced failures; liquefaction flowslide;
- Water management: surplus water balances; high phreatic levels; and
- Liner Durability and Leakage: coarse rock overliner systems; extreme pressure caused by weight of heap and equipment; durability against chemical attack.

Ulrich, Andrade, and Gardner (2003), in a review of heap leach operations in Chile and Peru, also noted problems with failed risers used to deliver solution to the heap, resulting in erosion or localized sloughing failures on the face of the heap. The failures did not affect overall performance but did require remedial action (Ulrich, Andrade, and Gardner 2003).

During operation of the heap leach pad, slope failure could result in rupture of the irrigation or collection pipes or liner damage and subsequent discharge of barren process solution or pregnant solution, both containing cyanide, into the environment. During closure and decommissioning or post-closure, slope failure could result in damage to the heap cover or to destruction of the wetland downstream, or exposure of PAG materials. The spill or release of barren or pregnant solution will be discussed in Section 21.5.3.

Thiel and Smith (2003) found no documentation of static flowslide liquefaction in leach piles, although seismic-induced dynamic liquefaction has occurred. A review of the regional seismicity was carried out to enable selection of an appropriate design earthquake event for seismic stability assessment of the Casino Project HLF. Analyses were carried out to examine the stability of the heap leach pad under both static and seismic conditions and factors of safety were calculated; the minimum acceptable factor of safety for the heap leach pad under static conditions for short-term operating conditions long-term (post-closure) are 1.3 and 1.5, respectively; Results of the stability analyses indicate that the leach pad will be stable with a minimum static factor of safety of 1.6 (Knight Piésold 2012b). Estimation of seismically induced deformations of the pad from the design earthquake was included in the assessment; for a design earthquake magnitude of 8.0 negligible heap leach pad deformations were predicted. Knight Piésold (2012b) concluded that consequences of failure during an earthquake event are likely to be minimal and restricted to some displacement of the heap leach pad slopes; a conservative design earthquake corresponding to the 1 in 500 year return period event was adopted for the design.

To minimize saturation of the heap, rough grading and backfill will be used to grade the naturally undulating bedrock surface to provide a uniformly and positively drained surface (minimum pad grade of 2%) upon which to place the pad liner system and ensure leachate flow toward the leachate collection piping system and sump located at the centre of the embankment toe.

Linear low-density polyethylene (LLDPE) will be used for the geomembrane liner systems for the heap leach pad because it generally exhibits higher interface friction values compared to other geomembrane liners, shows good performance under high confining stresses, and higher allowable strain for projects where moderate settlement may become an issue (Knight Piésold 2012b). Since the stability of the heap leach pad is sensitive to the interface shear strengths associated with the liner system laboratory, shear strength tests for each of the liner interfaces within the composite liner systems will be tested for detailed design studies.

Closure measures for the heap leach pad will include grading, covering, and revegetation of final heap slopes to provide adequate drainage and erosion protection from surface runoff. Bench lift heights of 8 m will be constructed at repose bench face angles of 1.4H:1V. The 9 m wide benches left at the toe of each lift to establish a final overall slope angle of 2.5H:1V will provide stability of the heap and allow for on-going reclamation during operations.

The likelihood of slope failure of the heap leach facility during operations has been rated as Unlikely, based on the design parameters, and the consequence has been rated as Moderate. The 8 m high lifts proposed for the Casino Project are significantly less than the 50 m to 150 m high lifts discussed by Thiel and Smith (2003), for which factor of safety margins and reliability estimates are based on techniques and methods designed for much smaller heaps. Site investigations at the Casino site were used to determine geotechnical implications for the Feasibility design; additional subsurface investigations will be conducted to confirm foundation conditions for future design studies. The likelihood of slope failure of the heap leach facility post-closure has also been rated as Unlikely, based on closure design parameters; the consequence has been rated as Very Low.

The VCs potentially affected by slope failure of the heap leach pad are:

- Surficial Geology, Terrain, and Soils; and
- Water and Sediment Quality

Localized slumping of the heap leach during operations could result in deposit of ore adjacent to the pile; if not remediated in a timely manner the slope failure could cause localized soil contamination. Geotechnical instrumentation will be installed to monitor the performance of the HLF on an on-going basis to ensure the safe and effective operation of the HLF (Knight Piésold 2012b). Slope movement monuments and survey control points will be installed and monitored to ensure the integrity and stability of the ore heap.

Closure measurements of the heap leach pile will include rinsing and drain-down of the ore and cyanide destruction. A constructed wetland established downstream of the facility and upstream of the TMF will treat any residual low levels of cyanide and trace metals resulting from precipitation infiltrating through the closure cap. Water will not be discharged until it meets existing standards or site-specific water quality objectives.

21.4.2.4 Topsoil / Overburden and Waste Rock Storage

During operations potentially reactive waste rock and overburden, comprising PAG and Metal Leaching (ML) materials will be disposed of subaqueously in the waste storage area of the TMF (Knight Piésold 2012c). In addition, NAG waste rock will be produced during pre-production mining and used in the construction of the TMF overburden from the Open Pit will be stripped and if suitable for reclamation purposes, will be stored in stockpiles

adjacent to the Open Pit The waste storage area will be fully contained within the final TMF at closure, therefore no closure activities will be required to ensure long-term geotechnical stability.

The Topsoil/Overburden Stockpiles will be located on hilltop areas, where permafrost is generally limited or absent, north of the HLF and south of the TMF (Knight Piésold 2012c). Overburden and topsoil materials will be stockpiled separately.

Factors that affect slope failure were previously mentioned (slope angle, the presence of water, and physical properties of the slope material). Hazards associated with slope failure of the stockpiles include deposition of material onto surrounding terrain, and discharge of contact water into Casino Creek.

The minimum acceptable factor of safety for waste stockpiles under static conditions is 1.3 for short-term operating conditions and 1.5 after closure and reclamation; the Topsoil/Overburden Stockpiles will be removed before or at closure of the mine for use in reclamation of the TMF and HLF (Knight Piésold 2012c). The design earthquake defined for seismic stability assessment of the stockpile slopes is the 1 in 500 year earthquake, with a corresponding magnitude of 8.0.

Waste rock deposition shall satisfy short and long term stability requirements. Design measures to minimize the risk of waste storage area slope failures include (Knight Piésold 2012c):

- An overall slope of 1.5H:1V has been assumed for design purposes;
- TMF will be operated to maintain a minimum distance of 1 km between the waste storage area and TMF embankments to allow development of a NAG tailings beach and provide a low permeability transition zone to function as a seepage limitation and control measure;
- Trial sections may be constructed in the field during the initial stages of development to monitor waste pile stability and foundation performance; and
- Waste rock shall be end dumped over the crest to allow for maximum segregation of the coarser material at the base of each bench.

Design measures to minimize the risk of Topsoil/Overburden Stockpile slope failures include (Knight Piésold 2012c):

- Wet conditions will be avoided when possible during soil salvage operations;
- Topsoil/Overburden Stockpiles will be limited to a maximum height of about 20 m, with consideration of site-specific ground conditions, and constructed as wrap around dumps in an ascending sequence to improve overall stability, as each constructed lift will act as a buttress for the toe of the next lift;
- The overall slope angle will average 14 degrees (4H:1V) to minimize the risk of slope instability, reduce erosion potential and improve the amenability for vegetation growth;
- Toe berms to ensure stockpile stability may be required, depending on foundation conditions and the strength characteristics and condition of the stockpiled material;
- Excessive traffic will be avoided during the salvage process to minimize admixing, compaction and rutting;
- Erosion will be managed by limiting the height and slope of stockpiles. Erosion control measures will be implemented to reduce exposure of bare soil; and

- Where possible soil stockpiles will be oriented to reduce wind erosion and located to reduce wind exposure.

A stability assessment was carried out for the waste storage area Topsoil/Overburden Stockpiles. The slope of the waste material adjacent to the tailings deposit will be buttressed by the tailings, with only a few metres height of the waste pile above the surface of the tailings; therefore, stability was not deemed a concern (Knight Piésold 2012c). Slopes and benching of the waste rock will depend on the elevation difference between the waste rock, tailings and supernatant pond during operations, as well as the condition of the tailings (Knight Piésold 2012c).

The likelihood and consequence of waste rock stockpile slope failure were rated as Possible and Very Low, respectively. Any slope failure or sloughing and ravelling of waste material will be contained within the TMF; it is anticipated that the tailings beach will slope upward between the pond and embankments, and be approximately 200 m wide (Knight Piésold 2012c).

Based on the Topsoil/Overburden Stockpile design measures using the site specific geotechnical, and seismic information, the likelihood of stockpile slope failure has been rated as Possible. In the event of a slope failure the consequence was rated as Moderate.

Failure of the Topsoil/Overburden Stockpile slopes could result in release of small amounts of sediment onto the surrounding terrain. This section discusses the potential effects of this scenario on the following VCs:

- Surficial Geology, Terrain, and Soils

Topsoil and overburden material is not anticipated to travel far from the toe of the stockpile slopes should a slope failure occur, given the low gradient slopes. However, in the event of a failure the Emergency Response Plan would be implemented. The Plan will outline containment and cleanup and site restoration and remediation measures.

21.4.2.5 Freegold Road Extension Foundation

The Freegold Road extension will be located in valley bottoms where feasible to avoid unstable terrain. However sections of the road will necessarily cross relatively mountainous terrain with moderate to steep cross slopes. The hazard scenario assessed for slope failure associate with the Freegold Road extension is discharge of sediment and road fill material to the environment. Accidents associated with use of the road are discussed in Section 21.4.4.

Terrain stability mapping was conducted for the proposed road development. Terrain stability “refers to the likelihood of a landslide initiating in a terrain polygon following road construction activities and timber harvesting” (Knight Piésold 2012d). Terrain stability was evaluated based on slope angle, slope aspect, surficial geology, permafrost conditions and the presence of gullied terrain, the key attributes controlling landslide susceptibility (Knight Piésold 2012d). The terrain stability classification scheme focussed on the likelihood of slope detachments such as slides and flows as opposed to slope displacements such as soil creep, which could be expected to occur in gently sloping, ice-rich terrain that is classified as ‘stable’ in the terrain mapping (Knight Piésold 2012d). The terrain stability mapping indicated that approximately 9% of the proposed Freegold Road extension will be within ‘potentially unstable’ terrain and approximately 3% within ‘unstable’ terrain.

The proposed alignments traverse extensive areas of permafrost terrain, which presents a sensitive construction environment. The terrain assessment noted that “permafrost degradation can occur both during and after construction, resulting in the possibility of differential settlement of embankments and bridge foundations, slope instability and, erosion and sediment delivery to watercourses” (Knight Piésold 2012d). The key objective in such an environment is to maintain a stable permafrost regime. The road surface elevation will be constructed on

rockfill embankment 2.0 m above the existing ground and the existing ground will not be disturbed. This stabilises the road against washouts and protects against permafrost degradation under the road. Where the road climbs out of the valley bottoms, the road construction method will include cut and fill. Where permafrost is encountered, cut slopes will require buttressing with a layer of angular rock fill on top of filter fabric to prevent permafrost degradation and act as a retaining structure to improve slope stability. Road drainage systems to control runoff and to provide a barrier and storage for snow and falling rocks have been considered in the road design. The Freegold Road Extension will be actively maintained year round to provide access to and from the Casino Project. Regular road maintenance will include snow clearing to ensure user safety and preserve the condition of the access road. Construction activities will follow best practices that will be outlined in an Environmental Health and Safety Management System. Casino Mining Corporation will engage in discussions with the Yukon Government to determine the closure and decommissioning objectives for the Freegold Road Extension; for the purpose of this risk assessment it is assumed that the will be decommissioned following closure of the Casino Project.

The likelihood of a slope failure along the Freegold Road extension during construction and operation has been rated as Rare. Consequence is rated Low.

Local effects to Surficial Geology, Terrain, and Soils could result from a slope failure of the Freegold Road extension foundation. Road slumping or sloughing would be contained and remediated to ensure continued operation of the Casino Project.

21.4.2.6 Borrow Sites

Local effects to Surficial Geology, Terrain, and Soils could result from a slope failure of borrow sites; the likelihood of such an event was rated as Possible and Consequence has been rated as Very Low, since effects would be restricted to the immediate area and remedied if necessary.

21.4.3 Spills/Leaks

Spills or leaks from Project equipment or machinery could be associated with each of the following components and activities:

- Spill of fuel from mobile and stationary equipment during refueling and maintenance in pit or on site;
- Failure of the HLF liner, tanks, pipes, and pumps and release of leach/pregnant solution;
- Failure of tanks, pipes, pumps between HLF and gold recovery building, resulting in release of pregnant solution;
- Failure of control system or operator error during handling or mixing resulting in on-site reagent spill;
- Failure of mechanical equipment or control system resulting in on-site concentrate spill;
- Failure of the thickeners, pipes, and pumps from sulphide ore processing facility to the TMF and release of PAG tailings;
- Tailings distribution pipelines failure (bulk non-PAG tailings, PAG tailings, cyclone sand, cyclone overflow);
- Vehicle collisions (trucks, track and wheel dozers, graders, water trucks, etc.);
- Hazardous materials spill resulting from aviation accident during takeoff or landing;
- Spill or release of liquid or solid chemicals during on-site transfer and handing;

- LNG storage tank rupture;
- LNG spill during transport;
- Leaks from storage or disposal containers;
- Leaching from landfill; and
- Release of uncured cement or concrete leachate to environment from a failure of the Concrete Batch Plant.

Accidental release of hazardous materials could result in contamination of soil, air or water; cause vegetation damage; and be toxic to wildlife or humans, either on site or along the transport route. Consequences of any spill depend on the magnitude and extent of the spill; the material, quantity, location, and duration of the spill; and environmental conditions at the time. Hazardous materials associated with the Project can be grouped into four categories:

- Petroleum products and lubricants (e.g., LNG, diesel, oils and degreasers);
- Sulfide and oxide ore processing reagents;
- Blasting compounds (e.g., ammonium nitrate, fuel oil); and
- Tailings.

Likelihood and consequences and hazard scenarios associated with each of these are discussed in this section.

21.4.3.1 Refueling Spills

During construction and operation, heavy equipment will be used for clearing and grubbing; stripping and removing overburden; mining and transporting ore and waste to stockpiles, crushers, or waste rock dumps; and maintaining disturbed and working areas. Heavy equipment will include drills, cable shovels, trucks, wheel and track dozers, graders, excavators, and loaders. The primary fuel sources are diesel and LNG.

A diesel bladder tank farm will be used in early construction; this will be replaced by a permanent steel diesel fuel storage tank with dispensing facilities at the supplementary power plant in Year -4. The LNG will be stored at the Casino plant site and re-gasified to natural gas as required. In addition to providing natural gas for the power plants, LNG will be used in the tanker trucks transporting the LNG, over-the-highway tractors hauling concentrates, lime, grinding media; and, if feasible, to power the mine fleet.

Diesel and LNG will be transferred from tanker trucks to storage tanks by enclosed lines, hoses, and pumps equipped with pressure transducers and volume counters to ensure tanks cannot be overfilled. All storage tanks will be constructed and managed in accordance with the National Fire Code and in conformity with the Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products. Stationary equipment will be located away from watercourses and bermed and lined with an impermeable barrier with a holding capacity equal to 110% of the largest tank within the berm. Two mobile re-fuelers and two portable fueling stations will supply LNG to required locations throughout the Casino mine site.

The hazard scenario assessed for refueling is the discharge of a hazardous material to the environment.

The likelihood of a spill during re-fueling of equipment with LNG or diesel in the Open Pit during mining activities throughout the mine life was rated as Likely. Because the spilled material would be within the Open Pit and not discharged to the environment the Consequence is rated as Very Low. No effects to VCs are therefore anticipated. The likelihood of a LNG spill during refueling of Project equipment outside of the Open Pit is rated as

Likely. Because of the potential for the spilled material to be discharged to land in the area surrounding the spill the Consequence is rated as Low. The likelihood of a diesel fuel spill during re-fueling of mine equipment is rated as Likely and the Consequence is rated as Very Low, since equipment will be re-fueled from a central location, and the diesel refueling facility will have secondary containment.

The VCs that could be affected by spills that occur during refueling of equipment with LNG or diesel are:

- Surficial Geology, Terrain, and Soils

Spills to land during re-fueling activities are expected to be localized and small to moderate volume. Small diesel spills will usually evaporate and disperse naturally within a day; naturally occurring soil microbes will readily degrade diesel oil within one to two months (National Oceanic and Atmospheric Administration 2013). However, spills to land can affect soil physical properties, soil chemistry, and biological organisms, affecting soil biodiversity (Hughes and Stallwood 2006). Following a spill, the low molecular weight volatile fractions quickly evaporate, leaving the high molecular weight poly-aromatic hydrocarbons which may sink below the ground surface and pool in depressions above the permafrost (Hughes and Stallwood 2006). The rate of naturally occurring biodegradation will depend on contaminant and substratum properties (Coulon and Delille 2006) as well as soil liquid water and temperature (Schafer et al 2009). Natural remediation by Antarctic soil microorganisms was found to be slow due to low availability of liquid water, lack of nutrients to support microbial growth, and low temperatures (Hughes and Stallwood 2006).

Unlike diesel spills, LNG spills completely evaporate, leaving no residue that could harm soil or groundwater (Drube et al 2012).

Should a spill occur, site staff will implement the Emergency and Spill Response Plan. Any contaminated materials will be handled in accordance with the Waste Management Plan. Any hydrocarbon contaminated material will be collected and deposited within land-farm treatment facilities for remediation at the Casino site. Soil remediation occurs through volatilization and natural biological processes and once hydrocarbon levels meet the applicable Yukon Government remediation standards, the soil will be transferred to the landfill, likely to be used as cover material. If treatment is not effective, the material will be disposed of off-site at a licensed disposal facility. Hydrocarbon contaminated water, snow and ice will be treated within the oily water treatment systems within the maintenance shops located at the Casino mine site. Excessive volumes of contaminated snow and ice will be stored within a dedicated cell of the land-farm until the material has melted and can be transported by pump truck to the oily water treatment system in the maintenance shop.

21.4.3.2 Vehicle Accidents

On-Site Vehicle Accidents

Heavy equipment required during the construction phase includes drills, cable shovels, trucks, wheel and track dozers, graders, excavators, and loaders for site clearing and grubbing, stripping and removing overburden; mining and transporting ore and waste to stockpiles, crushers, or waste rock dumps; and maintaining disturbed and working areas. The number of vehicles and equipment will range from 17 during Year -3 to 26 in Year -1.

During operations, shovels and front-end loaders will be used to load mine haul trucks. Backhoe excavators will be utilized for general earthworks, snow removal, and limited mining activity. Wheel and track bulldozers will be used for cleanup around mining activities and for control of rock on the benches. Graders and water trucks will be used for main haul road maintenance. All movement of vehicles within the Open Pit will be monitored by a central dispatching system to ensure worker health and safety and efficiency in operation.

For the purpose of this assessment, on-site vehicle accidents include aircraft accidents during takeoff or landing at the Casino airstrip. The existing airstrip will be replaced with a facility that permits safe and efficient all season operations for aircraft such as the Hawker-Sidley HS 748 turboprop aircraft and the Bombardier Dash 8-100 or 200 series turboprop. These aircraft may be better suited than larger aircraft to fly in the area as their slower speeds would be an asset in the challenging terrain. Aircraft will be used primarily for transport of personnel; therefore, hazardous materials are those associated with the running and maintenance of the aircraft itself.

The likelihood of vehicle collisions (trucks, track and wheel dozers, graders, water trucks, etc.) resulting in spills or leaks of deleterious substances outside of the Open Pit is rated as Possible. Consequence is rated as Low, since the volume of material spilled will be equal to, or less than, the volume of the fuel tank of each vehicle.

The likelihood and significance of vehicle collisions resulting in spills or leaks of deleterious substances within the Open Pit is rated as Rare, since vehicle movement will be monitored by a central dispatching system; Consequence is rated as Very Low because the spilled material would be contained within the Open Pit and not discharged to the environment.

The likelihood of an aircraft accident resulting in spills or leaks of deleterious substances is rated as Rare. Consequence is rated as Moderate, since the volume of material spilled will be equal to, or less than, the volume of the fuel tank of each aircraft. However, consequence will depend on the location and magnitude of the spill in relation to any watercourse; materials entering Dip Creek could result in effects beyond the event site that would not be readily remediated.

The VCs that could be affected by spills that occur as a result of on-site vehicle collisions are:

- Surficial Geology, Terrain, and Soils;
- Water and Sediment Quality; and
- Fish and Fish Habitat.

Spills would be expected to be localized and small to moderate in volume. Should a spill occur, site staff will implement the Emergency and Spill Response Plan. Any contaminated materials will be handled in accordance with the Waste Management Plan. Any hydrocarbon contaminated material will be collected and deposited within land-farm treatment facilities for remediation at the Casino site. Soil remediation occurs through volatilization and natural biological processes and once hydrocarbon levels meet the applicable Yukon Government remediation standards, the soil will be transferred to the landfill, likely to be used as cover material. If treatment is not effective, the material will be disposed of off-site at a licensed disposal facility. Hydrocarbon contaminated water, snow and ice will be treated within the oily water treatment systems within the maintenance shops located at the Casino mine site. Excessive volumes of contaminated snow and ice will be stored within a dedicated cell of the land-farm until the material has melted and can be transported by pump truck to the oily water treatment system in the maintenance shop.

Off-Site Vehicle Accidents

The Freegold Road Extension, a new, 120 km long, two-lane, gravel, all-weather resource road will be used for year-round hauling of materials into and out of the Casino mine site during operations. There will be 18 major bridge crossings located along the route, which include crossings of Bow Creek, Big Creek, Hayes Creek, and Selwyn River, and 71 major culvert crossings. Of particular concern to the Proponent is the spill of any substance to water at any of the watercourse crossings along the transport route. During the last two years of construction, LNG will be transported from Fort Nelson to the Casino Project via tanker trucks at an average frequency of two trucks per day; during operations this number will increase to eleven. The volume, form and transportation

logistics of the process reagents noted in Table 21.3-1 and Table 21.3-2 will be determined during detail design engineering of the Project.

The likelihood of a vehicle accident resulting in a spill is a combination of the likelihood of a vehicle accident times the likelihood of loss of cargo from the vehicle and a failure of the containment method. Transportation of goods and materials will be in accordance with all applicable regulations and legislation, as well as the Explosives and Hazardous Materials Transport Permit required for the Project. The likelihood of an off-site vehicle accident resulting in the release of reagents or concentrate to the environment is rated as Possible; Consequence is rated as Moderate. Copper concentrate will be dewatered and transported as a filtered cake; molybdenum concentrate will be dewatered and packaged in super sacks for transport.

The likelihood of an off-site vehicle accident resulting in the release of LNG to the environment is rated as Unlikely; Consequence is rated as Low given the characteristics of the material. The likelihood of an off-site vehicle accident resulting in the release of diesel to the environment is rated as Unlikely; Consequence is rated as High given the characteristics of the material. Spills to water could result in a significant impact on water and sediment quality and on fish and fish habitat, depending on the location of the spill; the volume and characteristics of material spilled; and the flow within the watercourse. Chinook and chum salmon have been documented in Big Creek. Chinook have also been reported in the Selwyn River and Dip Creek (Knight Piésold 2012d). Impacts could include direct mortality to aquatic biota, sediment contamination resulting in chronic adverse effects, and loss of habitat. Effects could be localized in slower flowing, low gradient streams, or extend for several kilometres in higher gradient or larger rivers. Fish mortality affecting the species population could have an indirect effect on the Sustainable Livelihood VC, if that species was part of a traditional fishery. The VCs that could be affected by spills that occur as a result of off-site vehicle collisions are:

- Surficial Geology, Terrain, and Soils;
- Water and Sediment Quality;
- Fish and Fish Habitat; and
- Sustainable Livelihood.

Soil contamination from diesel spills would be localized and remediated following measures outlined in the Emergency and Spill Response Plan, as described above. Any contaminated materials will be handled in accordance with the Waste Management Plan. Spills to land are expected to be localized and small to moderate in volume. Small diesel spills will usually evaporate and disperse naturally within a day; naturally occurring soil microbes will readily degrade diesel oil within one to two months (National Oceanic and Atmospheric Administration, 2013). However, spills to land can affect soil physical properties, soil chemistry, and biological organisms, affecting soil biodiversity (Hughes and Stallwood 2006). Following a spill, the low molecular weight volatile fractions quickly evaporate, leaving the high molecular weight poly-aromatic hydrocarbons which may sink below the ground surface and pool in depressions above the permafrost (Hughes and Stallwood 2006). The rate of naturally occurring biodegradation will depend on contaminant and substratum properties (Coulon and Delille 2006) as well as soil liquid water and temperature (Schafer et al 2009). Natural remediation by Antarctic soil microorganisms was found to be slow due to low availability of liquid water, lack of nutrients to support microbial growth, and low temperatures (Hughes and Stallwood 2006).

Diesel spills to water could result in direct mortality of fish and invertebrates, since diesel is considered to be one of the most acutely toxic oil types (National Oceanic and Atmospheric Administration, 2013). Because of its low viscosity it is readily dispersed in the water column; this oil could then adhere to fine-grained suspended sediments which would settle out and result in sediment contamination (National Oceanic and Atmospheric

Administration, 2013). Lytle and Peckarsky (2001) assessed the effects of a diesel fuel spill on stream macroinvertebrates over a 15 month period and found that the spill significantly reduced invertebrate density and taxonomic richness in the area immediately below the spill. Schein et al (2009) concluded that diesel toxicity could impair the health of fish populations, depending on the extent of chemical or mechanical dispersion (naturally caused by fast-flowing, turbulent rivers) and life stage of the fish. Dispersion of diesel increases the bioavailability and apparent toxicity to fish embryos - dispersion was reported to cause acute lethality to juvenile trout between 40 mg/L and 200 mg/L (Schein et al 2009). Best practices will be followed when siting and using the mobile re-fuelers and two portable fueling stations (e.g., ensuring that they are more than 30 m from any watercourse).

As previously noted, LNG spills completely evaporate, leaving no residue that could harm soil or groundwater (Drube et al 2012). Liquefied natural gas evaporates at -162°C (it's normal boiling point) at atmospheric pressure and forms a visible cloud which is initially heavier than air until the methane vapour warms to -108°C; at this point the natural gas becomes lighter than air and therefore dissipates (Drube et al 2012; ABS Consulting 2004). If spilled to water, LNG is lighter than water and boils on top until it evaporates (Drube et al 2012). As described by ABS Consulting (2004): "When spilled onto water, LNG will initially produce a negatively buoyant vapor cloud (i.e., the cold vapors are more dense than air and stay close to the water or ground). As this cloud mixes with air, it will warm up and disperse into the atmosphere." Natural gas is also non-toxic; therefore, no impacts to water or sediment quality or fish and fish habitat are expected.

In the event that a transport truck carrying reagents or concentrate is involved in a collision or accident, the effects of a reagent or concentrate spill will depend on the volume released, which will be primarily determined by the containment methods used. Environmental effects could range from negligible to moderate, depending on the location of the spill (to land or water) and the characteristics of the product. The following materials released to water could result in impacts to fish and fish habitat:

- Sodium-diisobutyl dithiophosphinate: at high concentrations acutely toxic to aquatic life
- Pebble Lime (CaO), because of the high pH, would be expected to be toxic to aquatic organisms and aquatic systems;
- Sodium Hydrosulfide (NaHS): strongly alkaline
- Potassium amyl xanthate: may persist for several days in water; highly toxic to aquatic life and may increase metal uptake in fish
- Sodium Cyanide (NaCN): highly toxic to fish, amphibians, aquatic insects and aquatic vegetation; cyanide is acutely toxic to most species of fish at concentrations greater than 200 µg/L.

Access and transportation management during the operation phase will include regular maintenance and inspections for safe operation of vehicles, snow clearing, and the application of dust suppressants as required. Ore handling and spills response is included in the Emergency and Spill Response Plan. The Project Road Use Plan will outline speed limits and their enforcement; right-of-way; truck traffic communications; and the community notification and update process for the village of Carmacks.

21.4.3.3 Heap Leach Facility Systems Failure

The hazard scenario assessed for the heap leach facility systems is failure of the liner, pipes, and sumps and release of leachate into the environment. Liner failure could include puncture of the geomembranes and pipe rupture could result from deformation of adjacent soil liner or overliner from sub-optimal compaction or from freezing and cracking. The following paragraphs discuss the design measures to be implemented to minimize the potential for release of leachate into the environment.

Operations will involve the irrigation of a weak cyanide solution over each ore lift and the recovery of pregnant solution in collection pipes and pumps. The solution will be pumped to the gold extraction plant for metal extraction and recycled for re-use in the leaching process. The irrigation lines will be buried to prevent freezing during winter conditions.

The heap leach pad liner system is designed to eliminate to the greatest extent possible leakage losses of pregnant solution through the bottom and sides of the leach heap pad. The composite liner consists of synthetic and natural materials to act as 'barrier' and 'drainage' layers (Knight Piésold 2012b). The heap leach pad is designed to operate as a dry pad (minimal solution storage during normal operating conditions); however, the liner system was designed to meet the required performance standards for fully saturated solution storage conditions. The liner on the upper sloped surfaces of the heap leach pad (above the in-heap leachate solution elevation) will be comprised of:

- 1 metre thick overliner (38 mm minus with less than 10% fines content);
- 80 mil (2 mm) linear low-density polyethylene (LLDPE) geomembrane; and
- 0.3 metre thick compacted low permeability soil liner.

The liner in the sections of the heap leach pad that will be below the leachate collection pipes, on the lower portions of the slopes, will be a double liner system comprised of the following components:

- 1 metre thick overliner (38 mm minus with less than 10% fines content);
- 80 mil (2 mm) LLDPE geomembrane;
- 0.3 metre thick compacted low permeability soil liner;
- Non-woven, needle punched geotextile layer;
- Leak Detection and Recovery System (LDRS); and
- 60 mil (1.5 mm) linear low-density polyethylene (LLDPE) geomembrane.

Geomembranes refer to synthetic lining materials typically consisting of any of a number of types of plastic polymer (Ulrich, Andrade, and Gardner, 2003). Issues to consider when selecting geomembranes relevant to the Casino Project site include resistance to puncture and the interface friction angle with materials above and below them (Ulrich, Andrade, and Gardner, 2003). The LLDPE geomembrane was selected based on its higher interface friction values, compared to other geomembrane materials; ease of installation in cold climates; good performance under high confining stresses; and higher allowable strains for moderate settlement (Knight Piésold 2012b). The layers of the liner system will be extended to the top of the embankment and perimeter berms to provide full containment, and anchored and backfilled in a trench along the perimeter to ensure that ore loading does not pull the liner into the pad. A perimeter berm will be constructed as part of the liner tie-in around the perimeter to ensure that heap solution is contained and prevent surface runoff from the adjacent slopes entering the pad collection system. A one metre layer thick of coarse crushed ore will be placed over the entire liner system footprint to protect the liner against damage during ore placement and act as a drainage layer for the piped leachate collection system, reducing head loading on the liner.

The leachate collection system will recover the pregnant solution and facilitate solution transport off the heap leach pad as quickly as possible to reduce the potential risk of leachate solution losses through liner system. The collection system consists of the following:

- Lateral collection pipes;

- Collection header pipes;
- Main header collection pipes; and
- Leachate collection sumps.

The piping system will be embedded within the one metre thick overliner layer. Ulrich, Andrade, and Gardner (2003) note that several researchers and pipe manufacturers have modelled in-heap conditions and found that small pipes, despite changing their shape, will maintain a flow path beneath the heap even under simulated loads of 100 metres or more of ore; the pipes did change shape but in almost all cases, maintained a similar opening size. The sumps will be located at the toe of the confining embankment and will be comprised of a 600 mm diameter steel vertical riser pipe. The lower collection zone will be embedded in a 3 m thick zone of clean screened gravel and the upper zone will be embedded in a 3 m thick zone of compacted crushed ore. The compacted crushed ore ensures that settlement around the vertical riser does not occur and damage the collection system. The collection system is designed to convey the leachate off the pad, thereby minimizing the potential for geochemical breakdown of the liner.

The LDRS will capture and convey any solution that leaks through the overlying geomembrane and low permeability soil layers. The heap leach pad leachate collection system will be sub-divided into 16 independently monitored cells separated by small berms; each cell will have a dedicated leakage detection collection system. Flow rates from the collection pipes will be continuously monitored and measured prior to discharging into a collection sump.

Based on the design criteria and monitoring proposed, the likelihood of failure of any of the heap leach pad liners or irrigation and collection pipes resulting in discharge of leachate solution to the environment is rated as Unlikely. The consequences of a release would be High if leachate were to enter Casino Creek.

Failure of any component of the heap leach facility systems could result in release of leachate, containing high concentrations of cyanide and metals, and potentially blasting residues and suspended solids, into Casino Creek. As noted by Canadian Council of Ministers of the Environment (1999) “Soils represent the major potential pathway for cyanide contamination of groundwater … high concentrations of cyanide in effluents present a hazard to both soil and groundwater, since microbial degradation of the compound may be inhibited”.

This section describes the potential effects of this hazard scenario on the following VCs:

- Surficial Geology, Terrain, and Soils;
- Water and Sediment Quality;
- Fish and Fish Habitat; and
- Wildlife.

Surficial Geology, Terrain, and Soils

The transport and distribution of cyanide in soils is affected by volatilization and biodegradation; cyanides may also be adsorbed by clays and biological solids in the soils (Canadian Council of Ministers of the Environment 1999). The rate of hydrogen cyanide and metal cyanide adsorption in soils is small in comparison to rates of volatilization and biodegradation; however, cyanide must be present as hydrogen cyanide in order to volatilize from soils (Canadian Council of Ministers of the Environment 1999). Cyanide ions may also complex with heavy metals, especially iron, and precipitate out of solution (Canadian Council of Ministers of the Environment 1999). Soil fungi or bacteria can convert cyanide to carbonate and ammonia; in aerobic conditions at low concentrations cyanide will decompose to ammonia, carbon dioxide, and nitrogen or nitrate. Under anaerobic conditions cyanide

could decompose to ammonium ion, nitrogen, thiocyanate, and carbon dioxide (Canadian Council of Ministers of the Environment 1999).

The Canadian Council of Ministers of the Environment has derived soil quality guidelines for different land uses. In the unlikely event of a heap leach pad systems failure resulting in release of leachate to the soil, the Emergency and Spill Response Plan will be implemented. The results of soil quality monitoring will be compared to the soil quality guidelines and further remediation will be implemented if necessary.

Water and Sediment Quality

Potential effects to surface water and sediment quality directly from a release of leachate from the heap leach pad are considered to be minimal, since Casino Creek will be located more than 3 km from the southwest perimeter of the heap leach pad.

The potential for adverse effects on groundwater quality exists via soil contamination. In soils with pH greater than 4, cyanides dissolved in leachate tend to precipitate out; however, some could remain in solution and cause groundwater contamination, especially under anaerobic conditions (Canadian Council of Ministers of the Environment 1999). Surface water contamination could occur as a result of surface water interaction with groundwater. A surface and groundwater monitoring program would be implemented following remediation of any spill, and water sample results would be compared to Canadian Environmental Quality Guidelines for the end user (e.g., aquatic life).

Fish and Fish Habitat

Cyanide is acutely toxic to most fish species at high concentrations (greater than 200 µg/L). (Ministry of Environment, Lands and Parks 1998). Cyanide can combine with metals to form a variety of compounds, depending on pH, temperature, dissolved oxygen, salinity, and the presence of other ions (Ministry of Environment, Lands and Parks 1998). Free cyanide is the sum of hydrogen cyanide (HCN) and the cyanide ion (CN^-) – the distribution of free cyanide between hydrogen cyanide and the cyanide ion depends on pH and temperature; in water with pH less than 8, the predominant form is hydrogen cyanide, which is volatile (Gensemer et al. 2006). Free cyanide toxicity to aquatic life mainly results from HCN; according to Gensemer et al. (2006) “most metallocyanide complexes are not very toxic”.

The U.S. Environmental Protection Agency current ambient water quality criteria for cyanide (developed in 1984) for freshwater aquatic life are 22 µg and 5.2 µg CN/L (free cyanide) for chronic and acute, respectively (Gensemer et al. 2006). The Canadian Environmental Quality Guideline for water quality the protection of aquatic life (derived in 1987) is set at 5 µg/L as free cyanide; no sediment quality guidelines currently exist.

Potential effects to aquatic life from a release of leachate to surface water from the heap leach pad is considered to be minimal, since Casino Creek will be located more than 3 km from the southwest perimeter of the heap leach pad. As previously discussed, there is potential for contamination of groundwater via soil contamination from a heap leach systems failure. Following cleanup and disposal of contaminated soil in accordance with the Emergency and Spill Response Plan, a surface and groundwater monitoring program would be implemented. Water sample results would be compared to Canadian Environmental Quality Guidelines for the protection of aquatic life.

Free cyanide is readily absorbed by terrestrial animals through inhalation, ingestion, and contact with skin and mucous membranes; ingestion of plants containing cyanide is the most frequent cause of poisoning (Canadian Council of Ministers of the Environment 1999). Most mammal and bird species are able to rapidly degrade low doses of cyanide to nontoxic products; however large doses result in death (Canadian Council of Ministers of the Environment 1999). The LD_{50}s (lethal dose, or amount of substance, required to kill 50% of a test population) for

mammals and birds range from 1.43 mg CN/kg body weight to 11.15 mg CN/kgbody weight (Canadian Council of Ministers of the Environment 1999). It is anticipated that the perimeter berm around the heap leach pad will limit the amount of in-heap leachate released and thus the area of soil contaminated to areas immediately adjacent to the heap leach pad; therefore, the potential impacts to wildlife are not considered significant since animals are assumed to exhibit avoidance behaviour of the area due to noise and human presence.

21.4.3.4 Tailings Distribution Facilities Failure

Three tailings streams will discharge into the TMF: PAG tailings, bulk NAG tailings and the cyclone overflow (the fine fraction of bulk NAG tailings) (Knight Piésold 2012a). The TMF design includes separate tailings lines from the main plant site for the PAG tailings and NAG tailings. Thickened NAG tailings from the processing plant will have a solids concentration of 55% solids by weight; this will be directed to the cyclone feed tank where it will be diluted with pond reclaim water to an optimum solids concentration of 36%, and will then flow by gravity to the cyclones.

The cyclone feed tank will be comprised of four compartments: the NAG tailings and dilution water report to the first compartment before flowing over a baffle to a rubber lined 38” carbon steel pipe to the cyclone cluster. In the event that bypass of the cyclones is required, the 38” carbon steel pipe can be isolated with a knife gate valve. The slurry level would then increase in the overflow compartment before reaching an overflow weir; from the overflow weir the slurry flows to a bypass compartment piped through the cyclone plant and cyclone overflow distribution system, where it will be deposited on the upstream side of the tailing dam (Knight Piésold 2012a). The fourth compartment of the cyclone feed tank takes all tank overflows and spillage in emergency situations and feeds into a 42” emergency spillage line, which takes the spillage to the nearest location of the tailings pond .

The cyclone underflow (sand fraction) will be discharged from the sand plant as slurry at 65 – 74% solids (by weight) to construction cells along the upstream and downstream shells of the TMF embankment. The cyclone overflow material (fine fraction) will be discharged directly to the TMF impoundment as slurry at approximately 25% solids by weight. The cyclones will be in operation for approximately nine months of each year, since cyclone operations become more problematic as the temperature decreases during the winter months (Knight Piésold 2012a). The bulk NAG tailings will be deposited during the winter months and any other time the cyclone plant is not in operation. The bulk NAG tailings and cyclone overflow will be discharged to the TMF from valved off-takes located along the Main Embankment and from the West Saddle Embankment. The PAG tailings will be deposited within the TMF near the Waste Storage Area; the PAG tailings line will be laid heading east from the main plant, running between the low grade ore stockpiles. Upon mine closure the tailings and reclaim delivery systems, cyclone plant and all pipelines, structures and equipment not required beyond mine closure will be dismantled and removed from site.

The hazard scenario assessed for the tailings distribution lines is rupture, either due to freezing temperatures or to damage from heavy equipment, resulting in a release of tailings to the environment during the construction and operation phases. Three scenarios are discussed:

- PAG tailings line rupture between the main plant and TMF;
- NAG Bulk tailings line rupture between the main plant and the cyclone plant; and
- NAG Tailings underflow and overflow into the TMF.

Risks and mitigation plans accounted for in the cyclone and transport system include (Knight Piésold 2012a):

- Slack flow and associated high tailings slurry velocities, up to 11 m/s, creates very high wear in the piping: risk of high pipeline wear in sloped sections (slack flow) was resolved through the use of ceramic orifices

to dissipate energy and reduce slack flow section lengths, and ceramic lined pipes on remaining slack flow pipe section;

- Risk of blockage of the cyclone underflow pipeline was mitigated through proper design and flush water availability along the whole pipe;
- Risk of freezing of pipeline addressed through design using heat tracing and insulation; during operations the slurry pipelines will be drained for shutdowns longer than two hours;
- Risk of valve malfunctions due to freezing will be mitigated through insulation and heat tracing; and
- Risk of pipeline failure addressed through drainage construction to ensure that spills are directed into the TMF through a 42" emergency spillage pipe.

The higher elevation of the main plant site relative to the TMF will enable gravity discharge for the tailings streams, therefore any PAG tailings released from a tailings line rupture between the main plant site and TMF would eventually report by gravity flow to the TMF, if not contained and cleaned up immediately. Similarly, release of material from a NAG tailings rupture between the main plant site and TMF embankments would flow by gravity to the TMF. Rupture of the cyclone sand piping system would result in release of cyclone underflow from the NAG tailings on the downstream side of the embankment; the underflow is approximately 74% solids by weight and is anticipated to be captured within the sand deposition cells. Rupture of the tailings fines from the cyclone overflow discharge lines would result in deposit of NAG tailings onto the beach of the TMF.

Based on the design measures the likelihood of a tailings line rupture is rated as Rare and the consequence is rated as Very Low.

Release of tailings into the environment could affect the following VCs:

- Water and Sediment Quality; and
- Fish and Fish Habitat.

Failure of the PAG tailings pipeline between the main plant and the TMF would result in release of material into the terrestrial environment; because the main plant site will be located at higher elevation than the TMF all material would be captured within the TMF. No impacts to VCs are anticipated.

Failure of the NAG tailings pipeline would result in release of tailings onto the downstream side of the embankment or onto the tailings beach within the TMF. Deposit of the cyclone underflow tailings on the downstream embankment could result in unplanned release of seepage water from the cyclone sand; this water would report to the surface ditch system, which discharges into the water management pond located downstream of the embankment or into Casino Creek between the embankment and the Water Management Pond. Seepage and runoff collected in the water management pond will be pumped back into the TMF. Tailings seepage water could have elevated concentrations of total suspended solids and some metals; the length of creek affected will be less than 500 metres; no fish have been documented in the upper reaches of Casino Creek in the area of the TMF.

21.4.3.5 Hazardous Materials Storage

Reagent spills occurring during storage, mixing and distribution could include:

- Spill of liquid chemicals during offloading of trucks;
- Release of solid chemicals during on-site transfer and handing;

- Overflow of storage tanks; and
- Failure of pumps, pipes, valves.

Facilities for storage and handling of reagents will be located on an area of relatively flat terrain approximately two kilometres south of the Open Pit. Spills would be expected to be localized and small to moderate in volume. Should a spill occur, site staff will implement the Emergency and Spill Response Plan; any contaminated materials will be handled in accordance with the Waste Management Plan. The likelihood of spills or leaks of reagents during storage, mixing and distribution is rated as Possible. Consequence is rated as Very Low, based on the location of the facility upslope of the TMF and away from any watercourse. Reagent storage and mixing facilities for flotation circuits located within a structurally independent building to ensure that any material released is fully captured on site.

The likelihood of spills from the LNG or diesel storage tank is rated as Rare, while consequence is rated as Very Low. All storage tanks will be constructed and managed in accordance with the National Fire Code and in conformity with the Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products. An LNG spill containment pond will be designed to capture any spill in the event of a storage tank rupture.

The VCs that could be affected by spills that occur as a result of on-site vehicle collisions are Surficial Geology, Terrain, and Soils. Soil contamination could result in areas down-gradient of the storage facilities. Soil contamination would be localized and remediated following measures outlined in the Emergency and Spill Response Plan, as previously described. Any contaminated materials will be handled in accordance with the Waste Management Plan.

21.4.3.6 Concentrate Loading

Thickened copper concentrate will be filtered in three tower-type copper concentrate pressure filters into filter cakes, which will be discharged on to a conveyor belt that transfers them to a covered copper concentrate stockpile until shipment. Copper concentrate will be moved by front-end loaders onto highway haul trucks.

Molybdenum concentrate slurries will be filtered in one tower type molybdenum concentrate pressure filter to create filter cakes, which then travel through a Holo-Flite type dryer and discharge to a molybdenum concentrate storage bin. Molybdenum concentrate will be withdrawn from the dried molybdenum concentrate storage bin by a packaging system and will be bagged in super-sacks for shipment by highway haul trucks.

The likelihood of a spill of small amounts of material is rated as Possible; consequence is rated as Very Low, since the material will be contained within the main plant and not released to the environment. No effects on VCs are therefore predicted.

21.4.3.7 Landfill Management

A permanent waste management facility established during the construction phase will consist of a building and adjacent laydown areas. The waste management facility serves as a central depot where wastes generated across the Casino mine site will be managed, properly processed, packaged, labelled, inventoried, secured (e.g., on pallets) and stored for transport, disposed of on site or reused on site. Landfill sites within the Casino mine site will be used to dispose of inert solid waste and ashes from the incinerator. Regular cover will be applied over the landfill sites and a cap of native overburden will be placed on top of the landfill before decommissioning, so that the content of the landfill will remain permanently isolated. Open air controlled burning of inert combustible

materials will be conducted on an as needed basis to eliminate large quantities of construction related wood waste and cardboard that would otherwise use up landfill capacity.

The likelihood of a leak from storage or disposal containers was assessed as Possible and consequence was rated as Very Low, since all containers will be maintained within a central depot prior to being shipped off-site for disposal. The likelihood of leaching from the on-site landfill was rated as Rare and consequence was rated as Very Low, since the landfill will only be used for deposition of inert solid waste and ashes.

Water and Sediment Quality was the VC identified as being potentially affected by a leak from storage or disposal containers or seepage from the landfill. The footprint of the landfill will be minimized through planned waste minimization and recycling practices, and volume reduction from the incineration of a portion of the waste stream. The landfill will only be operated by trained personnel who will carry out regular inspection and monitoring of the facility.

21.4.3.8 Concrete Batch Plant

The hazard scenario assessed for the concrete batch plant during site construction is the release of uncured cement or concrete wash water to the environment. The likelihood was rated as Unlikely and consequence was rated as Very Low, since a low-volume batch or portable concrete mixer will be used. Procedures outlined in the environmental management plans will be followed to minimize the likelihood of release and measures to ensure containment.

Water and Sediment Quality and Fish and Fish Habitat are the VCs potentially affected in the event of a concrete release. However, most of the project infrastructure for which concrete will be required (the main plant and SART plant) will be in the Casino Creek valley upstream of the TMF; any material released in these areas would report to the TMF.

21.4.4 Transportation Accident

Access and transportation management during the construction and operation phases is described in Sections 4. Projected traffic volume during construction and operations are provided in Section 4. Traffic accidents could result from operator error, equipment failure, poor road conditions, improper road maintenance, inclement weather, or wildlife interactions. Accidents include collisions between mine vehicles and public vehicles or other mine vehicles, collision between mine vehicles and public infrastructure, plane crash on takeoff or landing, or mine vehicle collision with wildlife. Accidents could result in wildlife injury or fatality or damage to public infrastructure. The assessment is restricted to the potential for transportation accidents occurring along the Freegold Road and Freegold Road Extension between Carmacks and the mine site, and to aircraft incidents at the Casino Project airstrip on takeoff and landing.

The likelihood of collision between mine related vehicles, between a mine vehicle and a public vehicle, or a mine vehicle and public infrastructure such as a bridge crossing along the Freegold Road resulting in blocked access along the road is rated as Possible, given the estimated traffic volume over the life of the mine. Consequence is rated as Low. The Upgrade portion of the road has been diverted away from the village of Carmacks to minimize the potential for damage to public services. Effects would be restricted to the immediate site; drivers will be trained to immediately implement the Emergency Response Plan (if able) and the site of the incident will be communicated to mine management and the public as necessary (via radio).

The likelihood of a collision of a mine vehicle with wildlife is rated as Likely; consequence is rated as Low based on potential impacts to wildlife at the population level. Creation of a movement barrier to wildlife as a result of

snow removal activities along the Freegold Road (Extension and Upgrade) is rated as Possible and Consequence is rated as low, since effects would be restricted to the immediate area.

The likelihood of an aviation accident is rated as Rare. In the event that one did occur, consequences of the accident itself (e.g., not related to any subsequent spill or fire) would be Low. The Emergency Response Plan would be implemented by Project personnel.

The VCs potentially affected by transportation accidents include:

- Wildlife;
- Sustainable Livelihood; and
- Land Use and Tenure.

The Project will not significantly affect wildlife populations as a result of transportation accidents. A Road Use Plan, as described in Section 23, will be developed and will specify rules for the use of the Freegold Road Extension to ensure safe access to the Casino mine site, including:

- Potential use of the access road by the public including hunters;
- Speed limits and enforcement;
- Yielding the right-of-way to wildlife and reporting wildlife observations;
- Travelling in convoys for safety;
- Emergency and spill response procedures;
- Radio control; and
- Community notification and update process for the village of Carmacks.

Speed limits and additional mitigation measures will be implemented at bridge crossings and during inclement weather to minimize the risk of damage to public infrastructure that could hinder the use of the publicly accessible portion of the road by other parties.

21.4.5 Water Management Failure

Water management procedures for the Casino Project are summarized in Section 4.4.1.4 and described in detail in the Water Management Plan. Water management features include the TMF, water supply, sediment control structures, cofferdams, pumping systems, runoff collection ditches, and diversion channels, as well as the engineered wetland at closure.

Accidents and malfunctions associated with water management at the mine site could include:

- TMF overflow;
- Events pond overflow;
- Diversion or collection ditches failure;
- Cofferdam failure or overtopping; and
- Water supply pipe or pump failure.

A preliminary dam classification for the TMF was carried out following the CDA Dam Safety Guidelines (2007) to select the appropriate flood event. The TMF was classified as a High consequence dam; in accordance with the

CDA guidelines the Inflow Design Flood (IDF) Annual Exceedance Probability for a High consequence dam is “One third between 1/1,000 and the Probable Maximum Flood”. The IDF is the most severe inflow flood for which a dam is designed. The IDF up to and including Year 1 of operations was designed for a 1,000 year event for 72 hour storm duration; during operations the IDF was selected as "one third between 1,000 years and the Probable Maximum Flood event for 72 hour storm duration". The IDF design for closure was the Probably Maximum Flood event for a 24 hour storm duration. The design includes sufficient freeboard to accommodate the IDF above maximum supernatant pond level at each stage plus 2 m allowance for wave run-up.

The 1 in 1000 year flood is a flood having a 0.1% probability of occurrence being exceeded in any year. The Probable Maximum Flood is the largest possible flood based on an analysis of the maximum possible precipitation in a given area. Based on the design criteria, the likelihood of the TMF overtopping was rated as Unlikely and consequence was rated as Moderate.

The Events Pond will be constructed to full size prior to commencing operations of the heap leach facility and will provide storage for excess leachate and runoff that could be generated as a result of rainfall events exceeding the in-heap storage capacity. The flood flow used in the design is the 1 in 100 year 24-hour storm event (98,600 m^3). The Events Pond spillway is designed to discharge the 1 in 200 year 24-hour storm event with a minimum embankment crest freeboard of 0.3 metres. The pond will be operated as a dry-facility, therefore will only receive and store runoff water during significant storm events. Based on the design criteria, the likelihood of the Events Pond overtopping was rated as Unlikely and consequence was rated as Very Low, since any material overtopping the Events Pond embankment or spillway would report to the TMF and be contained on site,

The diversion ditches for the ore stockpiles will meet the following design criteria:

- Design storm conveyance: 1 in 100 year 24-hour duration storm event;
- Minimum freeboard = 0.3 m;
- Maximum design storm flow depth = 0.5 m; and
- Minimum ditch grade = 0.01 m/m.

During the construction phase of the Casino Project, initial water requirements for the oxide ore processing facilities will be met by pumping water from the temporary fresh water pond located at within the TMF catchment area along Casino Creek. The temporary fresh water pond will be utilized from Year -3 to Year -1. A cofferdam to capture flows will be sized to ensure that it does not overtop. Likelihood of failure of the cofferdam was rated as Rare; Consequence was rated as Very Low.

The permanent fresh water supply for the Casino Project will be sourced from the Yukon River. The water will be collected in a riverbank caisson and radial well system and pumped through an aboveground, insulated 17.4 km long pipeline with four booster stations. The design capacity of the fresh water collection and transfer system will be approximately 3,400 m^3 per hour. The likelihood of a water supply mechanism failure was rated as Possible and consequence was rated as Low. Rupture of the freshwater supply pipeline could cause erosion and sedimentation into the adjacent Britannia Creek or downstream in the Yukon River; however, the fresh water pipeline will roughly follow an existing road that leads northward from the Casino mine site to the Yukon River along Britannia Creek; the existing road will act as a service road to facilitate access, inspection, and maintenance of the fresh water pipeline during construction and operation.

Failure of any of the water management structures could result in release of fresh or contact water into the Casino Creek or Britannia Creek watersheds. This section describes the potential effects of a failure on the following VCs:

- Water and Sediment Quality; and
- Fish and Fish Habitat.

Overflow of the TMF, Events Pond or collection ditches could result in the release of contact water to the environment. Contact water would contain elevated concentrations of deleterious substances such as tailings and supernatant (from the TMF), cyanide and metals (from the Events Pond) and suspended sediments (from the collection ditches). Failure of the water supply pipeline or related structures or overtopping of the diversion ditches would result in the release of fresh water high in suspended solids.

Release of tailings and supernatant could result in an increase in metals concentration in water and sediment; alteration or loss of fish habitat; and direct fish mortality. The spatial and temporal extent of any effect would depend on the magnitude of the flood. Any material released from the Events Pond would be contained within the TMF and not released into the environment. The TMF design includes sufficient freeboard to accommodate the IDF above maximum supernatant pond level at each stage, plus a 2 m allowance for wave run-up, therefore release to the environment and potential effects on Water and Sediment Quality and Fish and Fish Habitat are not anticipated.

The cofferdam and diversion ditches will manage fresh water; any overflow would contain elevated levels of suspended sediment but no other Project-related deleterious substances. Release of this non-contact water into the environment would occur only during high inflows; the volume released is anticipated to be a small proportion of the flood flows, therefore incremental effects of the high suspended sediment laden water would not have an impact on the VCs.

Water management procedures during construction, operations, and closure will include site hydrological and meteorological monitoring; additional mitigation or design measures will be implemented a necessary if high flood flows are forecast.

21.4.6 Fire/Explosion

A fuel source, heat, and oxygen all need to be present for a fire to ignite. An explosion is a sudden release of energy, either mechanical or chemical. Fires or explosions could be associated with each of the following Project components and activities:

- Blasting resulting in air overpressure or flyrock damage;
- Improper storage or handling of processing reagents;
- Vehicle collision;
- LNG or diesel spill;
- Waste management (waste oil burners, woody debris slash piles); and
- Plane crash.

As noted in Section 4.4.1.6, fuel, hazardous materials, and explosives will be stored in separate structures in accordance with applicable regulations and permitting requirements. Under the *Explosives Act* it is illegal to store any explosive in a magazine that is not a licensed magazine. All explosives will be transported, stored and handled in compliance with applicable federal and territorial legislation and guidelines, including the “Blasting Explosives and Initiation Systems Storage, Possession, Transportation, Destruction and Sale” publication of Natural Resources Canada (2008). Improper blasting techniques during construction and operation could result in fly rock or air overpressure injury to wildlife or the public. During operations, blasting will only occur during daylight

hours at designated times in order to minimize risk to all mine personnel in the vicinity. Blasting times will be posted at the Casino mine site and response measures put in place in case of an emergency according to the Explosives Management Plan. The likelihood of a fire or explosion resulting from improper storage or handling of explosive agents is rated as Unlikely; consequence is rated as Moderate.

Some of the processing reagents are flammable when exposed to an ignition source or in combination with other chemicals and could emit acrid smoke and corrosive fumes. Sodium cyanide, for example, could be combustible at high temperature and produce toxic and flammable vapours. When in contact with acid or acid salts, flammable hydrogen cyanide gas could be formed. Project buildings will include a fire protection system comprised of a primary fire pump (and backups) and sprinkler systems. The likelihood of a fire or explosion involving processing reagents is rated as Rare; consequence is rated as Moderate based on industry standard storage and handling procedures and control measures.

Vehicle collisions on site or along the transport route could release fuel (LNG or diesel) or combustible processing reagents; if an ignition source is present a fire or explosion could result. As noted in Section 21.4.3.2, the likelihood of a vehicle accident resulting in a spill is a combination of the likelihood of a vehicle accident times the likelihood of loss of cargo from the vehicle and a failure of the containment method; an ignition source must also be present for a fire or explosion to subsequently occur. Transportation of goods and materials will be in accordance with all applicable regulations and legislation, as well as the Explosives and Hazardous Materials Transport Permit required for the Project. An LNG spill could result in formation of a vapour cloud which could ignite in the presence of an ignition source if the concentration of the vapour cloud was within a flammability range of 5-15% by volume (Drube et al 2012). In an unconfined space the methane vapour would quickly evaporate and disperse (e.g., the fuel would be too light to burn); in a confined space there would be a risk of explosion of the vapour in the presence of an ignition source (Drube et al 2012). A diesel spill would pool on the ground since diesel has a lower vaporization rate; this leads to a higher potential for a fire or explosion (in comparison to LNG) if not cleaned up immediately.

Explosions associated with release of LNG from a container include (Drube et al 2012):

- Rapid phase transformation: transition of LNG to a gaseous state due to rapid pressure release from a storage tank;
- Rapid phase transition: small to moderate explosions could result if large volumes of LNG contact water, leading to a burst of heat transfer; and
- Boiling liquid expanding vapour explosion: in storage tanks lacking appropriately designed fire insulation, an external heat or fire source could heat the contents of the tank, leading to boiling of the liquid and increasing vapour pressure, which consequently reduces the strength of the tank above the liquid due to the increased temperature. If the temperature of the tank exceeds a critical temperature the container could fail, causing high pressure vapour to be released; the failure of the storage tank then causes a “rapid pressure reduction and subsequent phase change and pressure surge”.

Rapid phase transformation explosions are not likely because LNG will be stored at low pressure and tanks are equipped with pressure release devices. According to Drube et al (2012) a rapid phase transition resulting in a significant energy release requires a leak rate exceeding 10,000 gallons per minute (equivalent to 37,854 litres or 37.854 cubic metres per minute). All LNG tanks built to US standards require insulation jackets that remain in place during a fire and keep the upper portion of an LNG tank from reaching critical temperature (Drube et al 2012).

For these reasons the likelihood of a fire or explosion related to a vehicle collision or the LNG storage facility are both rated as Unlikely; due to the potential for a fire to spread or release toxic fumes, or an ensuing explosion, the consequences are rated as High.

Burning of any waste in waste oil burners or woody debris slash piles will be done by qualified and trained personnel in accordance with applicable guidelines and standards, as well as site-specific operating permit conditions. The likelihood of a fire related to waste management is rated as Possible, with consequences rated as Moderate.

The risk of a plane crash resulting in a fire or explosion is a combination of the risk of a plane crash, followed by the release of a flammable substance in the presence of an ignition source. The likelihood of a plane crash was assessed in Section 21.4.4 as Rare; therefore, the likelihood of a plane crash resulting in a fire or explosion is also Rare. The consequence of a fire or explosion on the environment is rated as High, since there would be a potential for the fire to spread over a wide area of the crash site.

A fire or explosion related to any of the Project components or activities could affect the following VCs:

- Air Quality;
- Noise;
- Rare Plants and Vegetation Health;
- Wildlife;
- Community Infrastructure and Services;
- Sustainable Livelihood; and
- Land Use and Tenure.

Explosions related to blasting are not anticipated to affect any VCs: wildlife would not likely be present in the mine area due to avoidance of human activity and would therefore not be affected by fly rock or air overpressure.

A fire or explosion releasing toxic fumes into the environment could have an adverse impact on air quality. Site wide firefighting measures would be implemented to contain the fire and minimize the duration of the release; however, existing air quality guidelines could be exceeded in the immediate area and in surrounding areas, depending on wind direction and velocity.

Explosions would have an adverse impact on ambient sound levels but the impact would be short term and infrequent.

Potential impacts to the remaining VCs would depend on the location and size of the fire and the ability of mine personnel to contain the blaze. Effects to wildlife could include direct mortality and loss of habitat; loss of rare plants would be permanent, while native vegetation would be expected to regenerate naturally over the medium term. Sustainable livelihood and land use and tenure could be impacted in the short to medium term if dependant on wildlife or vegetation lost to a fire.

The site water requirement for firefighting will be 341 m^3/h for two hours; this will be provided by ensuring a reserve capacity of 682 m^3 in the lower portion of the freshwater pond. Project buildings will include a fire protection system comprised of a primary fire pump (and backups) and sprinkler systems. Portable fire extinguishers will be provided in all buildings and mobile equipment. A Fire Response Plan developed as part of the Emergency Response Plan will include details of standard fire prevention measures and procedures to be

implemented for site activities, as well as standard equipment, training and emergency response measures to be used for the Project.

21.4.7 Erosion and Sediment Control Measures Failure

The following erosion and sediment control measures assessed and the potential for failure are discussed in this section:

- Ore, topsoil or overburden stockpile erosion causing blockage of collection or diversion ditches at the toe;
- Slumping or sloughing of the Freegold Road foundation; and
- Excess sediment generation from clearing and grubbing.

Material carried downslope on the ore, topsoil or overburden stockpiles has the potential to infill the collection or diversion ditches at the base, thereby decreasing the capacity of the channels and increasing the risk of discharge of a deleterious substance to the environment. The ore stockpiles will be developed with 20 m benches along the toe of each lift to capture sloughing or ravelling material.

Management practices to reduce potential for soil erosion during handling or storage are described in Section 4.4.7.5; the measures include limiting the height and slope of the piles, vegetation planting to reduce exposure time, and locating piles in areas to reduce wind exposure. Topsoil stockpiles will be constructed with an overall slope angle of 4H:1V to minimize slope instability, reduce erosion potential, and improve the amenability for vegetation growth.

Two areas along the Freegold Road route have potential terrain stability issues, indicating the likelihood of future slope erosion. Detailed design measures to address these concerns could include retaining walls.

Sediment generation during clearing and grubbing will be minimized. A site preparation plan will be implemented in conjunction with the Project Construction Environmental Management Plan to manage and minimise environmental effects during construction activities.

The likelihood of erosion and sediment control measures for each of these scenarios is considered Possible, with consequences ranging from Very Low to Moderate, depending on site specific locations. Consequence was rated as Very Low for the ore, topsoil or overburden stockpiles, since any material released from the piles would be contained on site; consequence was rated as Moderate for the Freegold Road, since terrain instability could extend beyond the immediate construction site, depending on construction methods and site conditions.

The VC that would be affected would be Surficial Geology, Terrain and Soils. Effects would be short-term and reversible with mitigation and remediation.

21.4.8 Reclamation Measures Failure

The malfunctions assessed related to reclamation activities include:

- Metals uptake in vegetation on reclaimed areas greater than predicted;
- Failure of vegetation to become self-regenerating; and
- Failure of constructed wetland passive treatment for water quality.

The likelihood for metals uptake in vegetation on reclaimed areas resulting in adverse effects on wildlife was rated as Possible and consequence was rated as Low. Progressive reclamation will occur during mine operations and reclaimed areas will be monitored for physical and geochemical stability. Monitoring programs will be designed to

determine the affinity for selected plant species to uptake metals and determine if the metals are bioavailable. Should monitoring during operations indicate that uptake of metals is a concern, mitigation measures will be taken into consideration, including re-vegetating with indigenous plants not used by wildlife.

The likelihood for failure of re-vegetated areas to become self-sustainable was rated as Possible; consequence was rated as Moderate. Challenges in establishing vegetation at northern sites include a short growing season, amount and timing of precipitation, and average temperatures. Disturbed areas will be progressively reclaimed during construction and operations and these areas will be monitored to assess revegetation success. Various seed mixes and soil mixes will be tested to determine the most effective one. This work will start early in the Operation Phase of the mine and given the long operations life of the mine will allow ample time to refine the choices. The information derived from the monitoring program will be used to inform the site closure plan, including any requirements for mulches, fertilizers, or other amendments.

The likelihood for failure of the constructed wetland for passive treatment of effluent from the HLF was rated as Rare and consequence is rate as Very Low. The proponent proposes to construct and commission the wetland in advance of the decommissioning of the Cyanide Destruction Plant (CDP) to demonstrate the effectiveness of the wetland. Monitoring during operations will assess the effect of climate on passive wetland treatment and confirm the modelling results for water quality. The CDP will not be decommissioned until such time as the wetlands are demonstrated to be functioning reliably. A contingency option includes adapting the operational seepage collection system for supplemental treatment using sulphate reducing bacteria. Water will not be discharged to the environment unless it meets existing guidelines or established water quality objectives.

21.5 SUMMARY

A total of 61 potential accident or malfunction hazard scenarios were identified and described in the Risk Register for the Project (Appendix 21-B). Based on likelihood and consequence, 15 scenarios were categorized as Non-actionable Risk (Table 21.5-1); 35 scenarios were categorized as Low Risk (Table 21.5-2); and 35 scenarios were categorized as Moderate Risk (Table 21.5-3). No accidents or malfunctions were categorized as High Risk based on the feasibility level design provided in the Project Description, therefore no accidents or malfunctions are expected to result in significant impacts on environmental or social VCs.

Table 21.5-1 Non-Actionable Activities

Scenario	Hazard	Likelihood	Consequence
1.d	Air overpressure infrastructure damage	Unlikely	Very Low
1.f	Ore stockpile slope failure	Rare	Very Low
1.h	Fuel spill in open pit from collision	Rare	Very Low
2.a	HLF embankment failure	Unlikely	Very Low
2.c	Events pond overflow	Unlikely	Very Low
2.d	Events pond embankment failure	Unlikely	Very Low
4.b	NAG and PAG tailings distribution pipeline failure	Rare	Very Low
9.a	Temporary freshwater supply pond cofferdam failure	Rare	Very Low
9.c	Process water pond failure	Rare	Very Low
10.a	LNG or diesel storage tank rupture	Rare	Very Low
10.d	LNG or diesel spill during transport	Unlikely	Low
11.c	Leaching from landfill	Rare	Very Low
12.c	Concrete or washwater spill	Unlikely	Low
13.c	Failure of constructed wetland passive treatment resulting in release of effluent higher than permit levels	Rare	Very Low

Table 21.5-2 Low Risk Activities

Scenario	Hazard	Likelihood	Consequence
1.a	Fuel spill in open pit during refueling.	Likely	Very Low
1.b	Pit wall failure resulting in slumping or mass wasting within the pit	Possible	Low
1.c	Fly rock from blasting	Possible	Low
1.e	Open pit overtopping during operations	Rare	Moderate
1.g	Ore stockpile erosion	Possible	Very Low
2.b	HLF slope failure, deposit of ore in surrounding terrain	Unlikely	Moderate
2.e	HLF liner, tanks, pipes, and pumps failure releasing leachate solution	Unlikely	High
3.a	Release of pregnant solution between HLF and Gold Recovery Building	Rare	Low
3.b	Reagent spill during mixing and handling in main plant or SART plant	Possible	Very Low

Scenario	Hazard	Likelihood	Consequence
3.c	Concentrate spill in sulphide ore plant site	Possible	Very Low
3.d	Tailings release between sulphide ore plant site and TMF embankment	Rare	Moderate
3.e	Reagent fire in sulphide ore plant site	Rare	Moderate
4.a	TMF embankment failure	Unlikely	High
4.c	TMF overflow	Unlikely	Moderate
4.d	TMF seepage greater than design	Possible	Low
4.e	TMF reclaim water line rupture resulting in release of contact water and causing erosion and sedimentation	Possible	Very Low
5.a	Stockpiles and dump erosion and sedimentation	Possible	Very Low
5.b	Waste Rock Stockpiles and dump slope failure	Possible	Very Low
6.a	Collision of mine related-vehicles causing blocked access along road	Possible	Low
6.d	Collision resulting in fire or explosion	Unlikely	High
6.e	Plane crash at airstrip causing injuring or mortality	Rare	Low
6.f	Plane crash at airstrip causing fuel spill to land or water	Rare	Moderate
7.a	Ammonium nitrate fuel oil (ANFO) spill on site	Possible	Very Low
7.b	Processing reagent spill on site	Possible	Very Low
7.c	Fire/explosion at explosives factory	Unlikely	Moderate
7.d	Fire/explosion in reagent storage area/oxide ore processing facility	Unlikely	Moderate
8.a	Freegold Road blocked drainage	Possible	Low
8.b	Freegold Road slope failure	Rare	Low
8.d	Improper snow management creating wildlife barrier resulting in wildlife mortality	Possible	Low
9.b	Freshwater Pond embankment failure or overtopping	Rare	Moderate
9.d	Water Management Pond failure	Rare	Moderate
9.e	Water supply system failure	Rare	Moderate
9.f	Diversion or collection ditches failure	Possible	Low
10.c	Fire/explosion during LNG or diesel transport	Unlikely	High
11.b	Leaks from waste disposal containers	Possible	Very Low
12.a	Borrow site slope/wall failure	Possible	Very Low

Scenario	Hazard	Likelihood	Consequence
12.b	Erosion during site prep	Possible	Low
12.d	Vehicle collisions resulting in spills or leaks of fuels, lubricants	Possible	Low
13.a	Failure of constructed wetland passive treatment resulting in release of effluent higher than permit levels	Possible	Low

Table 21.5-3 Moderate Risk Activities

Scenario	Hazard	Likelihood	Consequence
2.f	Fire involving processing reagents	Rare	High
5.c	Topsoil/Overburden Stockpiles and dump slope failure	Possible	Moderate
6.b	Collision resulting in spill to land or water - reagent or concentrate	Possible	Moderate
6.c	Wildlife collision	Likely	Low
6.g	Plane crash at airstrip causing fire or explosion	Rare	High
8.c	Freegold Road erosion into waterway	Possible	Moderate
10.b	LNG facility fire/explosion	Rare	High
10.e	LNG or diesel spill during refueling of Project equipment outside of Open Pit	Likely	Low
11.a	Fire/explosion associated with waste management	Possible	Moderate
13.b	Failure of vegetation to become self-regenerating resulting in erosion and sedimentation	Possible	Moderate

The risk rankings are summarized on the risk matrix (Figure 21.5-1).

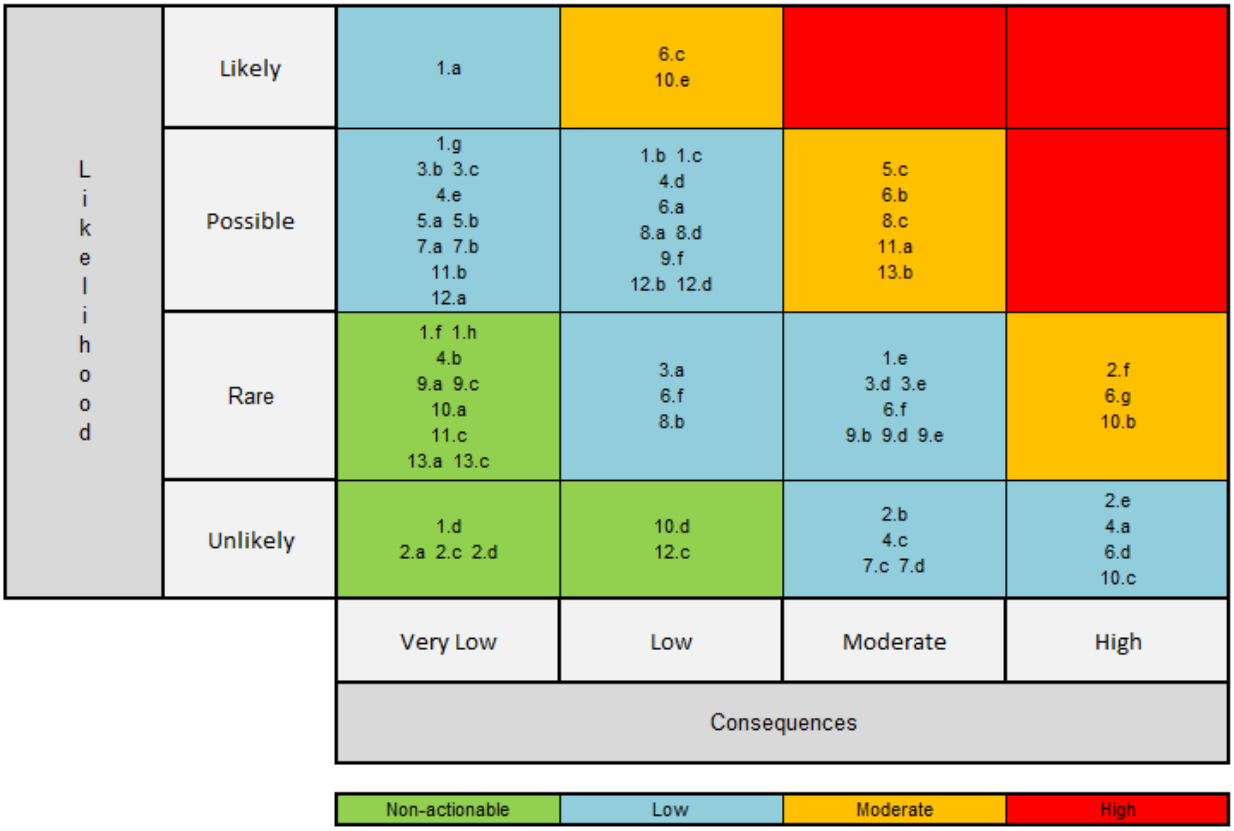


Figure 21.5-1 Casino Project Risk Matrix

The Casino Project considered site-specific geotechnical, hydrogeological and hydrometeorological characteristics in developing the feasibility level design to minimize the likelihood of any potential accidents or malfunctions. In northern environments, colder temperatures, permafrost, and snowfall can present specific challenges that need to be taken into consideration in the design, construction, and operation of the Project. The heap leaching process proposed has been demonstrated to be viable in climates similar to those of the Casino Project area; examples include the Brewery Creek Mine, near Dawson City, and the Fort Knox Mine in Alaska. The TMF has been designed to ensure that it has the ability to remain operational under winter freezing conditions; the design has taken into consideration the possibility of freezing of the supernatant pond, freezing of the tailings discharge stream, and the potential for excess dust generation resulting from the 'freeze drying' process which destroys capillary tensions in partially saturated sand materials. The projected energy requirement of the Casino Project at its peak is estimated as 130 MW; electrical power will be generated and distributed by an on-site LNG generation facility. The use of LNG as a fuel source was selected based on the lower air emissions and fewer environmental and safety concerns relative to other fossil fuels. All construction, operation, closure and reclamation activities will be closely governed by environmental management and monitoring plans, including an Emergency Response Plan, to ensure that the consequences of any accidents or malfunctions, should they occur, are minimized and remediated. Based on the likelihood and consequence ratings, none of the accidents or malfunctions were considered to have a significant impact on any of the Project VCs.

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22 CONCEPTUAL ENVIRONMENTAL MANAGEMENT PLANS

22.1 INTRODUCTION

All quartz mining projects in the Yukon require the submission of environmental protection and operational plans prior to development and operation, describing how mining activities will be conducted and completed in an environmentally responsible way through all project phases (Yukon Energy, Mines and Resources 2013). The following Environmental Management Plans (EMPs) are required for quartz mines in the Yukon (Yukon Energy, Mines and Resources 2013):

- Waste Management Plan;
- Hazardous Materials Management Plan;
- Wildlife Protection Plan;
- Spill Contingency Plan;
- Sediment and Erosion Control Plan;
- Emergency Response and Health and Safety Plan;
- Heritage Resource Protection Plan; and
- Environmental Monitoring, Surveillance, and Reporting Plan.

This section of the Proposal presents the management plans that will be developed for the Casino Project; Section 23 presents the monitoring plans that will be developed and implemented. In addition to the plans recommended in the guidance document, an Air Quality Management Plan and a Road Use Plan will be developed and implemented. The Emergency Response and Health and Safety Plan will be presented as two separate plans: the Emergency Response Plan can be found in Appendix 22A, while the Occupational Health and Safety Management Plan is outlined in this section.

The overarching goal of the EMPs is to demonstrate operational procedures and Best Management Practices (BMPs) to minimize adverse effects to the environment and employee and public health and safety, and ensure the stability of Project facilities and infrastructure. The component plans will describe how mining activities will be conducted in an environmentally responsible way and ensure that the Project complies with all applicable legislation and conditions set forth in territorial and federal certificates of approval, licenses, and permits.

The EMPs are conceptual at this stage and provide an outline of key components to be included in each of the plans; final EMPs will be completed with regulatory agency input and consultation as required to obtain a Quartz Licence and Water Licence for the Project. All mitigation and monitoring measures committed to during the YESAB review will be incorporated into the relevant plans. The plans are designed to be dynamic documents to be refined as mine planning and design are advanced. Key elements of each of the final EMPs will include:

- Objectives;
- Listing of all applicable legislative requirements; permits, approvals, and authorisations, and associated terms and conditions;
- Roles, responsibilities, and training programs;

- Concise and clear written instructions detailing the site-specific implementation of all identified mitigation measures and procedures; and
- Monitoring, reporting, and communication protocols.

Environmental training and awareness are integral to the successful implementation of the EMPs. Site-specific measures will be developed and implemented, in accordance with Environment Canada (2009) guidelines, to identify environmental training needs. The final plans will include training methods to be used and required frequency of training for all personnel, depending on the nature of their work.

In addition to the EMPs, the following operational plans are required for a project to obtain a Quartz Mining License and a Water Licence (Yukon Energy, Mines and Resources 2013):

- Site Characterization Plan;
- Mine Development and Operations Plan;
- Mill Development and Operations Plan;
- Heap Leach and Process Facilities Plan;
- Tailings Management Plan;
- Waste Rock and Overburden Management Plan; and
- Road Construction Plan.

Section 4 of this Proposal outlines the activities that would be included in each of these operational plans; this information will be expanded upon during the detail design phase following the environmental assessment process. The site-specific details presented in the operational plans will inform the EMPs and monitoring plans.

22.2 ENVIRONMENTAL FRAMEWORK

Environmental protection through adherence to applicable legislation and BMPs is considered an essential component of constructing, operating and reclaiming the Casino mine and access roads. Proper planning and implementation contributes to ongoing environmental site protection and greatly reduces the potential for adverse environmental effects. Mitigation measures such as delineation of environmentally and culturally sensitive areas, establishment of communications and reporting protocols, and implementation of environmental compliance monitoring and reporting programs will be integral to the program.

Casino Mining Corporation is committed to conducting its operations and activities in a manner that protects the natural and social environments, protects the environmental health and welfare of its employees and contractors, meets or exceeds requirements of all applicable environmental acts, regulations and permitting requirements, and keeps employees and the public informed about its environmental plans through its internal and external communication programs.

22.3 CONCEPTUAL ENVIRONMENTAL MANAGEMENT PLANS

22.3.1 Waste Management Plan

The objective of the Waste Management Plan is to ensure that the handling, storage, transportation, and disposal of all wastes (solids, liquids, special wastes) generated by the Casino Project are conducted in such

a manner as to reduce potential adverse environmental effects associated with waste materials. To achieve this, CMC will

- Comply with all applicable territorial and federal waste management regulations;
- Minimize waste generation;
- Select products that are less harmful to the environment;
- Reuse and/or recycle materials;
- Transfer wastes in a safe and responsible manner; and
- Train staff and contractors on policies and operations.

The handling, storage, transportation, disposal, and treatment of hazardous and non-hazardous waste, excluding sewage, are regulated under the *Environment Act* and its associated regulations. The *Environment Act* also governs the incineration or burial of waste materials, and the identification and management of contaminated waste. The management of sewage and sewage disposal and treatment systems are regulated under the *Public Health and Safety Act*.

The Waste Management Plan will describe the type of waste generated and related management strategies to responsibly handle, store, transport, and dispose of waste. The major sources of non-hazardous waste and special waste from the Project identified in Section 4.3 include:

- Hazardous waste: used reagent containers, batteries, paint;
- Non-hazardous solid waste: domestic camp waste (food, plastics, paper), and inert bulk wastes (rubber belts, drywall, etc.);
- Fuels and lubricants (petroleum products and oils); and
- Sewage (human sewage and gray water).

The final Waste Management Plan will describe the methods used to manage all domestic and industrial solid, liquid, and special wastes for all phases of the Project. The Plan will include a table of proponent commitments made during the environmental assessment process relevant to waste management, and indicate how the plan addresses the commitments.

A permanent waste management facility will be established at the Casino site during the construction phase. The waste management facility will serve as a central depot where wastes will be managed, processed, packaged, labelled, inventoried, secured and stored for either off-site transport or on site disposal. The Waste Management Plan will identify the types and amounts of waste expected to be generated from the Project, including all domestic wastes, construction and demolition wastes, tires and other relevant waste streams. Key elements to be described in the Waste Management Plan for the Project, as described in Yukon Guidance documents (Yukon Energy, Mines and Resources 2013) are outlined in Table 22.3-1.

Table 22.3-1 Waste Control

Waste Infrastructure and Treatment	
Storage Areas	• Location and type of all storage areas (inside or outside buildings, completely or partially enclosed); and • Storage area foundation (on the ground or on engineered liners/pads).
Storage Containers and Tanks	• Type (open, closed, size); and • Number and location of all storage containers and tanks. material to be stored in each; how material will be segregated, etc.
Landfill	• Soil characteristics, hydrogeological characteristics (depth to groundwater, etc.); • design permeability of the liner, • access restrictions, and • Closure methods (e.g., over material stockpile locations).
Incinerator	• Location, size, type, frequency of use; and • Manufacturer's specifications and other applicable information will also be included.
Land Treatment Facility	• Facility location, dimensions, liner systems, containment systems and measures used to store and treat any soil, sediment, water, ice, or snow that becomes contaminated with petroleum hydrocarbons.
Open Air Burning	• Composition and size of each batch of materials to be burned; • Frequency of use; and • Procedures that will be followed to ensure a complete burn and minimal air emissions; and handling of residues.
Oil/Water Separator	• Location of equipment used to separate oil from water; and • Manufacturer's specifications, dimensions.
Sewage Treatment Plant	• Location and size of the treatment plant; and • Manufacturer's specifications and other applicable information.
Waste Management	
Waste Minimization	• Procedures to minimize amount of packaging brought to site (e.g., bulk purchases, etc.)
Recyclable and/or Reusable Materials	• Materials that will be segregated for recycling or later reuse.
Off-site Transfer	• Materials that will be transferred off site for recycling or disposal; • Schedule, transport methods, receivers.

Burial	• Waste streams that will be buried, and procedures that will be followed.
Special Waste Management	
Special Waste Types, Sources and Amounts	Types, amounts and sources of special waste expected to be generated (e.g., oil and filters, diesel, gasoline, antifreeze, solvents, batteries, reagents, pesticides and containers).
Waste Handling and Storage	• Handling, storage and segregation procedures of special wastes; • Location; • Inventories, labelling; • Design of waste collection and storage areas, including any secondary containment or monitoring systems; and • Personal protective equipment or special precautions required for the handling of various types of special wastes.
Off-Site Transfer	• Types of special waste that will be transported off-site for disposal • Transfer methods and schedule.
On-Site Waste Disposal	• On-site disposal methods to be used for each type of special waste and handling of anticipated residuals.
Contaminated Materials	
Assessment	• Type, level and extent of contamination in any environmental media.
Treatment	• Method of treatment such as transfer offsite or on-site treatment facility; material segregation.
Sampling	• Methods for remediation work and confirmatory sampling in accordance with the requirements of the Contaminated Sites Regulation.

A waste monitoring and auditing program will be established for the Project, with the purpose of:

- Providing baseline data to enable continuous improvement of waste avoidance, reduction and management measures throughout the Project; and
- Assessing actual waste results and comparing with predicted results.

Monitoring of environmental media will be addressed in the Monitoring Plans (Section 23.0 of the Casino Proposal).

22.3.2 Hazardous Materials Management Plan

The objective of the Hazardous Materials Management Plan is to describe the transportation, storage, use, and handling of hazardous materials to ensure protection of the environment and human health and safety, both of mine employees and members of the public. Hazardous materials that will be used for the Casino Project include fuels (diesel and liquefied natural gas (LNG)), lubricants, solvents, antifreeze, explosives, and processing reagents, including cyanide. A separate Cyanide Management Plan will be developed and

implemented in recognition of the higher level of public concern associated with this substance; a template for the plan is provided as Appendix 22B.

The management of hazardous materials is governed by the *Dangerous Goods Transportation Act* as well as the Special Wastes Regulation and Storage Tank Regulations of the *Environment Act*. In addition, the *Occupational Health and Safety Act* pertains to this plan, especially the following sections:

- Employers must ensure that workers are aware of any hazard in the work and in the handling, storage, use, disposal, and transport of any article, device, or equipment, or of a biological, chemical, or physical agent (Section 3(2) (a));
- Employers must ensure that workers are informed of their rights, responsibilities, and duties under this Act (Section 3(2) (c));
- Duties of supervisors include proper instruction of workers and ensuring that work is performed without undue risk; ensuring that workers use applicable personal protective equipment; advising the worker of any known danger associated with the work; and providing written instructions on measures and procedures to be followed for the protection of the worker (Section 7);
- A worker has a right to refuse to do work that is believed to pose an undue hazard (Section 15); and
- Injuries and accidents include accidental release of a controlled product (Section 30(1) (i)).

The use, storage, and handling of hazardous substances are also governed by the Occupational Health Regulations and the Workplace Hazardous Materials Information System Regulations of the *Occupational Health and Safety Act*.

The final plan will include detailed information on:

- Hazardous material transport methods, routes, frequency, driver qualifications, spill kit requirements;
- Volumes and amounts of each material used, storage locations, containment measures (segregation, secondary containment, etc.), Material Safety Data Sheets;
- Employee training programs (e.g., Workplace Hazardous Materials Information System) related to proper handling techniques, use of personal protective equipment, and familiarity with the site layout and emergency stations;
- Site and substance-specific operating procedures describing unloading, mixing, plant operations, entry into confined spaces, and maintenance for reagents, including cyanide, to minimize risk to health and safety of mine personnel;
- Communication procedures between on-site and off-site personnel (suppliers, contractors, receivers);
- Personal protective equipment required for handling, transporting, storing all materials;
- Inspection measures and frequency;
- First aid equipment and first aid attendants;
- Monitoring and reporting requirements;

- Location of copies of the Spill Contingency Plan and Emergency Response Plan and how the plans will be implemented as needed as they relate to hazardous materials; and
- Waste disposal methods outlined in the Waste Management Plan.

The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation.

22.3.3 Wildlife Management Plan

The purpose of the Wildlife Mitigation and Monitoring Plan is to minimize effects to wildlife and wildlife habitat, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects given the final Project footprint. The plan is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader Project area, and reduce potential Project-related injury or mortality, while accounting for operational requirements and human health and safety requirements. The plan provides guidance to protect and limit disturbances to wildlife and wildlife habitat from Project activities.

The conceptual plan is provided in Appendix 22C. Detailed methods, cost estimates, and mitigation and monitoring schedule will be developed through continued discussion with the management agencies following approval of the Project.

22.3.4 Spill Contingency Management Plan

The objective of the Spill Contingency Management Plan is to minimize the potential effects of any spills associated with the Casino Project. While CMC will take all reasonable measures to prevent spills while undertaking the construction, operation and closure of the Casino Project, it is unlikely that all physical operations can attain zero risk. Unforeseen events, accidents and malfunctions can occur from time to time that may result in a spill. To minimize the effect of a spill and to prevent such spills from leaving the site, design features, background planning and diligent operational procedures are required. The Spill Contingency Management Plan will provide background planning and operational procedures for spills response to minimize:

- Danger to persons;
- Pollution of land and water;
- Size of the affected area;
- Degree of disturbance to the terrestrial and aquatic environments; and
- Degree of disturbance during cleanup.

The Spill Contingency Management Plan will provide specific guidance for the prevention, response, reporting and remediation of spills for the Casino Project. This section should be read in combination with relevant sections of the Emergency Response Plan, provided in Section 22.

The prevention of and response to spills in the Yukon is regulated under Part 11 of the *Environment Act* and in the Yukon Spills Regulations. These documents outline the definition of a spill, and what types and sizes of spills must be reported. Schedule A of the Yukon Spills Regulations defines reportable spill quantities in reference to hazardous material classes defined under the Transportation of Dangerous Goods Regulations.

The management of spill response is also governed by the *Occupational Health and Safety Act*. The *Quartz Mining Act* regulations and *Waters Act* regulations require a spill response plan as part of an application for a Quartz Mining License or a Water Use License.

A spill is defined under Section 132 of the Yukon *Environment Act* as a "release of a substance into the natural environment; from or out of a structure, vehicle or other container; and that is abnormal in quantity or quality in light of all the circumstances of the release; or in excess of an amount specified in the regulations". The following components of the Casino Project have the potential to generate a spill:

- The transfer, storage, and shipment of fuels (primarily diesel and LNG), waste, and other hazardous liquids;
- The storage, mixing, and distribution of chemical reagents associated with the heap leach facility;
- Release of water from the TMF; and
- Offsite release of sediment laden water from a construction zone.

The following components will be included in the Spills Contingency Management Plan:

- Spill categories: description of all fuels, chemicals and other materials (e.g., oils, solvents, antifreeze). Material safety data sheets for all substances will be appended;
- Spill prevention procedures: description of storage and handling procedures, designated areas, secondary containment requirements, fueling guidelines, etc.;
- Spill response plan:
  - Identification and location of all supplies and equipment available for spill responses;
  - List of all supplies contained in spill kits, any additional supplies that are in the kits at stationary caches, and the frequency which the supplies are inventories and replenished; Identify equipment available for responding to larger spills;
  - Containment protocols for each spillable material in soil, water, snow and ice;
  - Clean-up protocols for each spillable material in soil, water, snow and ice;
  - Description of how collected spilled material, used spill response equipment, and contaminated soil and snow/ice will be handled, stored and treated; and
  - Methods to assess whether all contaminated environmental media has been captured.
- Roles and responsibilities: description of the roles and responsibilities of various workers in the event of a spill and in clean-up and reporting;
- Training; description of the spill response training that all employees must take and the frequency of training;
- Internal and external reporting: a summary of all the reporting thresholds for chemicals and fuels used on site; description of how non-reportable spills will be handled and how these incidents will be recorded; description of the sequence of reporting that will be followed to ensure efficient and effective response occurs; contact information for agencies with which spill reports must be filed; and
- Monitoring: procedures to identify any leaks, spills, stains etc. in or around fuel, chemical and hazardous material storage and transfer areas; outline of responsibilities for site services staff

and environmental department staff with regard to inspections that will be carried out to identify if there are any leaks, losses, blockages, or other equipment issues; and identification of any intrinsic monitoring or alarm systems.

The Spill Contingency Management Plan will be designed to initiate an immediate strategic response with trained personnel and equipment to clean-up any accidental spill and ensure minimal impact to the land or aquatic environment in the immediate and surrounding area. The plan will be reviewed and updated as information changes over the duration of the Project. The review will include checks of all relevant contacts (confirmation of correct telephone numbers) and availability of spills response resources. This document will be amended or updated as required, to accommodate change in construction, operational procedures, regulations and guidelines.

22.3.5 Erosion and Sediment Control Management Plan

The objective of the Erosion and Sediment Control Management Plan is to control run-off, minimize erosion on exposed slopes and substrates, and prevent inputs of silt or sediment into watercourses during all phases of the Project. Erosion control measures are those designed to prevent exposed soil particles from becoming detached and transported by water or wind. Sediment is comprised of soil particles resulting from erosion; sedimentation is the deposition of the transported sediment. Best management practices will be the primary tool used to mitigate erosion and sedimentation risks. The Erosion and Sediment Control Management Plan will provide specific details on what types of erosion and sedimentation control measures will be used and where and when they will be applied. It will describe the requirements for inspection, cleaning, repair and ultimately removal of the erosion and sediment control measures.

The Erosion and Sediment Control Management Plan will describe the measures to be undertaken to manage erosion and sedimentation during all phases of the Casino Project. To achieve the objectives of the Erosion and Sediment Control Plan, CMC will:

- Comply with applicable federal and territorial legislation, Project permits, licences and approvals;
- Understand the potential for erosion to occur by identifying all potential erosion and sediment sources prior to undertaking any activities that will disturb ground;
- Adopt a multi-barrier approach for erosion and sedimentation control measures; and
- Inspect and maintain sedimentation control equipment and infrastructure, and remove once work is complete.

The protection of the natural environment and management of environmental risk from erosion and sedimentation in the Yukon is governed by the *Quartz Mining Act*, *Waters Act*, *Lands Act and Territorial Lands Act,* and the *Environment Act (*Yukon Environment 2011). Additionally, sediment and sediment laden water can be considered a deleterious substance under Section 34 of the federal *Fisheries Act*.

Guidance documents relevant to the topic include:

- Environmental Code of Practice for Metal Mines. Environment Canada. 2009;
- Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment (Guidelines for Canadian Drinking Water Quality, Recreational Water Quality, Protection of Aquatic Life, Agricultural Water Uses, as applicable); and

- Best Management Practices for Works Affecting Water in Yukon. Yukon Environment 2011.

Earth moving activities during construction or operation of the Casino Project which may result in erosion or sedimentation in watercourses include:

- Land clearing and topsoil stripping;
- Stockpiling of topsoil and ice-rich materials;
- Pit excavation, site grading, and land filling;
- Construction of roads, bridges, and culverts; and
- Construction of the TMF, waste rock dumps, and heap leach facility.

Potential adverse effects from erosion and sedimentation can be minimized through project planning, following BMPs, and providing site specific controls that are commensurate with the potential risks to the natural environment. The Plan will provide a detailed description of the methods of sedimentation and erosion prevention and control that will be used, the specific situations that they will be used in, and the implementation procedures that will be followed. The Erosion and Sediment Control Management Plan will include details regarding:

- The appropriate location of control measures;
- The timing of installation, inspection and maintenance of control measures; and
- The responsible parties for implementation, operation, modification, inspection and maintenance control measures.

The following BMPs will be followed as part of the Erosion and Sediment Control Management Plan:

- Adopt a multi-barrier approach to provide erosion and sediment control;
- Retain existing vegetation and stabilize exposed soils with vegetation where possible;
- Limit the duration of soil exposure and phase construction when possible;
- Limit the extent of disturbed areas by minimizing nonessential clearing and grading;
- Minimize slope length and gradient of disturbed areas;
- Delineate areas that are susceptible to erosion (e.g., silty soils, long steep slopes);
- Stockpile topsoil away from watercourses, drainage features, and tops of steep slopes;
- Ensure contractors and staff understand the objectives of the Erosion and Sediment Control Plan;
- Make the Erosion and Sediment Control Management Plan flexible and adaptable to different project areas, phases and risks; and
- Assess all erosion and sedimentation control measures before and after all significant rainfall and snowmelt events to ensure they are functioning as designed.

Monitoring of relevant water quality and sediment parameters in any receiving environment will be included as a component of the Monitoring Plans (Section 23.0 of the Casino Proposal). The frequency of erosion and

sedimentation control monitoring and receiving environment monitoring will be established following Project permitting in consultation with regulatory agencies.

22.3.6 Occupational Health and Safety Management Plan

The objective of the Occupational Health and Safety Management Plan is to ensure protection of mine employees, as well as members of the public. The plan will be implemented in conjunction with other component plans, including:

- Waste Management Plan;
- Hazardous Materials Management Plan;
- Wildlife Protection Plan;
- Traffic and Access Management Plan; and
- Spill Contingency Plan.

Occupational Health and Safety and public safety are governed by the following Yukon Acts:

- *Occupational Health and Safety Act;*
- *Environment Act;*
- *Public Health and Safety Act;*
- *Dangerous Goods Transportation Act;* and
- *Quartz Mining Act.*

The Occupational Health and Safety Management Plan will be developed in accordance with all applicable Acts and Regulations, as well as terms and conditions of all required licences, authorizations, and approvals. Key elements of the plan will include:

- Roles and responsibilities;
- Hazard identification and mitigation;
- Safe work practices and safe job procedures;
- Personal protective equipment;
- Safety orientation and training;
- Incident reporting procedures;
- Communication systems to convey health and safety information to employees and contractors to ensure that all employees are aware of all aspects of the Project health and safety management system, especially those aspects that directly affect their daily work tasks; and
- Monitoring and review for continuous improvement.

The final plan will include a table of commitments pertaining to health and safety arising from the environmental assessment review, and indicate how the commitments are addressed within the plan.

22.3.7 Heritage Resource Protection Plan

The objective of the Heritage Resources Protection Plan is to outline methods for avoiding, mitigating, reporting, and recovering any heritage resources that are found during development of the Casino Project, including the Freegold Road. To achieve this, CMC will:

- Design the Casino Project to avoid known or suspected cultural and historical heritage features, where possible;
- Establish clear procedures and actions to be followed in the event of a heritage resource discovery;
- Train staff and contractors on CMC heritage resource protection policies, and mandatory actions in the event of a discovery; and
- Train staff to identify and record potential heritage resource finds.

Key components of the Heritage Resources Protection Plan will include (Yukon Energy, Mines and Resources 2013):

- Heritage resource protection policy;
- Heritage resource overview;
- Summary of the heritage resource impact assessment conducted as part of this Proposal;
- Methods for identification, reporting, and protection of heritage resources;
- Reporting requirements and contact list; and
- Employee training.

The CMC heritage resource protection policy will be clearly stated within the Plan; the Plan will describe how the policy will inform and guide staff and contractor decisions relating to heritage resources.

Heritage resources in the Yukon are protected under the *Historic Resources Act.* Portions of the *Quartz Mining Act* and Land Use Regulations under the *Territorial Lands Act* also provide guidance on and restrictions for historical objects and burial grounds. The heritage resource overview will describe desktop and field assessments completed to identify landscape features and locations in the Project area that are likely to be associated with heritage resources, and any identified heritage resources. Heritage resources refer to sites or objects that have cultural or scientific value due to their archaeological, paleontological, ethnological, prehistoric, historic, or aesthetic features. Specifically, this refers to:

- Pre-contact archaeological sites, which include stone tools, butchered bones, and fire-cracked rock originating from occupation of Yukon by Aboriginal people before contact with European traders;
- Historical archaeological sites, which include structures, artefacts, or features that can be Aboriginal or non-Aboriginal and date from after the time of European contact; and
- Paleontological sites, which include fossilized prehistoric plants or animals, or evidence of prehistoric plants or animals such as leaf imprints or animal tracks (Yukon Tourism and Culture 2010).

Specific strategies related to the identification, reporting, and protection of heritage resources developed through the impact assessment will be summarized in a commitment table and incorporated into the final plan. The Heritage Resources Protection Plan will be developed in cooperation with members of the Selkirk and Little Salmon/Carmacks First Nations to understand and address specific cultural knowledge and values. The plan will reference the Handbook for the Identification of Heritage Sites and Features (Yukon Tourism and Culture 2007) and the Mineral Exploration Best Management Practices for Heritage Resources (Yukon Tourism and Culture 2010). General mitigation measures and BMPs to protect heritage resources include the following:

- Follow applicable regulations and policies for identifying, marking, and reporting any heritage resources found during Project construction, operation, and closure phases;
- Stop work if a heritage resource or suspected heritage resource is found;
- Record details about any discovery, including location, size, type, and specific features;
- Notify appropriate staff, managers, First Nations, and government agencies in the event of a discovery; and
- Inform crews on laws protecting Yukon heritage resources, including prohibition of removal of objects from heritage sites.

The Plan will outline the internal and external reporting structure to be put in place for the reporting of any heritage resources that were not located during previous assessments, including any requirements for confidentiality. The First Nation in which any heritage resources are discovered over the life of the Project will be involved in the monitoring, identification and recovery (if applicable) of heritage resources. Contact information for all mine personnel who will be involved in the reporting structure for heritage resources will be listed, as will all appropriate First Nations, Yukon Government and RCMP contacts. The Plan will also describe the training that will be given to all employees and contractors regarding the protection of known and newly identified heritage resources, and identify the frequency which this training is updated.

22.3.8 Air Quality Management Plan

The objective of the Air Quality Management Plan is to minimize impacts of mine-derived dust on sensitive receivers and minimize the Project's carbon footprint. To achieve this, CMC will:

- Comply with Yukon Air Emissions Regulations;
- Comply with National Ambient Air Quality Objectives (NAAQO)
- Implement energy minimisation initiatives;
- Recognize the potential effects of dust on terrestrial habitats and take steps to mitigate potential effects; and
- Inspect and maintain Project equipment and infrastructure.

Air quality in the Yukon is regulated under the Air Emissions Regulations of the *Environment Act*. Specific air quality objectives are provided by the Yukon Ambient Air Quality Standards, and by Health Canada under the *Canadian Environmental Protection Act* for parameters including: particulate matter, carbon monoxide, sulphur dioxide and nitrogen dioxide. If a material or chemical other than water is to be used as a dust suppressant, written approval must be obtained from Environment Yukon (Yukon Environment 2012). Additionally, an Air Emissions Permit may be required for the LNG Power Plant and the Incinerator.

The Air Quality Management Plan will outline the procedures to mitigate potential air quality effects though all phases of the Project. Dust and greenhouse gas emissions are potential air contaminants that will occur primarily during construction and operation of the mine. Guidance documents relevant to development of the plan include:

- Dust Management Plan Guidelines. Yukon Environment. 2012;
- Air Emissions Monitoring. Yukon Environment. 2010; and
- Environmental Code of Practice for Metal Mines. Environment Canada. 2009.

The following BMPs and mitigation measures related to air quality management recommended by the guidelines include:

- Applying dust suppressants;
- Paving roadways and work areas;
- Installing engineering controls such as dust covers or collection mechanisms;
- Setting vehicle speed limits within areas that could be affected by the generation of dust or reducing traffic by considering different scheduling and routing options;
- Implement a complaint management system to ensure that complaints are recorded and acted on promptly; and
- Maintain a record of dust suppression activities.

Project activities identified as potentially increasing ambient air emissions and mitigation measures to minimize effects on human health, vegetation, soil, and surface water quality presented in Section 8 are summarized in Table 22.3-3.

Table 22.3-2 Project Effects and Proposed Mitigation Measures

Potential Effect on Air Quality	Proposed Mitigation Measure
Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO,	Use construction equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.
	Institute a “no idling” policy for all equipment and vehicles.
	Use well maintained vehicles to minimize air emissions
Exceedance of Canadian Air Quality Objectives for TSP, dustfall, PM_{10} and $PM_{2.5}$	Cover or use water sprays at dust generating areas.
	Reduce drop heights for process plants.
	Minimize wind exposure at conveyors, drop-off points and truck load/unload locations
	Establish blasting procedures for open pit activities to minimize dust
Contribution to global greenhouse gases	Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance.
	Institute a “no idling” policy for all equipment and vehicles.

Monitoring of air emissions, including fugitive dust, will be conducted following procedures outlined in the Monitoring Plans (Section 23.0 of the Casino Proposal).

22.3.9 Road Use Plan

Casino Mining Corporation requires the upgrade and extension of the Freegold Road to the proposed mine site. The airstrip will also require the construction of an access road to connect it to the mine site. The airstrip access road will be a 14 km long single lane road. Road construction will require an application for a lease for the route in order to facilitate final engineering design and an application for a Land Use Permit for construction of the road.

The Freegold Road Extension will be a two-lane, gravel resource road designed for all weather use by haul trucks with highway legal loads. The road design criteria satisfies provincial road engineering guidelines for a 70 km/h design speed, with some short 50 km/h sections where terrain limits road geometry. The road will be 8.2 m wide with maximum grades of 8%.

The Yukon Government has statutory authority to impose license terms and conditions for the access road on Crown lands; one of these terms is a requirement for a management plan. Implementation of the management plan will become a commitment of CMC and an enforceable license requirement for the operators of the mine. First Nations governments also have statutory authority to enact laws and enter into agreements with respect to settlement lands and impose conditions, including a requirement for a management plan. It is the intent of CMC to negotiate a Freegold Road Extension Access Management Agreement with the Yukon Government, SFN and LSCFN to address how the private road and access control could be managed to meet the Project requirements with consideration of existing tenure holders and individuals. A framework for the Road Use Plan is provided in Appendix 22D; following Project approval the plan will be revised to include all license terms and conditions.

22.3.10 Metal Leaching / Acid Rock Drainage Management Plan

The objective of the ML/ARD Management Plan is to ensure that pit walls, waste rock and all ore stockpiles are managed to minimize the potential for generation of ARD and elevated ML. A final plan will be developed prior to construction to ensure that risks to the environment are minimized. The plan will identify the zones of potential ARD generating material that will be encountered during mining and describe measures for the handling and management of these materials. The Plan will be developed in accordance with the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (BC Ministry of Energy and Mines 1998). The Plan will include the following information:

- ML/ARD Prediction Testwork:
  - Geology
  - Minesite Hydrology and Water Chemistry
  - Static Test Results
    - ABA
    - Elemental Composition
    - More Refined Testing of Mineralogy, Particle Size and Other Properties
  - Kinetic Test Results
    - Humidity Cell
    - Site Drainage Monitoring
    - Characterization of Field Weathering
    - Field Test Pads

- Other Kinetic Test Information

- ML/ARD Prediction and Prevention Plan for Each Mine Component:
  - For each unique waste unit or mine component, the following must be described or provided:
    - Materials Handling and Deposition
    - Evaluation of ML/ARD Potential
    - Mitigation Measures including Contingencies
    - Ongoing Testwork and Planning
    - Waste Production and Facility Development Schedule

The plan will be a working document that allows for revisions and additions as mining progresses, and mitigation occurs. Paper and digitized copies of all raw data will be appended. Figures and tables will be clearly presented. Reports will specify all test methods and identify the laboratories which conducted the analytical work.

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23 CONCEPTUAL ENVIRONMENTAL MONITORING PLANS

23.1 INTRODUCTION

This section of the Proposal outlines the monitoring plans that will be developed for the Casino Project

23.2 ENVIRONMENTAL FRAMEWORK

Environmental protection through adherence to applicable legislation and Best Management Practices (BMPs) is considered an important component of constructing, operating and reclaiming the Casino mine and access road. Proper planning and implementation contributes to ongoing environmental site protection and greatly reduces the potential for adverse environmental effects. Mitigation measures such as delineation of environmentally and culturally sensitive areas, establishment of communications and reporting protocols, and implementation of environmental compliance monitoring and reporting programs will be integral to the program.

Casino Mining Corporation is committed to conducting its operations and activities in a manner that protects the natural and social environments, protects the environmental health and welfare of its employees and contractors, meets or exceeds requirements of all applicable environmental acts, regulations and permitting requirements, and keeps employees and the public informed about its environmental plans through its internal and external communication programs.

23.3 ENVIRONMENTAL MONITORING AND REPORTING PLAN

An Environmental Monitoring and Reporting Plan will be developed in accordance with the Plan Requirement Guidance for Quartz Mining Projects (Yukon Energy, Mines and Resources 2013) to monitor the predicted residual effects of the Project and the effectiveness of implemented mitigation measures. The Plan will identify any variances from predictions that occur and whether such variances require action, including any additional mitigation measures. The Plan will be comprised of the following components:

- Water Monitoring Program;
- Air Quality and Fugitive Dust Monitoring;
- Geochemical Monitoring Program;
- Meteorological Monitoring Program;
- Aquatic Monitoring Program;
- Permafrost Monitoring Program;
- Wildlife Monitoring Program; and
- Reclamation Monitoring Program.

The monitoring programs will encompass all phases of the mine life, from construction through post-closure. The monitoring program scopes will be developed based on the results of the environmental assessment review, and in accordance with terms and conditions of subsequent permitting processes, including those under the Yukon *Quartz Mining Act, Waters Act, Environment Act*, and federal *Fisheries Act*.

Site-specific environmental monitoring plans will be developed, implemented, and updated throughout the mine life, in accordance with Environment Canada (2009) guidelines. The monitoring plans will describe:

- Environmental monitoring and reporting required under regulation and permits, and committed to through the environmental assessment;
- Applicable environmental standards and environmental quality objectives;
- Design and objectives;
- Specific monitoring areas, locations, or stations;
- Schedules for monitoring activities;
- Sampling procedures, sample preservation requirements, and analytical methods, as applicable;
- Procedures for comparison of monitoring results against environmental standards and environmental quality objectives;
- Actions to be implemented when requirements set out in regulations or permits have not been met;
- Procedures for reporting results to regulatory agencies;
- Roles and responsibilities of key staff, for internal and external reporting of monitoring activities and results, as well as management of the Plan;
- Quality assurance and quality control (QA/QC) processes; and
- Procedures for reviewing and updating plans.

Each monitoring program will include a table of commitments for all environmental assessment and decision document terms and conditions, and outline how they have been addressed in the monitoring and reporting plan.

23.3.1 Water Monitoring Program

The water monitoring program for the Casino Project will include surface water and groundwater water quality and water quantity components.

23.3.1.1 Surface Water Quality

During the Operations Phase and at the start of the Closure Phase, monitoring under the Metal Mining Effluent Regulations (MMER) for effluent characterization (chemistry, acute and chronic toxicity tests) and the associated Environmental Effects Monitoring (EEM) for receiving environment conditions (fish populations, benthic invertebrate conditions, water and sediment quality), is required. Results from these monitoring programs will be used to confirm predictions made regarding downstream effects to water quality and aquatic biota. The proposed water quality, sediment quality, and aquatic biota monitoring program for EEM is described in Section 23.3.5.

An operational surface water quality monitoring program will be developed and implemented to track the residual effects of the Project on water quality in nearby watercourses to assess whether the mitigation measures are functioning as predicted. The potential effects on water quality identified were change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage, project discharge, blasting residues, atmospheric deposition during operations and change in surface water quality from increased erosion and sedimentation, primarily during construction. Effective implementation of the site water management plan and Best Management Practices were identified as mitigation measures.

Surface water quality monitoring will be conducted at stream sites downstream of the Project and from collection ditches or ponds associated with the following components:

- Waste rock dumps, overburden stockpiles, topsoil stockpiles;
- Open Pit;
- Heap Leach Facility Leak Detection Recovery System;
- Tailings Management Facility.

23.3.1.2 Hydrology

The objective of the hydrology data collection program is to continue to monitor water surface flow (seasonal and annual patterns) in the Project area to support water management measures, refine the water balance, and inform water quality modeling. Surface water flow monitoring will be continued at established stations. Ten hydrometric monitoring stations have been operated in the Project area at various times since 2008, with three located in the Canadian and Britannia Creek watersheds and seven in the Casino and Dip Creek watersheds. Station W16, located on lower Dip Creek, is the largest watershed of the Project gauging stations, at 384 km^2. Stations W18 and W11, located in the upper part of Casino Creek sub-watershed, are the smallest gauged watersheds, at 25 km^2 and 39 km^2, respectively. The monitoring plan will detail flow measurement. Water level will be recorded continuously with a pressure transducer and datalogger at automated stations, with discharge measurements conducted at a range of flows during scheduled site visits. Each site visit will include downloading stage data from dataloggers, conducting discharge measurements, recording gauge height, recording observations of the hydraulic control. Bench marks will be surveyed on as-needed basis and following spring freshet to verify staff gauge elevations and calibrate gauging instruments.

23.3.1.3 Hydrogeology

Baseline water quality was characterized for the proposed Open Pit area, the hillslope area, and the Casino Creek valley area. Water quality samples were collected from 20 groundwater quality monitoring wells that were strategically installed in the vicinity of and downgradient of key proposed project facilities, which include the Waste Rock and Ore Stockpiles, Open Pit, TMF, and Heap Leach Facility (HLF). Monitoring during operations and during post-closure will continue at the same sites.

Groundwater level measurements will be used to monitor any changes in groundwater direction and quantity from baseline conditions. Groundwater quantity monitoring will include monitoring wells and peizometers up gradient and down gradient of Project components.

For all programs, the sampling frequency, reporting requirements as outlined in any permits, licences, or approvals and response measures for surface and groundwater quality and quantity will be outlined. The parameters that will be monitored will be defined both for field monitoring activities (in situ) and laboratory activities. Results will be compared to baseline values as well as applicable federal guidelines to determine if there is a change in water quality as a result of mine activities. Detailed QA/QC procedures will be provided, and will include calibration and validation of field measurement equipment as well as sampling QA/QC measures. Data will be reviewed to update loading assumptions in the site water balance and water quality models, verify assumptions, and inform the site closure plan.

23.3.1.4 Incident Monitoring

Monitoring required as a result of spills or leaks to water will be outlined in the Emergency Response Plan. Monitoring procedures, locations, number of samples, sampling frequency, and parameters to be analyzed will be site and incident specific.

23.3.2 Air Quality and Fugitive Dust Deposition Monitoring Program

Some permits issued under the Yukon Air Emissions Regulations require monitoring of contaminants released to the air. Monitoring requirements are based on the results of the air quality assessment, existing air quality regulations, Project permits, and commitments detailed in the Project Proposal. The study design will be developed in consideration of the Air Emissions Regulations Air Emissions Monitoring (Yukon Environment 2010) and Air Emissions Regulations Dust Management Plan Guidelines Yukon Environment (2012). The following parameters will be monitored:

- Dustfall: construction and operation
- Nitrogen oxides (NOx): construction and operation
- Suspended Particulate Matter (PM_{10} and $PM_{2.5}$): operations

Monitoring locations will be established based on the prevailing wind patterns identified in the baseline climate program.

A total of five Dustfall monitoring sites will be established: one near-field (“fenceline”) site 500 m from the Project disturbance area at each dominant wind direction (South and North-East) and one far-field site 500 m from the first along the same tangent (South and North-East). A fifth site will be established to the west of the TMF and HLF. Dustfall canisters will be exchanged monthly and sent to an accredited laboratory for analysis of soluble materials, insoluble materials, and total metals.

The NOx passive samplers will be co-located with the near-field Dustfall stations. The samplers will be exchanged monthly and sent to an accredited laboratory for analysis. National Air Pollution Surveillance (NAPS) program

Suspended particulate matter will be monitored during operations using a High-Volume sampler located in the North-East area of the mine site near the accommodations camp. Methodology will be in accordance with the National Air Pollution Surveillance (NAPS) program, with a nominal sampling period of 24 hours every 6 days. Filter samples will be analyzed for trace elements and major ions.

All data will be summarized and compared to applicable guidelines in an annual air quality compliance report.

23.3.3 Acid Rock Drainage/Metal Leaching Monitoring Program

The objective of the Geochemical Monitoring Program is to provide on-going characterization of rock excavated during construction and operation to confirm the results of the Metal Leaching (ML) and Acid Rock Drainage (ARD) assessment.

Natural sources of ARD were found to exist near the mineral deposit, with effects seen most clearly in Proctor Gulch, a tributary of upper Casino Creek. Elevated metal concentrations and high acidity from Proctor Gulch are major contributors to the existing chemistry in the surface waters of Casino Creek. Other sources of natural ARD include groundwater that flows directly into upper Canadian Creek (a tributary to Britannia Creek) and groundwater that discharges from an historical adit via a pipe to upper Meloy Creek,

which flows into Casino Creek. Surface water quality monitoring will document the water chemistry in these creeks during operations.

The majority of rock that will be excavated at the Casino mine site is considered Potentially Acid Generating (PAG) and/or has a high ML potential. Management of mine waste has been designed to mitigate the ARD/ML potential of these rock types. A few facilities are expected to produce acidic to mildly acidic drainage that will require management during mine operations. Acidic drainage is predicted for ore stockpiles containing supergene ore. Mildly acidic drainage is predicted from the gold ore stockpile, and from waste rock stored in the TMF early in mine life before significant quantities of hypogene waste rock are produced. Tailings are not predicted to have acid generating potential as the sulphide will be removed from the bulk rougher tailings and tailings sands used to construct the embankment. The pyrite concentrate produced from the sulphide removal process will be deposited sub-aqueously in the centre of the TMF to prevent ARD. None of the mine waste facilities are predicted to produce ARD after closure; however, portions of the sub-aerially exposed pit wall could be a source of continued acid generation.

Operational monitoring is required to:

- Verify/validate geochemical predictions made during the mine planning phase;
- Fill information gaps;
- Guide handling and depositional procedures;
- Support aspects of the mine closure plan; and
- Evaluate the effectiveness of mitigation measures.

The program will include testing of overburden, waste rock, low grade ore, tailings, heap leach residuals, and pit walls during the operations phase. The surface water quality and groundwater quality monitoring programs will monitor watercourses in the surrounding environment to ensure that the mitigation measures are functioning as designed.

The Geochemical Monitoring Program will include:

- Field and laboratory geochemical characterizations tests of exposed or mined materials (assays, ICP scans, etc.);
- Predictive tests including humidity cells, leach columns, field test pads or bins, pit or mine wall washing stations, and kinetic tests to monitor the acid rock or metal leaching potential of exposed and residual materials; and
- Field validation tests of placed materials (e.g., tailings) to monitor physical and geochemical properties over time, including in situ density, hydraulic conductivity, leachate quality, and the development of secondary minerals.

Operating mines are required to maintain a detailed inventory of the location, mass and ML/ARD potential of all wastes and exposed materials. This information will be regularly updated and readily accessible to guide site management and regulation. The inventory will include the following information:

- Composition, mass, volume, surface area and storage locations of all materials excavated, exposed or disturbed;
- Materials handling and mitigation;

- Figures showing the locations of materials, mine components, ML/ARD mitigation and site drainage features and
- Progress of material weathering.

An annual (or other regular reporting period as determined by license requirements) report will be prepared summarizing the above information and the results of all on-going geochemical tests. This information will be supported by the results of other monitoring programs as necessary to interpret any results, including hydrology monitoring, hydrogeological monitoring, and water quality monitoring.

23.3.4 Meteorological Monitoring Program

Ongoing meteorological data are required to verify design assumptions for water management systems, and the operation of the heap leach facility and cyclone plant. The climate station installed near the Casino exploration camp at an elevation of (1,200 m) will be maintained throughout the life of the Project. The Meteorological Monitoring Program will include a summary of the measured parameters, including:

- Air temperature;
- Rainfall;
- Wind speed and direction;
- Relative humidity;
- Barometric pressure; and
- Snow depth.

The plan will compare the collected data with the predictions for extreme events or for performance predictions; results will be used to revise operational procedures as necessary. The results will also be used in the air quality monitoring

23.3.5 Aquatic Monitoring Program

The Aquatic Monitoring Program will be developed in accordance with Water Use Licence conditions under the *Water* Act and considering the MMER of the *Fisheries Act*. The objective of EEM under the MMER is to identify effects on fish or fish habitat caused by mine effluents. Effluent (which includes seepage and surface drainage) and water quality monitoring studies will be included in the Water Monitoring Program.

The aquatics monitoring portion of the EEM program will be established in accordance with the MMER; annual biological assessment will include the following three main components:

- Fish and fisheries resources;
- Benthic invertebrate community surveys; and
- Sediment monitoring.

The requirement for sublethal toxicity testing (e.g., phytoplankton, zooplankton, benthic invertebrates, fish, macrophytes) as part of the fisheries resources component will be discussed with relevant regulatory authorities.

Prior to Project operation, a study design will be developed and will describe, for each of the aquatic monitoring components:

- Objectives of the field monitoring program, including overall approach and rationale for biological monitoring;
- Statistical design criteria, hypotheses, statistical methods and data needs;
- Description of the biological monitoring studies to be conducted to determine if there are effects, taking confounding influences into consideration;
- Field sampling plans outlining parameters or indicators to be measured; location of exposure and reference sites, and rationale for selection;
- QA/QC measures; and
- Field monitoring and interpretative report submission schedules.

The fish and fisheries resources component of the Aquatic Monitoring Program will provide detailed information regarding fish species and indicators to be used; sampling methods; timing of sampling; QA/QC procedures; tissue sample collection and analysis; and data entry and analysis.

Backpack electrofishing and minnow trapping will be used to capture fish and Catch Per Unit Effort (CPUE) will be calculated and compared to baseline results. Individual fish data (species, length, weight) will be collected to infer fish community composition, relative abundance, and life history use. Ageing structures (scales, otoliths) and fish tissues will be collected from a sub-sample of resident fish species and analyzed to determine fish ages and metal concentrations.

To support the benthic invertebrate survey, sediment samples will be collected, where conditions permit, and assessed for particle-size distribution, total organic carbon, and metals. The purpose of the sediment monitoring program is to determine if habitat differences are contributing to effects in the benthic invertebrate community, if effects are noted between control and reference sites. The sediment monitoring study design will include information on sampling device; number of samples; sample site locations; sample depth and volume; and QA/QC measures. The sample site locations will generally be the same as the 21 stations monitored during the 1993 to 1995 and 2008 to 2012 baseline programs in order to compare results. Sampling sites for the proposed water quality, sediment quality, and aquatic biota monitoring program will vary based on project phase. The following sampling locations are recommended at each stage of the project:

- Operation Phase (years 1 – 22):
  - Monitoring at sites H18 and W4 in Casino Creek, site W5 in Dip Creek, and downstream of site W7 in Canadian Creek.
- Closure Phase I (years 23 – 30):
  - Monitoring at sites H18 and W4 in Casino Creek, site W5 in Dip Creek, and downstream of site W7 in Canadian Creek.
- Closure Phase II and III (years 31 – 113 and 114+):
  - Monitoring downstream of the TMF in the WSMP, the inlet to the TMF Closure Spillway, and the mixing point of the two discharges.
  - Monitoring at sites H18 and W4 in Casino Creek, W18 in Bryneslon Creek, sites W5, W9 and W16 in Dip Creek, reference site R2 in Victor Creek, and downstream of site W7 in Canadian Creek.

The proposed water quality, sediment quality, and aquatic biota monitoring program will contain each of the following elements that will be consistent for each project phase:

- Water and sediment quality monitoring for metals, cyanide, nutrients, and general physical and chemical parameters consistent with the methods employed for the baseline studies;
- Aquatic biota monitoring for fish population, fish tissue, and benthic communities (sediment, benthic invertebrates, and periphyton) consistent with the methods employed for the baseline studies;
- Monitoring frequency will be determined through permitting and licencing, but will likely include daily monitoring for effluent during the initial discharge period and then decreasing to monthly thereafter, monthly for receiving environment water quality during Operations and Closure Phase 1, and a one to three year cycle for aquatic biota sampling; and
- Monitoring will continue until it has been determined that closure methods are functioning as predicted and resulting in acceptable effluent and receiving water quality in Casino Creek relative to water quality objectives.

23.3.6 Permafrost Monitoring Program

Permafrost is widespread but discontinuous in the northern Dawson. Permafrost is close to ground surface at summits and ridgelines. Vegetation cover on upper slopes, north-facing slopes and colluvial aprons is indicative of a generally shallow permafrost table. The Terrain Hazard Assessment conducted for the Project sit found evidence of ‘natural’ permafrost degradation as well as degradation due to anthropogenic processes. Regionally, thaw lakes, thermokarst depressions, thermal erosion gullies and thaw slumps provide evidence of possible permafrost degradation. Several possible thaw lakes were identified on the alluvial terrace in the area to the west of the confluence of Britannia Creek with the Yukon River. In many cases, there was no clear association between the permafrost degradation observed and anthropogenic processes. Permafrost degradation features noted along the road alignment could be partly anthropogenic in nature.

Significant uncertainty can be expected regarding the baseline rate of permafrost degradation and the extent to which it is anticipated to be affected by anthropogenic processes. Permafrost degradation can result in slope instability and enhanced erosion and sediment delivery to watercourses. Currently permafrost conditions are measured at the Casino Project site to provide in situ information for mine design. In all areas of known or suspected ice-rich soil, design solutions and construction methodologies will be assessed that mitigate possible permafrost degradation. Some non-anthropogenic permafrost degradation is anticipated; therefore the site permafrost monitoring program will be maintained during construction and operations.

To support the Project design ground temperature data are currently being collected at a number of locations across the site using thermistor strings and data loggers installed in vertical drillholes. Two additional thermistor strings were installed in 2013 at the location of the proposed air strip.

The permafrost monitoring program for operations will include:

- Quarterly monitoring of key control and impact area thermistors to assess trends in temperature changes in the permafrost adjacent to and down-gradient from mine components;
- Survey monuments; and
- Sub-permafrost groundwater level monitoring using piezometers.

The number and location of monitoring sites will be addressed in the final plan.

23.3.7 Wildlife Monitoring Plan

The Wildlife Management Plan (Section 22) summarizes potential Project effects and mitigation measures committed to by CMC. A wildlife monitoring program will be established during construction and maintained throughout all phases of the mine to assess the effectiveness of these mitigation measures. This plan will be based on the recommendations and commitments provided in the Project Proposal and on input from regulatory agencies during the Project licensing phase. An outline of the monitoring plan is provided in Appendix 23A and described briefly here.

Monitoring will occur on and in areas adjacent to the Project footprint (Facilities Monitoring) and within the Regional Study Area (Focal Species Monitoring).

The Project facilities will be monitored on a frequent basis to determine whether effects are occurring and if mitigation is adequate. Project facilities monitoring will include:

- Footprint assessment: measure the evolving Project footprint and compare the area prediction in the Project description.
- Building assessment: observe use of buildings by nest predators, nesting structures, or as a haven for potential problem wildlife.
- Road monitoring: Reported observations of wildlife along the road, report on mitigations required. Report on follow-up investigations to wildlife-vehicle collisions and management actions. Report on traffic volumes and public access.
- Nest monitoring: Raptor nests adjacent to disturbance area and active migratory bird nest surveys – survey areas that must be cleared 01 May to 31 July.
- Incidental human activity reporting: record of non-Project-related human activity in project area that may have interacted with wildlife. Data includes location, date, time, type of activity, number of people.
- Incidental wildlife reporting: Observation sheets placed throughout Project facilities encouraging personnel to record wildlife sightings. Data includes location, date, time, species, activity, etc.
- Waste area monitoring: Observations of wildlife use and mitigation actions taken to deter wildlife use.
- Exotic invasive plant species: Regular botany surveys and observations within disturbance area throughout life of Project.
- If water quality monitoring results exceed acceptable standards, wildlife monitoring in the vicinity of TMF will be triggered.

Results of Facilities monitoring program will be reported annually, or as required by regulatory agencies; successive reports will include a review of previous years' data to detect trends in wildlife occurrences and results of mitigation actions.

Focal species monitoring will continue to be conducted to enhance baseline information, as a surveillance of occurrence in the Project area, and as ongoing monitoring efforts to validate Project effects predictions. The following species will be included in focal species monitoring:

- Vegetation will be monitored during Project construction, operation, and closure. Operational Monitoring will occur every five years and will focus on invasive species and vegetation health in the vicinity of the Project and at control sites within the RSA for comparison;
- Cliff-nesting raptors: occupancy and productivity;
- Klaza caribou herd: distribution and habitat use in the Project area (10 km radius of mine and road);
- Moose: distribution and habitat use in the Project area (10 km radius of mine and road);
- Grizzly bear, black bear, and wolf dens: activities relative to distance from the disturbance area; and
- Collared pika: continued presence in the Project area.

Adaptive management actions that will be employed to address any negative effects on wildlife will be described.

23.3.8 Reclamation Monitoring Program

A monitoring plan to assess the effectiveness of reclamation and closure strategies will be implemented by CMC to provide the framework for progressive and closure reclamation activities, as required in the Yukon Mine Site Reclamation and Closure Policy (Yukon Energy, Mines and Resources 2006). The primary objective of the mine closure and reclamation initiatives will be to achieve physical and geochemical stability of the reclaimed mine components. Progressive reclamation activities and monitoring with respect to the effectiveness of mitigation measures will be conducted and reported on annually to Yukon Energy, Mines and Resources during operations.

Progressive reclamation activities could include:

- Contouring and vegetation of waste rock and overburden piles; re-slope, contour, or construct ramps on waste rock and overburden piles to facilitate wildlife access if wildlife habitat is the end land use;
- Closing borrow sites by re-contouring to establish drainage patterns and topography consistent with the surrounding landscape;
- Closing water management facilities such as ditches and settling ponds that are no longer required; and
- Landfill closures.

Monitoring of progressive reclamation activities in many cases will overlap with other components of the Environmental Monitoring and Reporting Plan, such as:

- Re-vegetation monitoring;
- Water monitoring downstream of reclaimed structures;
- Stability analyses (permafrost degradation);
- Metals uptake in vegetation monitoring (on re-vegetated sites); and
- Geochemical monitoring on waste rock and overburden piles to confirm predictions.

Monitoring of closure reclamation activities will comprise the following:

- A water quality monitoring program will be initiated at the start of pit flooding to validate the predictions of water quality and identify if any changes are required in order to achieve the passive care closure scenario.
- Following processing of the supergene oxide ore in Year 22 the groundwater seepage mitigation system will be operated until monitoring shows that groundwater seepage water quality is acceptable.
- Following removal of low grade ore and contaminated material from the footprint of the stockpiles, the surface will be covered with topsoil salvaged during mine development, and re-vegetated: vegetation recovery will be monitored.
- A HLF water quality monitoring and seepage detection program will be in place during operations and into closure to determine when cyanide concentrations have reached acceptable levels to discontinue use of the cyanide treatment plant;
- Monitoring of draindown water from the HLF; a bio-reactor will be designed for selenium removal; if post-draindown seepage monitoring shows elevated selenium, then the bio-reactor will remain in place to treat seepage before it flows into the TMF.

Monitoring of the site will be required during the post-closure period; the conceptual closure and reclamation plan (Appendix 4A) describes two basic types of maintenance activities that will occur during this period:

- Active Care: pumping and treating contaminated drainage, which will require continuous and ongoing site presence and activity during the initial years of closure.
- Passive Care: monitoring (environmental or geotechnical) and maintenance as necessary (repairs to spillways, covers, wetlands). This phase will require regular or infrequent site presence.

The mine plan has proceeded through several iterations in design, with the ongoing input of mine designers, geologists/geochemists, water quality specialists and mine closure experts, to ensure that post-closure active care is not required by minimizing potential impacts during and following operations.

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24 – CONCLUSION

The development of the Casino Project Proposal has relied upon many years of study, analysis, interpretation, and consultation in order to present findings with a high degree of understanding. The content and format of the Proposal was guided by input from YESAB, as well as from First Nations and other stakeholders. The Proposal is in accordance with the requirements specified in paragraph 42(1) of the *Yukon Environmental and Socio-economic Assessment Act*.

Fourteen Valued Components were identified and assessed with due consideration of the temporal and geographic boundaries. Wherever possible, impacts to each VC were eliminated or reduced through Project design. Where this proved unfeasible, mitigation was proposed such that none of the identified residual adverse effects were assessed as Significant. A summary of the effects assessment for each Valued Component is provided in Table 24.1-1. An analysis of potential Accidents and Malfunctions likewise revealed no areas of High Risk to any of the identified Valued Components.

Several positive effects were identified, including employment opportunities with an expected $43 million in annual wages during operations. It is anticipated that approximately $274 million of the Yukon GDP will be generated by the Casino Project.

Casino Mining Corporation believes that the Project will be developed and operated in an environmental and socially acceptable manner. As the Project progresses, CMC will uphold its commitments to undertake comprehensive monitoring and management to ensure avoidance of unacceptable project effects. A summary of the commitments upon which the Proposal relies is provided in Table 24.1-2.

Table 24.1–1 Summary of Effects Assessments

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
Surficial Geology, Terrain, and Soils												
	Loss of or damage to terrain features. (C, O, CD)	Avoidance, realignment, minimize footprint	Yes	Adverse	High	Localized	Permanent	Infrequent	Irreversible	Low Resilience	High	Not significant
	Covering terrain features. (C, O, CD)	Avoidance, minimize footprint	Yes	Adverse	Medium	Localized	Permanent	Infrequent	Irreversible	Low Resilience	High	Not significant
Water and Sediment Quality												
	Change in surface water quality in Casino Creek and Dip Creek from unrecovered seepage. (O, CD)	Water management pond will intercept 90-95% of seepage and pump it back to the TMF	Yes	Adverse	Medium	Local	Short term	Frequent	Irreversible	Low Resilience	Moderate	Not Significant
	Change in surface water quality in Casino Creek and Dip Creek from project discharge. (PC)	Water Management, including a Reclamation Plan (i.e. Construction of two engineering wetlands: North TMF wetland and South TMF wetland, construction of a WSMP to contain seepage during December to April and release during higher flows)	Yes	Adverse	Medium	Local	Permanent	Frequent	Irreversible	Low Resilience	High	Not Significant
Air Quality												
	Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the mine site. (C, O, CD)	Adherence to Occupational Health and Safety Act Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance. Institute a “no idling” policy for all equipment and vehicles.	Yes	Adverse	High	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Exceedance of Canadian Air Quality Objectives for PM_{10} at the mine site. (C, O, CD)	Adherence to Occupational Health and Safety Act Cover or use water sprays at dust generating areas. Reduce drop heights for process plants.	Yes	Adverse	Medium	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the mine site. (C, O, CD)	Adherence to Occupational Health and Safety Act Cover or use water sprays at dust	Yes	Adverse	Medium	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
		generating areas. Reduce drop heights for process plants.										
	Exceedance of Yukon Ambient Air Quality Standards for NO_2 at the road. (C, O, CD)	Use construction equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance. Institute a “no idling” policy for all equipment and vehicles. Use well maintained vehicles to minimize air emissions	Yes	Adverse	High	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Exceedance of Canadian Air Quality Objectives for PM_{10} at the road. (C, O, CD)	Minimize land disturbance, grubbing and clearing activities Water unpaved portions of the road to minimize fugitive dust.	Yes	Adverse	Low	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Exceedance of Canadian Air Quality Objectives for $PM_{2.5}$ at the road. (C, O, CD)	Minimize land disturbance, grubbing and clearing activities Water unpaved portions of the road to minimize fugitive dust.	Yes	Adverse	Low	Local	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Contribution to global greenhouse gases. (C, O,CD)	Use construction and mining equipment that meets the latest applicable Canadian emissions standards. Ensure regular equipment maintenance. Institute a “no idling” policy for all equipment and vehicles.	Yes	Adverse	Medium	Widespread	Long Term	Frequent	Reversible	High Resilience	High	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
Noise												
	Increase in baseline noise level conditions during construction. (C)	Ensure regular equipment maintenance, including lubrication and replacement of parts. Keep noisy equipment inside of buildings and sheds whenever possible. Equipment will be operated with covers, shields, and hoods if provided by their manufacturer. Site workers will be trained in proper machine use and maintenance.	Yes	Adverse	Medium	Localized	Short Term	Frequent	Reversible	High Resilience	High	Not Significant
	Increase in baseline noise level conditions during operations. (O)	Ensure regular equipment maintenance, including lubrication and replacement of parts by following manufacturer's recommendations. Keep noisy equipment inside of buildings and sheds whenever possible. Adhere to a blasting plan developed by an explosives contractor that implements controlled blasting procedures. Optimisation of blasting operations by licensed staff which maximise localised rock breakage within the ore body of interest, while minimising non-productive noise, vibration and fly rock effects. Impose speed limits for all vehicles. Implement a "no idling" policy for mobile equipment. Wherever practicable, noisy equipment will be located near ground level to minimize noise propagation.	Yes	Adverse	Medium	Localized	Long Term	Infrequent	Reversible	High Resilience	High	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
Fish and Fish Habitat												
	Non-fish-bearing in-stream habitat loss and riparian habitat loss at airstrip access road crossings. (C)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Fish-bearing in-stream and riparian habitat loss within the airstrip footprint. (C)	Fish habitat compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration within airstrip footprint. (C)	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Direct mortality of perphyton, benthic invertebrates, and fish eggs due to infilling within the airstrip footprint. (C)	Fisheries working windows to avoid destroying incubating fish eggs.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation within the airstrip footprint. (C, O, CD, PC)	Sediment and erosion control plan, fisheries working windows, fish salvage, modify culvert and bridge design for areas with increased sensitivity to disturbances, airstrip diversion channel.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation within the airstrip footprint. (C, O, CD, PC)	Sediment and erosion control plan, fisheries working windows, fish salvage, modify culvert and bridge design for areas with increased sensitivity to disturbances, airstrip diversion channel.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity within the airstrip footprint. (C, O, CD, PC)	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
	Non-fish-bearing in-stream and riparian habitat loss within the open pit footprint in upper Canadian Creek. (O)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to loss of surface drainage to the open pit. (O)	Fish habitat compensation for usable Arctic grayling habitat loss.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration in Canadian Creek Diversion. (O, CD)	Sediment and erosion control plan	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Non-fish-bearing habitat loss (e.g., nutrients, food) in upper Canadian Creek. (CD)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Reduced stream flows, nutrients, food, woody debris in lower Canadian Creek due to decommissioning of the Canadian Creek Diversion. (CD, PC)	Fish habitat compensation for usable Arctic grayling habitat loss.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation in due to the Canadian Creek Diversion. (O, CD)	Sediment and erosion control plan.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Direct mortality of periphyton, benthic invertebrates, and fish eggs in the Canadian Creek Diversion due to infilling in the open pit footprint, and loss of habitat area downstream following reduced stream flows due to the Canadian Creek Diversion. (O, CD)	Fisheries working windows to avoid destroying incubating fish eggs.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation due to the Canadian Creek Diversion. (C, O, CD, PC)	Sediment and erosion control plan.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity due to the Canadian Creek Diversion. (C, O, CD, PC)	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
	Sub-lethal impacts (e.g. stress, habitat avoidance) on fish and incubating eggs from Drilling and Blasting (Noise, Fly Rock, Vibration). (C)	Adhere to DFO guidelines for The Use of Explosives In or Near Canadian Fisheries Waters	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Fish-bearing in-stream and riparian habitat loss in lower Britannia Creek due to Fish Habitat Compensation Construction. (C)	Fish habitat compensation for usable Arctic grayling habitat loss.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration due to Fish Habitat Compensation Construction. (C)	Sediment and erosion control plan.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to diversion of lower Britannia Creek. (C)	Fisheries working windows to avoid destroying incubating eggs.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from Fish Habitat Compensation Construction. (C)	Sediment and erosion control plan, fisheries working windows, fish salvage	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from Fish Habitat Compensation Construction, (C)	Sediment and erosion control plan, fisheries working windows, fish salvage	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant

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				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity from Fish Habitat Compensation Construction. (C, O, CD, PC)	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings due to Freegold Road Extension. (C, O)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration due to Freegold Road Extension. (C, O, CD)	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Direct mortality of periphyton and benthic invertebrates due to infilling from construction of the Freegold Road Extension. (C)	Minimize disruption of fish food production by installation culverts on non-fish bearing streams only.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from the Freegold Road Extension. (C, O, CD)	Sediment and erosion control plan, fisheries working windows, modify culvert and bridge design for areas with increased sensitivity to disturbances.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from the Freegold Road Extension. (C, O, CD)	Sediment and erosion control plan, fisheries working windows, modify culvert and bridge design for areas with increased sensitivity to disturbances.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity from the Freegold Road Extension. (C, O, CD)	Monitoring of fish habitat to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant

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				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Non-fish-bearing in-stream habitat loss and riparian habitat loss at Freegold access road crossings due to Freegold Road Upgrade. (C)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration due to Freegold Road Upgrade. (C, O, CD)	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling from construction of the Freegold Road Upgrade. (C)	Minimize disruption of aquatic biota by installing culverts on non-fish bearing streams only. Fisheries working windows to avoid destroying incubating fish eggs around Nordenskiold Bridge.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from the Freegold Road Upgrade. (C, O, CD)	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances. For the Nordenskiold Bridge installation: fisheries working windows, fish salvage.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from the Freegold Road Upgrade. (C, O, CD)	Sediment and erosion control plan, modify culvert and bridge design for areas with increased sensitivity to disturbances. For the Nordenskiold Bridge installation: fisheries working windows, fish salvage.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity from the Freegold Road Upgrade. (C, O, CD)	Monitoring of fish habitat to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Low	Not Significant
	Fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek due to TMF construction. (C)	Fish habitat compensation.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Non-fish-bearing in-stream and riparian habitat loss within TMF footprint in mid-upper Casino Creek due to TMF construction. (C)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Increased erosion and sedimentation causing habitat loss and alteration due to TMF construction. (C)	Sediment and erosion control plan.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Medium	Not Significant
	Change in water temperature in lower Casino Creek due to reduced flows from TMF construction and operation. (C, O)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Long term	Frequent	Reversible	High resilience	Medium	Not Significant
	Reduced stream flows, nutrients, food, woody debris in lower Casino Creek due to the TMF. (C, O, CD, PC)	Fish habitat compensation for usable Arctic grayling habitat loss.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Change in stream morphology from flow decreases due to TMF construction and operation. (C, O)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Long term	Frequent	Irreversible	High resilience	Medium	Not Significant
	Change in water temperature in lower Casino Creek due to release of TMF pond. (CD, PC)	No mitigation required, refer to Section 10.4.3 (Significance of Residual Effects) for details.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	High resilience	Medium	Not Significant
	Increased stream flows due to TMF closure spillway. (CD, PC)	Modification of closure spillway location, magnitude and timing.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Change in stream morphology from flow increases due to the TMF. (CD, PC)	Site-specific fluvial geomorphology studies.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling and reduction of wetted habitat area from TMF construction. (C)	Fisheries working windows to avoid destroying incubating fish eggs.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant

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	Lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from TMF construction. (C)	Sediment and erosion control plan, fisheries working windows, fish salvage.	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Lethal effect of change in water quality due to the TMF. (O, CD, PC)	Water Management, including a Reclamation Plan (i.e. construction of two engineering wetlands: North TMF wetland and South TMF, construction of a Winter Seepage Mitigation Pond to contain seepage during December to April and release during higher flows).	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows due to the TMF. (C, O, CD, PC)	Monitoring of biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to increased erosion and sedimentation from TMF construction. (C)	Sediment and erosion control plan, fisheries working windows, fish salvage.	Yes	Adverse	Medium	Localized	Permanent	Frequent	Irreversible	Low resilience	High	Not Significant
	Sub-lethal effect of change in water quality due to the TMF. (O, CD, PC)	Water Management, including a Reclamation Plan (i.e. construction of two engineering wetlands: North TMF wetland and South TMF, construction of a Winter Seepage Mitigation Pond to contain seepage during December to April and release during higher flows).	Yes	Adverse	Low	Localized	Short Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity due to the TMF. (C, O, CD, PC)	Monitoring of fish habitat and biological communities to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	Yes	Adverse	Low	Localized	Permanent	Frequent	Irreversible	Low resilience	Moderate	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
Rare Plants and Vegetation Health												
	Loss of rare plants and rare plant habitat. (C, O)	Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.	Yes	Adverse	Low	Localized	Long Term	Infrequent	Reversible	Low Resilience	High	Low significance
	Deposition of dust and emissions on vegetation, particularly rare plants. (CD, PC)	Dust control measures will be implemented as per the Air Quality Management Plan.	Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	Low Resilience	High	Low significance
Wildlife												
	Habitat availability (loss) for Klaza Caribou. (C)	Placing construction camps outside of the KCH winter range, and borrow pits outside of KCH winter range where possible	Yes	Adverse	Low (4.75% of high quality habitat or 2.75% of all habitat combined)	Localized	Permanent	Infrequent	Reversible	High resilience	High	Not significant
	Habitat availability (reduced effectiveness) for Klaza Caribou. (C, O)	Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range	Yes	Adverse	Low	Widespread	Long term	Frequent	Reversible	High resilience	Moderate	Not significant
	Movement for Klaza Caribou. (O)	Implementing a policy to ensure caribou approaching the road are given the right-of-way Implementing snow bank management measures to facilitate caribou movement across the roadway; Designing road embankment heights and materials to allow for caribou movement	No	Adverse	Low	Widespread	Long-term	Infrequent	Reversible	Low resilience	Moderate	Not significant
	Mortality risk for Klaza Caribou. (O, CD, PC)	Restricting access to the road during operation by installing a continuously manned gate at Big Creek	No	Adverse	Low	Widespread	Long term	Infrequent	Reversible	High resilience	Low	Not significant
	Habitat availability (loss) for Moose. (C)	Placing construction camps outside of the KCH winter range, and borrow pits outside of KCH winter range where possible Manage roadside vegetation along Project roads to discourage moose foraging	Yes	Adverse	Low (0.80% of high and 2.72% of moderate quality habitat)	Localized	Permanent	Infrequent	Reversible	High resilience	High	Not significant

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	Habitat availability (reduced effectiveness) for Moose. (C, O)	Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range Manage roadside vegetation along Project roads to discourage moose foraging; minimize Project footprint.	Yes	Adverse	Low	Widespread	Long term	Frequent	Reversible	High resilience	Moderate	Not significant
	Movement for Moose (C, O)	Pipeline clearance (distance from bottom of pipeline to ground) could be a minimum of 180 cm every 400 to 700 m (depending on terrain) Portions of the pipeline could be completely buried (not visible aboveground) to prevent a barrier to movement. Pipeline crossing structures (made of vegetated fill or soil) may be constructed in high density crossing/ movement areas or areas where the pipeline cannot be raised to sufficient height or buried completely	Yes	Adverse	Low	Widespread	Long-term	Infrequent	Reversible	High resilience	Moderate	Not significant
	Mortality risk for Moose. (O, CD, PC)	Implement a no-hunting policy for Project employees while on site. Implement a zero tolerance policy for wildlife harassment by employees and contractors. Give wildlife right-of-way on all roads Radio communication among drivers to warn when wildlife are observed along roads. Restricting access to the road during operation by installing a continuously manned gate at Big Creek.	No	Adverse	Low	Widespread	Long term	Infrequent	Reversible	High resilience	Low	Not significant

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	Habitat effectiveness for Grizzly Bear. (C, O)	Active den sites will be avoided during the denning season (November to May) Blasting within 500 m of active bear dens will be avoided Active bear dens will be avoided on a case by case basis	Yes	Adverse	Low	Localized	Long term	Frequent	Irreversible	Low resilience	Moderate	Not significant
	Security habitat for Grizzly Bear (C)	Active den sites will be avoided during the denning season (November to May) Blasting within 500 m of active bear dens will be avoided Active bear dens will be avoided on a case by case basis	Yes	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
	Denning habitat for Grizzly Bear. (C)	Active den sites will be avoided during the denning season (November to May) Blasting within 500 m of active bear dens will be avoided Active bear dens will be avoided on a case by case basis	Yes	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
	Linkage habitat for Grizzly Bear. (C)	Active den sites will be avoided during the denning season (November to May) Blasting within 500 m of active bear dens will be avoided Active bear dens will be avoided on a case by case basis	Yes	Adverse	Low	Localized	Long term	Frequent	Reversible	Low resilience	Moderate	Not significant
	Mortality risk for Grizzly Bear. (O, CD, PC)	Incorporating Best Management Practices for food, waste and fuel management into the design on the Project. Implement a no-hunting policy for Project employees while on site. Radio communication among drivers to warn when wildlife are observed along roads.	No	Adverse	Low	Localized	Long term	Infrequent	Reversible	Low resilience	Low	Not significant

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	Habitat availability (loss) for Collared Pika. (C)	Minimize Project footprint. Avoid interfering with active dens. Implement a zero tolerance policy for wildlife harassment by employees and contractors.	Yes	Adverse	Low	Localized	Permanent	Infrequent	Reversible	Low resilience	High	Not significant
	Habitat availability (direct loss) for birds. (C)	Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen etc.). Dust suppression methods will be employed along roads during dry summer periods.	Yes	Adverse	Low (less than 10% of high quality habitats lost to PDA)	Localized	Permanent	Infrequent	Reversible	High resilience	Moderate	Not significant
	Habitat availability (reduced effectiveness) for birds. (C, O)	Where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m buffer between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen etc.). Dust suppression methods will be employed along roads during dry summer periods.	Yes	Adverse	High within the LSA, but Low within the region	Localized	Long term	Frequent	Reversible	High resilience	Moderate	Not significant
	Physical loss of nest sites for cliff-nesting raptors. (C, O)	Nest-specific management plans within 500 m of PDA, wherever possible, a 500 m no-disturbance buffer around nests, annual occupancy surveys.	Yes	Adverse	High to individuals	Localized	Permanent	Infrequent	Reversible	Low Resilience	Low	Not Significant
	Sensory disturbance at nest sites for cliff-nesting raptors. (C, O)	Nest-specific management plans within 500 m of PDA, wherever possible, a 500 m no-disturbance buffer around nests, annual occupancy surveys.	Yes	Adverse	High to individuals	Localized	Long term	Frequent	Reversible	Low Resilience	Moderate	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Health Effects on waterfowl. (O, CD, PC)	Water quality monitoring, and if necessary, potential water quality mitigation, wildlife monitoring of tailings, and wildlife deterrence.	Yes	Adverse	Medium	Localized	Permanent	Infrequent	Reversible	High Resilience	Moderate	Not Significant
Employment and Income												
	Project purchases and Project workforce demands would generate employment opportunities for LSA and RSA residents. (C, O, CD)	Implementing a procurement process that gives preferences to suppliers from the RSA and in particular rural communities within the LSA; requiring cultural awareness training for employees and contractors.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	Increased employment opportunities would positively affect labour income for LSA and RSA residents. (C, O, CD)	Encouraging training and education so that workers can maximize incomes through: providing on-the-job training to assist local and regional workers to develop mining-specific skills; providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; partnering with First Nation communities to access additional funding for training; implementing career training and development opportunities for employees once hired; and providing continuous, on the job safety training.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	Project competition for local labour may result in shortages in other sectors and industries. (C, O, CD)	Work with closing mines to transfer workers; target unemployed for trainable positions	Uncertain	Adverse	Low	Localized	Long Term	Continuous	Reversible	High resilience	Moderate	Not Significant
Employability												
	Training programs during operations would enhance the local and regional skills profile and employment levels. (C, O, CD)	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	Yes	Beneficial	High	Localized	Long Term	Continuous	Irreversible	High resilience	High	Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
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	Employment opportunities will increase incentive for educational attainment and training of local residents. (C, O, CD)	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	Yes	Beneficial	Medium	Localized	Long Term	Continuous	Irreversible	High resilience	Moderate	Not Significant
	Project employment will improve capacity and industry experience of workers. (C, O, CD)	Implementation of a Recruitment, Training, and Employment Plan that would seek to encourage recruitment of local/regional/territorial residents to the extent practical	Yes	Beneficial	High	Localized	Long Term	Continuous	Irreversible	High resilience	High	Significant
	Improved capacity and industry experience of contractors. (C, O, CD)	CMC will implement a procurement process that, where feasible, gives preference to suppliers from the RSA and LSA; Contractors would be encouraged to hire local/regional/territorial residents to the extent practical	Yes	Beneficial	Medium	Localized	Long Term	Continuous	Irreversible	High resilience	Moderate	Not Significant
Economic Development and Business Sector												
	Economic Growth											
	Project purchases would increase Yukon's GDP and employment. (C, O, CD)	Contractors would be encouraged to hire local/regional residents to the extent practical.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	Project workforce demands would increase Yukon's GDP and employment. (C, O, CD)	CMC would seek to recruit local/regional/territorial residents to the extent practical (Section 14 Employment and Income).	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant

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	Increased access from Freegold Road Upgrade may provide opportunities for more exploration activities, which in turn will increase Yukon's GDP and employment. (C, O, CD)	Local community members may enjoy enhanced access to recreational opportunities along this section of the road.	Yes	Benficial	Medium	Localized	Long Term	Continuous	Reversible	High resilience	Moderate	Not Significant
	Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increased economic activity and businesses. (C, O, CD)	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes. The proponent would seek to recruit local/regional/territorial residents to the extent practical.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	Business Opportunities											
	Proposed Project purchases will create contract and business opportunities across the Yukon. (C, O, CD)	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	Government Revenue											
	Direct and indirect taxes by Project, contractors and individuals will positively contribute to the Yukon tax revenues. (C, O, CD)	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes. The proponent would seek to recruit local/regional/territorial residents to the extent practical.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
	During operations Project will pay royalties/Yukon Mining Tax to Yukon resulting in increased Government revenue. (O)	None	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant

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	Additional direct and indirect taxes paid by Project employees will increase government revenues. (C, O, CD)	CMC would use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes; The proponent would seek to recruit local/regional/territorial residents to the extent practical.	Yes	Beneficial	High	Localized	Long Term	Continuous	Reversible	High resilience	High	Significant
Community Vitality												
	Population changes from out-of-territory mine workers and their dependents moving residency to RSA. (C, O, CD)	Priority hiring for qualified local residents. employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues related to mine staff	Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project. (C, O, CD)	Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA; implementing a procurement process that gives preference to suppliers from the RSA and LSA.	Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	Moderate	Not Significant
	Employment opportunities and increased income would reduce economic hardship and improve well-being of local families. (C, O, CD)	None	Yes	Beneficial	Medium	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
	Potential lack of employment and income equity for women, Aboriginal peoples, people with disabilities, and visible minorities. (C, O, CD)	Implementing a hiring policy that encourages the employment of workers from rural communities within the LSA; Work with Yukon Government agencies and Yukon College to identify barriers to employment and offer training programs to improve local hire and retention of staff	Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	Low	Not Significant

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	Positive spending decisions would enhance family and community wellbeing (i.e. positive spending on education)/ Negative spending decisions would reduce family and community wellbeing (i.e. crime, addictions). (C, O, CD)	Offer to deposit workers' salaries in their bank accounts. Identify money management training opportunities as required to those employees who do not have experience with high wage earnings and working in mines. Implement a zero tolerance policy with respect to drug and alcohol at the Project site for Project employees and contractors. Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate	Yes	Beneficial/ Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	Moderate	Not Significant
	Influx of workers and their families could create negative behavioural changes and reduce family and community well-being if transient population engages in socially disruptive or illegal activities (i.e. crime, alcoholism). (C, O, CD)	The project will have a self-contained camp on site to house workers. A zero tolerance policy with respect to drug and alcohol use will be implemented at the Project site for Project employees and contractors. Identify money management training opportunities as required as required to those employees who do not have experience with high wage earnings and working in mines. Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate	Yes	Adverse	Low	Localized	Short Term	Frequent	Reversible	High Resilience	Moderate	Not Significant
	Separation of workers from family and dependants for extended periods of time could lead to deterioration of family relationships. (C, O, CD)	Facilitate communication between workers and their families by providing phone and Internet services on-site. Explore shift schedules that meet the needs of the operation and that are attractive to local hires. Identify money management training opportunities as required as required to those employees who do not	Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant

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		have experience with high wage earnings and working in mines. Work with local agencies to monitoring Project socio-economic effects and to take corrective actions where appropriate.										
	Loss of jobs and income at the end of operations and potential out-migration could negatively affect family and community well-being. (C, O, CD, PC)	CMC will work with the community to develop a plan that identifies strategies and actions to help minimize potential adverse effects from closing the mine. Provide training opportunities to help employees get employment elsewhere.	Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
Community Infrastructure and Services												
	Increase in demands for municipal infrastructure that are within the current LSA capacity and approved expansion plans. (C, O)	Providing a fly in\fly out camp. The pioneer camp will have local water and power supply and on-site sewage treatment plant and indoor and outdoor recreation services, which will offset Project's demand for municipal infrastructure; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services/planning issues related to mine staff; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	Increase in housing demands that are within the current LSA capacity and approved expansion plans. (C, O)	Implementing priority hiring for qualified local residents; Providing incentives for workers hired from outside Yukon to relocate; Employing a community liaison staff member who focuses on community relationships and working with community staff on housing/planning issues	Yes	Adverse / Beneficial	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

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		related to mine staff; Providing a fly in/fly out camp to partially offset Project's demands for housing services; Monitoring project socio-economic effects and adapting management measures where required.										
	Increases in demands for education services that are within the current LSA capacity; Project will expand education supply and enhance local qualifications. (C, O)	Providing a fly in/fly out camp; Providing support programs and initiatives at local schools and Yukon College; Implementing a Recruitment, Training, and Employment Plan; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse / Beneficial	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	Increase in demands for health services that are within the current LSA capacity. (C, O)	Providing a camp will partially offset Project's demands for regional health services; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services/planning issues related to mine staff; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	Accidents at worksite could increase demand for regional health services and emergency services. (C, O)	Requiring all construction and operation activities to follow best practices as outlined in CMC's Environmental Health and Safety (EHS) Management System; Providing, at the site and the camp, health and medical equipment and personnel as well as arrangements to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility within the LSA;	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

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		Providing full firefighting equipment and trained personnel to meet all on-site fire and rescue needs; Providing, at the mine site, trained mine rescue personnel and mine rescue equipment security; Monitoring project socio-economic effects and adapting management measures where required.										
	The arrival of workers and their families to the LSA will create additional demand on protective services. (C, O)	Committing to work closely on an ongoing basis with WGH, local fire departments, RCMP, and Yukon Ambulance to ensure that the appropriate information on the changes in area transportation volumes, and the change to the local population are considered; Providing contracted security services that will focus on ensuring a secure and safe work site with the following policies: no alcohol or drugs on-site, a respectful workplace, no harassment, safety and security, multi-cultural workforce considerations, and Aboriginal awareness training; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	The arrival of workers and their families to the LSA will create additional pressure on traffic and transportation infrastructure. (C,O)	Monitoring ground and air transportation infrastructure traffic and mitigation measures; Employing a community liaison staff member who focuses on community relationships and working with community staff on infrastructure and services planning issues related to mine staff; Monitoring project socio-	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

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		economic effects and adapting management measures where required.										
	Traffic volumes to and from mine site would increase demand for health services and protective services (RCMP, fire department, ambulance) along the access road if accidents occur. (C, O)	Developing a Materials Transport Plan and Emergency Response Plan; Controlling speed limits; Committing to perform regular vehicle maintenance and regular road maintenance to reduce risk to motor vehicle safety; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	Commuting workers from outside the LSA will create additional air passenger volumes and demands on air transportation infrastructure. (C, O)	Socioeconomic monitoring including monitoring ground and air transportation infrastructure traffic and mitigation measures; Liaising with Whitehorse Airport authority re. Worker Transportation Plan and evaluate peak passenger/aircraft volumes; as necessary, stagger work rotation schedule to minimize airport and passenger congestion; Monitoring project socio-economic effects and adapting management measures where required.	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
	Project transportation activities will increase traffic, road wear, and risk of accidents (e.g., collisions, spills, etc.) along the access road. (C, O)	Implementation of Casino Traffic Management Plan that includes: • Adherence to posted speed limits • Regular truck inspection and maintenance • Signage and verbal and written notification about wildlife crossings • Truck traffic communications and codes on access road • Travelling in convoys in extreme	Yes	Adverse	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant

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		winter conditions • Regular inspection, maintenance, dust suppression, and snow removal on Freegold Road and extension • Implementation of Emergency Response and Spill Management Plan • Carriers of dangerous goods will be in compliance with all international and territorial guidelines, acts, and regulation and will carry appropriate documentation • Drivers of dangerous goods vehicles will be required to be familiar with all aspects of the Emergency Response and Spill Management Plan • Monitoring of ground and air transportation infrastructure traffic and mitigation measures • Building a new airstrip/access road at mine site and bussing workers from airstrip to onsite camp.										
	Road extension and upgrades will improve transportation infrastructure. (C, O)	A 24/7 manned security and gate at start of Freegold Road Extension to control access to permitted users	Yes	Beneficial	Low	Local	Long Term	Continuous	Reversible	High Resilience	High	Not Significant
Cultural Continuity												
	Loss of or decreased area for recreational or subsistence hunting. (C, O, CD)	Reclamation and Closure Plan; compact Project footprint; Access Management Strategy	Yes	Adverse	Low	Localized	Long Term/ Permanent	Infrequent	Reversible	High Resilience	High	Not Significant
	Loss of or decreased area for recreational or subsistence plant harvesting. (C, O, CD)	Reclamation and Closure Plan; compact Project footprint; Access Management Strategy	Yes	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High Resilience	Unknown	Not Significant

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	Access for recreational and subsistence hunting. (C, O, CD)	Access Management Strategy; Project employees and contractors will be restricted from hunting and fishing while on the job at any time	Yes	Adverse/ Beneficial	Low	Widespread	Long Term	Frequent	Reversible	High Resilience	High	Not Significant
	Access for recreational and subsistence plant harvesting. (C, O, CD)	Access Management Strategy; Project employees and contractors will be restricted from hunting and fishing while on the job at any time	Yes	Adverse/ Beneficial	Low	Localized	Long Term	Infrequent	Reversible	High Resilience	Moderate	Not Significant
	Increased noise, emissions and traffic (C, O, CD)	Implement appropriate EMPs (i.e. Air Quality Management Plan); equipment maintenance; sound buffering equipment/buildings; employees flown to site; Communications Plan (ensuring ongoing communications with First Nations and local stakeholders)	Yes	Adverse	Medium	Localized	Long Term	Frequent	Reversible	Low Resilience	High	Not Significant
Land Use and Tenure												
	Loss of area available for traditional land use activities (C,O, CD)	Limit mine footprint; implement appropriate best management practices and reclamation and closure measures; ensure ongoing communication with FN and local stakeholders.	Yes	Adverse	Low	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant
	Loss of available area for quartz and placer mining activities (C,O, CD)		Yes	Adverse	Medium	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant
	Loss of area available for trapping and outfitting activities (C, O, CD)		Yes	Adverse	Low	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant

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	Easier access to area for others whose activities may conflict with FN traditional land use activities (Freegold Road Upgrade). (C, O, CD)	Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. Implement access management measures and associated monitoring and communication plans. Ensure ongoing communication with FN and local stakeholders. Limit mine footprint; implement appropriate EMPs (i.e. Air Quality Management Plan) and reclamation and closure measures; ensure ongoing communication with local stakeholders.	Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	Low / Moderate	Not Significant
	Reduced access to Traditional Territory due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Negotiated road access to Traditional Territory (Freegold Road Extension). (C, O, CD)		Yes/No	Adverse / Neutral / Positive	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Easier access to area for traditional land use activities. (Freegold Road Upgrade). (C, O, CD)		Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Reduced road access to permitted tenure areas due to road construction and traffic during construction, operations and decommissioning /closure (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Negotiated road access to area for existing mineral tenure holders (Freegold Road Extension). (C, O, CD)		Yes/No	Adverse / Neutral / Positive	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Easier access to existing tenure areas and new permitted exploration activities (Freegold Road Upgrade). (C, O, CD)		Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant

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	No road access to area for recreational activities (Freegold Road Extension). (C, O, CD)	Existing tenure and individual access arrangements will be negotiated under the Freegold Road Extension Access Management Agreement. Implement access management measures and associated monitoring and communication plans. Ensure ongoing communication with FN and local stakeholders. Limit mine footprint; implement appropriate EMPs (i.e. Air Quality Management Plan) and reclamation and closure measures; ensure ongoing communication with local stakeholders.	Yes	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	Low	Not Significant
	Reduced access to recreational areas due to road construction and traffic during construction, operations and decommissioning / closure (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Easier access to area for recreational activities (Freegold Road Upgrade). (C, O, CD)		Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Negotiated road access to area for existing trappers and guide outfitters (Freegold Road Extension). (C, O, CD)		Yes/No	Adverse / Neutral	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Easier access to permitted concession areas for trappers and guide outfitters (Freegold Road Upgrade). (C, O, CD)		Yes	Beneficial	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Reduced access to trapping and guide outfitting concession areas due to road construction and traffic during construction, operations and decommissioning /closure (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	High	Not Significant
	Easier access to area for others whose activities may conflict with trappers and guide outfitters (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	Low / Moderate	Not Significant

VC Affected	Potential Effect	Proposed Mitigation	Residual Effect (Yes/No)	Potential Degree of Effect after Mitigation								Significance of Residual Effect
				Direction	**Magnitude** (Low/ Medium/ High)	**Geographic Extent** (Localized/ Widespread)	**Duration** (Short Term/Long Term/ Permanent)	**Frequency** (Infrequent/ Frequent)	**Reversibility** (Reversible/ Irreversible)	**Context** (Low Resilience/ High Resilience)	**Probability of Occurrence** (Low/ Moderate /High)	
	Reduced wilderness experience for FN traditional land use activities (mine site, Freegold Road Upgrade and extension). (C, O, CD)	Limit mine footprint; implement appropriate EMPs (i.e. Air Quality Management Plan) and reclamation and closure measures; ensure ongoing communication with local stakeholders.	No	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	High	Not Significant
	Reduced wilderness experience for trappers and guide outfitters utilizing the area (mine site, Freegold Road Upgrade and extension). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	Low / Moderate	Not Significant
	Reduced wilderness experience for recreational land use activities (Freegold Road Upgrade). (C, O, CD)		Yes	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	High	Not Significant

Table 24.1–2 Table of Commitments

Number	Commitment	Adverse Residual Effect	Proposal Section
Consultation			
1	CMC will develop management and monitoring plans, as described in Sections 22 and 23.	• Access management to reduce negative effects on caribou populations. • Access road route needs to consider known heritage resources. • Clarification of buffer distance requirements for heritage sites. • Effects on ability to practice traditional activities.	2
2	CMC intends to continue to discuss collection and consideration of traditional knowledge.	• Baseline information collection needs to be complemented by significant traditional knowledge of the area. • Establishment of a TK policy/protocol to ensure protection for Selkirk First Nation Elders' knowledge.	2
3	CMC intends to continue to engage with First Nations to discuss topics of interest.	• Benefits agreements should consider social and health impacts. • Concern about heap leach cover and stabilization with revegetation. • Concern about the cyanide treatment process and the duration of this part of the closure process. • Concerned about encumbering rights that allow mining companies to proceed with activities that may damage heritage sites without doing impact assessment studies. • Consultation with Selkirk First Nation regarding access points for the project. • Effects on increased access on	2

Number	Commitment	Adverse Residual Effect	Proposal Section
		subsistence hunting, fishing and harvesting. • Engagement of the whole Selkirk First Nation community in the preparation of the environmental assessment, including the socioeconomic effects assessment. • Have you yet performed a Failure Modes Effects Analysis (FMEA)?	
4	CMC will monitor project socio-economic effects and adapt management measures where required.	• Development and use of spur roads off of the primary Casino project access road.	2
5	CMC intends to continue discussions with First Nations regarding agreements and funding to participate in the review of the Project Proposal.	• First Nations need capacity to participate in the assessment process.	2
6	CMC will work with First Nations to arrange for access as appropriate consistent with the access road management plan as approved by First Nations and Yukon Government.	• Increased traffic and spur roads.	2
Environmental Management Plans			
7	Erosion and Sediment Control Management Plan • CMC will develop a final plan prior to construction and operations. • The Plan will describe the measures to be undertaken to manage erosion and sedimentation during all phases.	• As described in Section 7.4.	22.3
8	Air Quality Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation.	• As described in Section 8.4.	22.3

Number	Commitment	Adverse Residual Effect	Proposal Section
9	Waste Management Plan • CMC will develop a final plan prior to construction and operations. • The Waste Management Plan will describe the type of waste generated and related management strategies to responsibly handle, store, transport, and dispose of waste.	N/A	22.3
10	Wildlife Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation.	• As described in Section 12.4	22.3.2 Appendix 23A
11	Heritage Resource Protection Plan • CMC will develop a final plan prior to construction and operations. • Key components of the Heritage Resources Protection Plan will include: • Heritage resource protection policy; • Heritage resource overview; • Summary of the heritage resource impact assessment conducted as part of this Proposal; • Methods for identification, reporting, and protection of heritage resources; • Reporting requirements and contact list; and • Employee training.	• As described in Section 18.4	22.3
12	Spills Contingency Management Plan • CMC will develop a final plan prior to construction and operations;	N/A	22.3 Appendix 22B

Number	Commitment	Adverse Residual Effect	Proposal Section

	• The following components will be included in the Spills Contingency Management Plan:
	  ○ Spill categories
	  ○ Spill prevention procedures
	  ○ Spill response plan
	  ○ Roles and responsibilities
	  ○ Training
	  ○ Internal and external reporting
	  ○ Monitoring		

13	Occupational Health and Safety Management Plan • CMC will develop a final plan prior to construction and operations. • The Occupational Health and Safety Management Plan will be developed in accordance with all applicable Acts and Regulations, as well as terms and conditions of all required licences, authorizations, and approvals. • The final plan will include a table of commitments pertaining to health and safety arising from the environmental assessment review, and indicate how the commitments are addressed within the plan.	N/A	22.3
14	Emergency Response Plan • CMC will develop a final plan prior to construction and operations.	N/A	22.3 Appendix 22A
15	Hazardous Materials Management Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation.	N/A	22.3 Appendix 22B

Number	Commitment	Adverse Residual Effect	Proposal Section
	• A separate Cyanide Management Plan will be developed and implemented in recognition of the higher level of public concern associated with this substance.		
16	Road Use Plan • CMC will develop a final plan prior to construction and operations. • The final plan will include a table of commitments with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation. • It is the intent of CMC to negotiate a Freegold Road Extension Access Management Agreement with the Government of Yukon, SFN and LSCFN to address how the private road and access control could be managed to meet the Project requirements with consideration of existing tenure holders and individuals.	N/A	22.3 Appendix 22A
Monitoring Programs			
17	An Environmental Monitoring Plan will be developed in accordance with the Plan Requirement Guidance for Quartz Mining Projects (Yukon Energy, Mines and Resources 2013) to monitor the predicted residual effects of the Project and the effectiveness of implemented mitigation measures. The Plan will identify any variances from predictions that occur and whether such variances require action, including any additional mitigation measures. The Plan will be comprised of the following components: • Water Monitoring Program • Air Quality and Fugitive Dust Monitoring		23

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Geochemical Monitoring Program • Meteorological Monitoring Program • Aquatic Monitoring Program • Permafrost Monitoring Program • Wildlife Monitoring Program • Reclamation Monitoring Program.		
Surface, Geology Terrains and Soils			
18	Where possible, CMC will realign or relocate footprint features to avoid removing/destroying thaw lakes, tors, and pingos.	• Loss, damage to terrain features	6
Water Quality			
19	All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Air Quality Management Plan and Water Management Plan and Transport Canada Aerodrome Standards and Recommended Practices.	• Effects on water quality (general)	7.4
20	CMC will incorporate Best Management Practices (BMPs) such as: • Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading) • Monitoring of TSS and turbidity during construction to ensure compliance with applicable guidelines and permit conditions • Stabilizing and re-vegetating disturbed areas following construction • Designing appropriate sediment settling ponds that conform to applicable guidelines • Designing appropriate diversion ditching system upstream of ore stockpiles • Sediment control fencing installed around down-	• Effects on water quality (general)	7.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	gradient perimeter sections of the ore stockpiles • Dust suppressants and enforced traffic speed limits along all access roads.		
21	An environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and biological communities in the Water Quality LSA.	• Effects on water quality (general)	7.4
22	CMC will include design criteria for the various sediment control elements that will be based on industry standard guidance documents (BC MELP, 2001; MEMNG, 1998). Sediment mobilization and erosion will be managed throughout the site by installing sediment controls prior to construction activities, limiting the disturbance as much as possible and reducing water velocity across the ground.	• Effects on water quality (general)	7.4
23	During operations, CMC will: establish diversion ditches and implement progressive rehabilitation of disturbed land to minimize erosion; construct drainage controls and sediment control devices; and restrict access to rehabilitated areas.	• Effects on water quality (general)	7.4
24	A coffer dam will be constructed within the TMF starter footprint to capture all runoff from the upstream areas and route it to the sediment pond downstream.	• Water quality	7.4
25	Typical BMPs that will be used at the project are runoff collection ditches, energy dissipaters, sediment traps, slope drains, surface roughening, filter bags, water bars, diversion structures, silt fences, sediment basins, temporary seeding, and mulching.	• Effects on water quality (general)	7.4
26	Temporary sediment settling ponds will be constructed downstream of all construction activities to treat sediment laden water and discharge to existing channels via energy dissipating structures.	• Effects on water quality (general)	7.4
27	A water management pond will be constructed that will	• Change in surface water quality in Casino	7.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF.	Creek and Dip Creek due to unrecovered seepage	
28	A winter seepage pond will be constructed at closure to hold back water during the winter months (December to April).	• Change in surface water quality in Casino Creek and Dip Creek due to project discharge	7.4
29	The Reclamation Plan will include construction of two engineered wetlands: North TMF wetland and South TMF wetland.	• Change in surface water quality in Casino Creek and Dip Creek due to project discharge	Table 7.4-5
30	CMC will divert all contact water to the TMF and implement BMPs for drilling, handling and loading ore; traffic speed limits, dust suppressants.	• Changes in surface water quality due to atmospheric deposition	Table 7.4-5
31	CMC will implement water management measures and BMPs for sediment mobilization and erosion as outlined in the Erosion and Sediment Control Plan; and modify culvert and bridge design for areas with increased sensitivity to disturbances.	• Change in surface water quality from increased erosion and sedimentation	Table 7.4-5
32	Control contaminate discharge from the historic adit in upper Casino Creek.	• Reduced water quality in Casino Creek due to adit discharge and TMF discharge	7.5 Table 7.5.4
Air Quality			
33	Adhere to Occupational Health and Safety Act.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO	8.4. Table 8.4-7
34	Use ultra-low sulphur content fuel.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO	8.4 Table 8.4-7
35	Use construction and mining equipment that meets the latest applicable Canadian emissions standards at the time of purchase.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2.	8.4 Table 8.4-7
36	Ensure regular equipment maintenance recommended by manufacturers.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO.	8.4 Table 8.4-7
37	Institute a policy for all equipment and vehicles to reduce and limit idling.	• Exceedance of Yukon Ambient Air Quality Standards for SO_2, NO_2, CO.	8.4 Table 8.4-7

Number	Commitment	Adverse Residual Effect	Proposal Section
38	Cover or use water sprays at dust generating areas.	• Exceedance of Yukon Ambient Air Quality Standards for TSP, PM_{10}, $PM_{2.5}$.	8.4 Table 8.4-7
39	Reduce drop heights for process plants.	• Exceedance of Yukon Ambient Air Quality Standards for TSP, PM_{10}, $PM_{2.5}$.	8.4 Table 8.4-7
40	Cover or use water sprays at dust generating areas.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
41	Minimize wind exposure at conveyors, drop-off points and truck load/unload locations.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
42	Establish blasting procedures for open pit activities to minimize dust.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
43	Reduce drop heights for process plants.	• Exceedance of BC Air Quality Objectives for dustfall.	8.4 Table 8.4-7
44	Use construction and mining equipment that meets the latest applicable Canadian emissions standards at the time of purchase. Ensure regular equipment maintenance.	• Contribute to global greenhouse gasses.	8.4 Table 8.4-7
Noise			
45	Ensure regular equipment maintenance, including lubrication and replacement of parts.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
46	Keep noisy equipment inside of buildings and sheds whenever possible.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
47	Equipment will be operated with covers, shields, and hoods if provided by their manufacturer.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
48	Adhere to a blasting plan developed by an explosives contractor that implements controlled blasting procedures.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
49	Optimisation of blasting operations by licensed staff which maximise localised rock breakage within the ore body of interest, while minimising non-productive noise, vibration.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4

Number	Commitment	Adverse Residual Effect	Proposal Section
50	Impose speed limits for all vehicles.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
51	Institute a policy for all equipment and vehicles to reduce and limit idling.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
52	Wherever practicable, noisy equipment will be located near ground level to minimize noise propagation.	• Increase in baseline noise level conditions.	9.4 Table 9.4-4
Fish and Aquatic Resources			
53	All construction activities will adhere to CMC's Erosion and Sediment Control Plan, Environmental Management Plan and Water Management Plan.	• Lethal and non-lethal effects to fish and aquatic organisms.	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12
54	CMC will incorporate BMPs into all work, including: • Minimizing disturbances in and near watercourses (e.g., clearing, grubbing, grading) • The use of cofferdams or stream diversions to de-water construction areas • Diverting clean water around stream and river crossings during construction to maintain sufficient flows downstream • Monitoring of TSS and turbidity during construction to ensure compliance with regulatory requirements • Stabilizing and re-vegetating disturbed areas following construction • Dust suppressants and enforced traffic speed limits along all access roads to reduce any potential contamination of nearby watercourses • Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan • Completing fish salvages prior to any in-stream activities in fish-bearing watercourses	• Lethal and non-lethal effects to fish and aquatic organisms .	10.4 Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal Section

	• Following DFO guidelines for:
	  ○ Timing windows for the protection of fish and fish habitat during critical life history stages
	  ○ Freshwater Intake End-of-Pipe Fish Screen (DFO 1995), to avoid fish impingement and entrainment while pumping water during construction
	  ○ The Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998)		

55	An environmental monitoring plan will be designed and implemented to monitor water quality, fish habitat, and aquatic biological communities in the LSA. Additional mitigation or compensation measures will be incorporated on an as-needed basis. A site-specific risk assessment is proposed to determine local toxicity thresholds for selenium: fish eggs will be collected and analyzed where possible to develop local guidelines.	• Lethal and non-lethal effects to fish and aquatic organisms .	10.4
56	• Bridges will be installed on all fish-bearing creeks where reasonably possible. • Single-lane clear-span bridges designed for a minimal footprint within the stream channel will be used at all crossings with the exception of the Nordenskiold River Bridge, which will be two-span with a pier located in the river channel. • Clear-span bridge installation on fish-bearing watercourses will avoid any stream bed alteration, and rip rap will be installed below bridges to minimize the risk of slope failure. • Rip rap will be placed flush with the stream bank to avoid changes in channel volume or flows.	• Lethal effects on fish and aquatic organisms.	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Any required temporary crossing structures will comply with measures outlined in DFO operational statements. • Bridge construction will occur in the winter, where technically and economically feasible and reasonably practical. • All major culvert construction will be completed during the summer months. • Any temporary ice bridges will be removed prior to full spring break-up to prevent unnatural ice jamming and flooding. • Final crossing structure sites, orientations and spans will be designed for sensitive sites to mitigate any potential impacts on aquatic habitat.		
57	TMF spillway overflow to Casino Creek will follow a discharge schedule that will distribute flow increases across the summer months to limit downstream impact.	• Fish habitat – increased flows	10.4 Table 10.4-10
58	Site-specific surveys will be conducted during detailed design to determine whether any minor channel modifications are needed in Casino Creek to mitigate increased flow from the TMF spillway.	• Fish habitat – increased flows	10.4 Table 10.4-10
59	Erosion and suspended sediment will be monitored within the Project area watercourses to ensure control measures have been effectively implemented as outlined in the Erosion and Sediment Control Plan.	• Increased erosion and sedimentation causing habitat loss and alteration and potential changes to habitat productive capacity.	10.4
60	A water quality monitoring plan will be designed and implemented to ensure that water quality threshold objectives are met downstream of the TMF. Mitigation as built into design of the TMF, including the construction of wetlands both upstream and downstream of the TMF pond, a winter seepage mitigation pond (WSMP), strategic placement of waste rock in TMF, and	• Changes to Water quality - Lethal effects on fish and aquatic organisms	10.4 Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal Section
	protection of the dam shell with rip rap.		
61	Monitoring of biological communities in the Fish and Aquatic Resources LSA to identify any changes relative to baseline conditions. Mitigation may include habitat remediation or additional compensation.	• Lethal effects on fish and aquatic organisms due to stranding or winter kill following reduced flows	Table 10.4-11 Table 10.4-12
62	CMC will provide a Fish Habitat Compensation Plan for serious harm to Arctic grayling habitat. CMC will ensure post construction monitoring of compensation works to assess the effectiveness of the compensation measures.	• Fish-bearing in-stream and riparian habitat loss ; Reduced stream flows, winter kills, fish stranding	10.4 Table 10.4-10
63	CMC will work to minimize effects of instream works in fish and aquatic habitats: • Isolate all instream works where there is potential to affect downstream habitats • Limit duration and time activities to avoid high risk fisheries windows, weather or flow conditions • Structures and materials will be placed in a manner that does not impede fish passage or migration • Manage flow diversions and water abstraction to ensure adequate flows for fish • Conduct fish salvages before instream work is undertaken in areas where fish stranding could occur.	• Lethal effects to fish and aquatic organisms • Sub-lethal effects on fish and aquatic organisms due to change in habitat productive capacity	Table 10.4-11 Table 10.4-12
64	CMC will adhere to Fisheries and Oceans Canada (DFO) Freshwater Intake End-of-Pipe Fish Screen Guideline when using pumps or intake structures in fish bearing waters.	• Lethal and sub-lethal effects to fish and aquatic organisms	Table 10.4-11
65	CMC will adhere to Fisheries and Oceans Canada (DFO) guidelines for the Use of Explosives in or near Canadian Fisheries Waters when blasting in or near fish	• Lethal and non-lethal effects to fish and aquatic organisms	Table 10.4-11 Table 10.4-12

Number	Commitment	Adverse Residual Effect	Proposal Section
	bearing waters.		
66	CMC will implement a No fishing policy for CMC workforce.	• Lethal effects on local fish populations due to increased fishing pressure	Table 10.4-11
67	Instream and riparian construction will be within working windows established by DFO to avoid destroying incubating fish eggs.	• Direct mortality of periphyton, benthic invertebrates, and fish eggs due to infilling	Table 10.4-11 Table 10.4-12
68	CMC will implement traffic speed limits, dust suppressants, sediment and erosion control plan; Best Management Practices for dust and other air contaminants as outlined in the Air Quality Management Plan.	• Lethal effects on fish and aquatic organisms due to contamination from dust, emissions, and road runoff	10.4 Table 10.4-10 Table 10.4-11 Table 10.4-12
69	ML/ARD risk assessment and management plan.	• Lethal effects on fish and aquatic organisms due to ML/ARD	Table 10.4-11 Table 10.4-12
70	Divert contaminated water from the open pit into the TMF; Best Management Practices for explosives selection, drilling, handling and loading; environmental effects monitoring.	• Lethal effects on fish and aquatic organisms due to blasting residue contamination	Table 10.4-11 Table 10.4-12
71	Control contaminate discharge from the historic adit in upper Casino Creek.	• Cumulative effects	10.5
72	CMC will construct the Lower Britannia Creek Compensation Channel • reinstatement of the historical channel, to provide 13,643 m2 of in-stream habitat and 116,940 m2 of riparian habitat • restoration of natural morphology free of obstructions • re-introduction of flow • permanent diversion at the divergence of the existing and historical channel • fill and re-vegetate existing channel	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C

Number	Commitment	Adverse Residual Effect	Proposal Section
73	CMC will construct a Groundwater-fed Pool near the mouth of Britannia Creek - pond will be excavated up to 3 m below the observed groundwater table to provide 2.5 m deep pool beneath a 0.5 m ice cover.	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C
74	CMC will conduct Channel Restoration at seven historical fords: • accumulations of bar sediment will be removed and used to re-build natural bank morphology • Brush layers will be constructed in both banks • adjacent areas of floodplain will be replanted using live stakes of native willows.	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C
75	CMC will construct a naturalized airstrip diversion channel: • diversion of a small, unnamed tributary of Dip Creek around the Project airstrip • habitat area will be increased to 4,753 m^2, compared to the existing 1,509 m^2 • average gradient will be approximately 2%. • placement of gravel-cobble substrates and boulder groups along the straight riffle sections • Brush layers will be installed just below the tops of banks • Root wads will be embedded in the outer banks of meanders and secured with an anchor logs The existing channel will be filled and replanted upstream of the airstrip • Specifications on the alignment, dimensions and construction of the airstrip diversion channel will be finalized during detailed design.	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C

Number	Commitment	Adverse Residual Effect	Proposal Section
76	Chinook Project Contribution • CMC is in the process of consulting with SFN and Yukon-based organizations including the Yukon Salmon Sub-Committee and the Yukon River Panel to identify potential opportunities for off-site compensation specifically aimed at restoring, enhancing or creating Chinook habitat for the benefit of current and future generations • CMC commits to identifying, designing, constructing and monitoring at least 9,756 m^2 of new, enhanced or restored Chinook spawning and rearing habitat, with the option of introducing or re-introducing Chinook salmon to this habitat as appropriate • CMC is also exploring complementary measures, such as investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational or Aboriginal fisheries.	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C
77	Riparian Habitat Compensation • Reinstatement of lower Britannia Creek - 116,940 m^2 of existing mature forest adjacent to historical channel (assumes 30 m buffer) • Groundwater-fed pool near Britannia Creek mouth - 16,200 m^2 of existing mature forest and replanted shoreline embankments, with large woody debris structures, around perimeter of pool (assumes 30 m buffer) • Britannia Creek ford restoration - 2,400 m^2 of Replanted riparian vegetation with live willow stakes and brush layers, and native tree seedlings (assumes 15 m buffer) • Naturalized airstrip diversion channel - 57,030 m^2	• Habitat loss	4.3 Fish Habitat Compensation Plan Appendix 10C

Number	Commitment	Adverse Residual Effect	Proposal Section
	of existing mature forest encompassing area of proposed naturalized channel diversion (assumes 15 m buffer) • Chinook project contribution - 163,400 m^2 of riparian habitat, details TBD in consultation with Selkirk First Nation, DFO and other organizations.		
78	• Proposed habitat restoration and enhancement measures will be completed in accordance with the applicable "reduced risk timing window" for in-water work • All channel works will be completed "in the dry", either by conducting work along sections of channel that are dry or completely frozen or by isolating the work area from flowing water • Any fish that become stranded in isolated work areas will be captured, identified and released upstream by a qualified fisheries technician with a collection license • Erosion and sediment control measures will be established around the work area of the Groundwater-fed Pool near Britannia Creek Mouth • Erosion and sediment control measures will be established along the length of the proposed naturalized airstrip diversion channel	• Habitat loss	5.1 Fish Habitat Compensation Plan Appendix 10C
79	An erosion and sediment control plan will be developed as part of an overall environmental management plan, prior to initiation of habitat compensation activities.	• Habitat loss	5.2 Fish Habitat Compensation Plan Appendix 10C
80	Two main types of monitoring will be conducted to ensure success of the Fish Habitat Compensation Plan: • Construction monitoring • Effectiveness monitoring: A monitoring program	• Habitat loss	5.1 Fish Habitat Compensation Plan Appendix 10C

Number	Commitment	Adverse Residual Effect	Proposal Section
	will be established that focuses on the biological effectiveness of compensation works (channel morphology and fish habitat features, water quality monitoring, fish sampling, assessment of riparian vegetation)		
Rare Plants and Vegetation Health			
81	• Planning and conducting Project activities that the Project footprint will be minimized to the extent possible. • Using established roads within the PDA during operation thereby limiting new disturbance to the PDA.	• Loss of vegetation	11.4
82	• Using equipment clean of soils from other sites; • For reclamation, using only local soil and rock material, or ensure that it is clean fill; • Re-vegetating terrestrial habitat naturally, unless it is determined during progressive rehabilitation studies that re-seeding with native species is preferable and can be accomplished without introducing invasive, non-native plant species; and • Establishing a program for invasive plant detection on-site with a follow-up control and removal program, if required, in accordance with the recommendations of the Yukon Invasive Species Council for invasive plant control (YISC 2011).	• Establishment of invasive species	11.4
83	Implementing dust control measures, as per the air quality management guidelines.	• Dust deposition on vegetation, particularly rare plants	11.4
84	Site selection to consider potential for rare plants, realign or in extreme circumstances transplant.	• Loss of rare plants and rare plant habitat	11.4
85	• Use clean equipment. • Allow vegetation to re-establish naturally or by using native seed mixes.	• Loss of rare plant habitat due to introduction or expansion of invasive species	11.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Establish a program for invasive plant detection.		
Wildlife			
86	CMC commits to all of the mitigations listed in the Wildlife Mitigation and Monitoring Plan (Appendix 23A).	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	Appendix 23A
87	To minimize effects on wildlife from mine site infrastructure and activity, CMC will: • Minimize the Project footprint; • Not damage or interfere with active dens of any species; • Implement a no-hunting policy for Project employees while working on site, mitigating mortality risk; • Implement a zero tolerance policy for wildlife harassment by Project-related employees and contractors, mitigating mortality risk and habitat loss; • Suppress dust on the road and at mine site during dry conditions to reduce the extent of dispersal into adjacent environments, mitigating habitat loss; • Give wildlife the right-of-way when on all roads, mitigating mortality risk and habitat loss; and • Freshwater pipeline to well system will be constructed to allow animal movement across (over or under).	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	12.3
88	To mitigate potential effects on wildlife from construction, operation and closure and decommissioning of the Freegold Road upgrade and extension, CMC will: • Design road embankment heights and materials to allow for wildlife movement; • Manage snow embankments along the road to	• Loss of wildlife habitat • Restrict wildlife movement • Increased wildlife mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal Section
	allow wildlife easier crossing of the Freegold road and reduce the likelihood of wildlife getting trapped between embankments, mitigating potential barrier effects and mortality risk; • Control access of non-project personnel to the road by installing and manning a gate, mitigating mortality risk; • Radio communication among drivers to warn others when wildlife are observed along the road, mitigating mortality risk; and • Implement measures to prevent and manage spills to reduce the potential for wildlife exposure to contaminants, mitigating reduced health.		
89	CMC will partially mitigate the risk of reduced caribou habitat availability within the winter range of the KCH by: • Timing road construction activities to minimize or avoid disturbance during the late-winter period (1 February to 30 April) within the KCH winter range high quality habitat; • Implementing a policy to ensure caribou approaching the road are given the right-of-way; • Implementing snow bank management measures to facilitate caribou movement across the roadway; • Designing road embankment heights and materials to allow for caribou movement; and • Placing construction camps and borrow pits to minimize or avoid disturbance to the KCH.	• Loss of caribou habitat • Restrict caribou movement	12.3
90	CMC will partially mitigate the risk of increased caribou mortality due to collisions with vehicles travelling the road by: • Installing signage that warns drivers of known caribou crossing or foraging areas along the road;	• Increased caribou mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Reducing speed limits where caribou interact with the road during the winter; • Enforcing road speed limits by remotely tracking (e.g., GPS tracing) truck traffic; • Snow plowing escape routes for caribou; • Reporting of caribou sightings along the road to a wildlife monitor; • Ensuring constant radio communication among trucks to identify wildlife locations on an ongoing basis; • Employing a seasonal wildlife monitor to coordinate implementing caribou mitigations; • Reporting and investigating all Project-related caribou near-misses and mortalities; and • Triggering adaptive management strategies if there is a Project-related caribou mortality.		
91	CMC will mitigate the risk of increased caribou mortality from harvest by managing the Freegold Road extension as a private industrial road by: • Restricting access to the road during operation by installing a continuously manned gate at Big Creek; • Decommissioning the road during the reclamation and closure phase; and • Development of a wildlife management working group, including regulators and stakeholders, to provide advice to governments on mitigation, monitoring and adaptive management strategies.	• Increased caribou mortality	12.3
92	To reduce Project effects on moose, CMC will: • Manage roadside vegetation along Project roads to discourage moose foraging (e.g., cutting roadside vegetation in spring, not mid-summer; and	• Loss of moose habitat • Reduced movement	12.3

Number	Commitment	Adverse Residual Effect	Proposal Section
	• The 17 km long water pipeline will be designed to allow for moose, and other wildlife to move across the pipeline (i.e. pipeline clearance (distance from bottom of pipeline to ground) will be a minimum of 180 cm every 400 to 700 m to allow for moose passage under the pipeline or will be completely buried to allow for moose passage over the pipeline. Pipeline crossing structures may be constructed in high density/movement areas where the pipeline cannot be raised or buried sufficiently.		
93	To reduce Project effects on grizzly bears, such as loss of habitat or increased mortality, CMC will: • Assess any new den sites identified during construction or operation to determine if they are currently utilized; • Avoid blasting within 500 m of known den sites when bears are likely to be present; • Avoid known, active bear dens during the denning season November through to mid-April; and • Incorporate Best Management Practices for food, waste and fuel management into the design on the Project.	• Loss of grizzly bear denning habitat • Increased grizzly bear mortality	12.3
Employment and Income			
94	CMC commits to the continued recruitment, training, and advancement of Yukon workers and will work to increase the number of Yukon resident workers over the lifetime of the mine CMC will enhance these positive effects by: • Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA; • Implementing a procurement process that, where	• Project workforce demands would increase local and regional employment • Increased employment during construction and operations would positively affect labour income for LSA and RSA residents	13.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	economically feasible, gives preferences to suppliers from the RSA and in particular from rural communities within the LSA; • Requiring cultural awareness training for Project-related employees and contractors; • Monitoring Project socio-economic effects and adapting management measures where required; • Providing on-the-job training to assist local and regional workers to develop mining-specific skills; • Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; • Partnering with First Nation communities to access additional funding for training; • Supporting non-mining training and entrepreneurial initiatives; and • Implementing career training and development opportunities for employees once hired.		
95	CMC will work with other mining companies within the RSA to attract local workers set to be laid-off as other mines reach their end-of-life.	• Project competition for local labour may result in shortages in other sectors and industries	13.4
96	CMC will use reasonable best efforts to draw workers from the existing unemployed or underemployed regional labour pool.	• Project purchases would generate employment opportunities for LSA and RSA residents	13.4
97	CMC commits to the continued recruitment, training, and advancement of Yukon workers and will work to increase the number of Yukon resident workers over the lifetime of the mine by: • Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA; • Implementing a procurement process that, where	• Project workforce demands would increase local and regional employment • Increased employment during construction and operations would positively affect labour income for LSA and RSA residents	

Number	Commitment	Adverse Residual Effect	Proposal Section
	economically feasible, gives preferences to suppliers from the RSA and in particular from rural communities within the LSA; • Requiring cultural awareness training for Project-related employees and contractors; • Monitoring Project socio-economic effects and adapting management measures where required; • Providing on-the-job training to assist local and regional workers to develop mining-specific skills; • Providing training and education for potential employees from Yukon and in particular the rural communities within the LSA; • Partnering with First Nation communities to access additional funding for training; • Supporting non-mining training and entrepreneurial initiatives; and • Implementing career training and career advancement opportunities for employees once hired.		
98	CMC will work with other mining companies within the RSA to attract local workers set to be laid-off as other mines reach their end-of-life.	• Project competition for local labour may result in shortages in other sectors and industries	
Employability			
99	After Project production ends CMC will, for a reasonable amount of time, assist Project-related employees to enhance their employability and find new employment in the mining industry.	• Loss of operational employment at closure resulting in a large net decrease in local and regional employment	
100	CMC will implement a Recruitment, Training, and Employment Plan to encourage recruitment and retention of local/regional/territorial residents for Project-related employment.	• Training programs during operations would enhance the local and regional skills profile and employment levels • Employment opportunities will increase	14.4

Number	Commitment	Adverse Residual Effect	Proposal Section
		incentive for educational attainment and training of local residents • Project employment will improve capacity and industry experience of workers	
101	CMC will implement a procurement process that, where feasible, gives preference to suppliers from the RSA and LSA; Contractors would be encouraged to hire local/regional/territorial residents to the extent practical.	• Improved capacity and industry experience of contractors	14.4
Economic Development and Business Sector			
102	CMC will encourage contractors to hire local/regional residents to the extent practical.	• Project purchases of goods and services would increase Yukon GDP and employment	15.4

Number	Commitment	Adverse Residual Effect	Proposal Section
103	CMC will seek to recruit local/regional/territorial residents to the extent practical for Project-related employment.	• Project workforce demands would increase Yukon GDP and employment • Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses • Direct and indirect taxes paid by Project, contractors and individuals will positively contribute to the Yukon tax revenues and will increase government revenues	15.4
104	CMC will use local and regional suppliers when these suppliers can provide products and services at competitive prices and timeframes.	• Re-spending by households of additional income that has been derived directly or indirectly from the mine employment will increase economic activity and businesses • Proposed Project purchases will create contract and business opportunities across the Yukon • Direct and indirect taxes paid by Project, contractors and individuals will positively contribute to the Yukon tax revenues • Additional direct and indirect taxes paid by Project employees will increase government revenues	15.4
Community Vitality			
105	CMC commits to: • Priority hiring for qualified local residents • Encourage workers hired from outside Yukon to re-locate into the territory • Employing a community liaison staff member who focuses on community relationships and working with community staff on	• Population changes from out-of-territory mine workers and their dependents moving residency to RSA	16.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	housing/planning issues related to mine staff.		
106	CMC commits to: • Implementing a hiring policy that encourages the employment of workers from Yukon and in particular the rural communities within the LSA • Implementing a procurement process that gives preference to suppliers from the RSA and LSA.	• Population changes from migration to the RSA to take advantage of higher incomes and employment rates generated by the Project	16.4
107	CMC commits to: • Pursuing employment opportunities in negotiation of cooperation agreements with First Nations. • Implementing a hiring policy that encourages the hiring of Project-related employees from rural communities within the LSA.	• Potential lack of employment and income equity for women, Aboriginal peoples, people with disabilities, and visible minorities	16.4
108	CMC commits to: • Offer to deposit employees' salaries directly into their bank accounts • Assist Project-related employees to find counseling services where needed • Facilitate money management training as required to those employees who do not have experience with high wage earnings and working in mines • Implement a zero tolerance policy with respect to drug and alcohol at the Project site for Project employees and contractors • Work with local agencies in monitoring Project socio-economic effects and to take corrective actions where appropriate.	• Spending decisions in relation to disposable income could affect family and community well-being	16.4
109	CMC commits to: • A self-contained camp on site to house workers	• Influx of workers and their families could create negative behavioural changes and reduce family and community well-being	16.4

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Implementing a zero tolerance policy with respect to drug and alcohol use at the Project site for Project employees and contractors • CMC will help identify counseling services to its employees if needed • CMC will provide money management training as required to those employees who do not have experience with high wage earnings and working in mines • CMC will work with local agencies to monitor Project socio-economic effects and to develop and implement corresponding measures as appropriate.		
Community Infrastructure and Services			
110	To decrease potential Project effects on community infrastructure and services in the LSA, CMC will: • Provide a local fresh water supply, sewage treatment plant and power supply at the mine site • A permanent waste management facility will be established at the mine site during the construction phase • The camp will have indoor and outdoor recreation services • All construction activities will follow best practices and will be outlined in the Environmental Health and Safety (EHS) Management System • CMC will provide, at the site and the camp, health and medical equipment and personnel as well as arrangements to med-evac workers with life-threatening illnesses or injuries to the nearest appropriate facility.	• Population change will alter demand for health and social services.	
111	CMC will work closely on an ongoing basis with	• Population change will alter demand for	

Number	Commitment	Adverse Residual Effect	Proposal Section
	Whitehorse General Hospital, local fire departments, RCMP and Yukon Ambulance to ensure that the appropriate information on the changes in area transportation volumes, mine operations and the change to the local population are considered.	Protective Services	
112	CMC will provide contracted security services that will focus on ensuring a secure and safe work site.	• Infrastructure and service capacity	
113	CMC will provide a fly in/fly out camp to offset project demands for housing and temporary accommodation.	• Population change will alter demand for housing and temporary accommodation	
114	Casino Mining Corporation will provide on-the-job training to assist local and regional workers to develop mining-specific skills. CMC will support programs and initiatives at local schools and Yukon College. CMC will implement a Recruitment, Training and Employment Plan.	• Increase demand for educational services	
115	CMC will implement a Road Use Plan and an Emergency Response and Spill Management Plan. CMC will enforce speed limits on roads under its control. CMC will perform regular vehicle maintenance on its own vehicles and will perform regular road maintenance to reduce risk to motor vehicle safety. CMC will consult with Transport Branch of YG to ensure compliance with transport regulations.	• Increased traffic and risk for motor vehicle collisions on the Klondike Highway and Freegold Road	
116	CMC will discuss Worker Transportation Plan with Whitehorse Airport authority i.e. evaluate peak passenger/aircraft volumes and, as necessary, schedule work rotation schedules to minimize airport and passenger congestion.	• Demands on air transportation infrastructure	
117	CMC will work with communities in the LSA to develop a	• decrease demand for housing and	

Number	Commitment	Adverse Residual Effect	Proposal Section
	mine closure plan that identifies strategies and actions to help minimize the potential adverse effects of closing the mine.	temporary accommodation and local services	
Cultural Continuity			
118	CMC will develop a socio-economic monitoring plan jointly with community and regional partner organizations such as training institutions, economic development agencies, and municipal and provincial/territorial government agencies.	• General cultural effects	18.4
119	CMC will design the Project to have as compact a mine site footprint as practicable.	• General cultural effects	18.4 Table 18.4-4
120	CMC commits to progressive reclamation of the Maximum Disturbance Area (with the exception of the open pit and TMF).	• General cultural effects	18.4
121	A Heritage Resource Protection Plan will be developed to detail the methods for avoiding, mitigating, reporting, and recovering any heritage resources that are found during Project development activities.	• General cultural effects	18.4 22
122	Mitigation measures include avoidance of known or suspected historical, cultural, or archaeological places; if avoidance is not possible, archaeological mitigation will be completed following the Yukon Heritage Policy.	• General cultural effects in Maximum Disturbance Area	18.4 Table 18.4-4
123	Access Mitigation - A Road Use Management Plan (Section 22) will be developed for the Project in coordination with First Nations and the Yukon Government which will include: • No public access on the Freegold Road Extension or access by permit, as directed and agreed by the the Yukon and First Nation governments. • Controlled, gated, manned access at the new bridge over Big Creek or as otherwise agreed. • A stakeholder communication /engagement plan to	• General cultural effects related to access as the result of the use of the Freegold Road Extension.	18.4 22

Number	Commitment	Adverse Residual Effect	Proposal Section
	ensure concerns are identified and addressed.		
124	A traffic communication bulletin /update will be circulated in local communities and to key stakeholders on a routine basis to inform users of current road status.	• General cultural effects related to access	18.4 Table 18.4-4
125	An information line will also be established to answer questions regarding the Project status.	• General cultural effects related to access	18.4
126	A monitoring program will be implemented to ensure that local land users are not gaining access to the Freegold Road Extension via alternative routes.	• General cultural effects related to access	18.4
127	At closure, public health and safety assessment will be conducted for the mine site to identify potential risks and develop appropriate, specific long-term mitigation and management measures (such as fencing and signage).	• General cultural effects related to access	18.4 Table 18.4-4
128	Change in local ambience, such as traffic, noise and emissions, and related wilderness experience will be mitigated by: • Implement Environmental Management Plans • Minimizing traffic noise and emissions by incorporating accepted best management practices • Ensuring on-site equipment is regularly maintained to control noise and emissions • Proper sound buffering of the ore processing facility on site • Implement an Air Quality Management Plan • On-going communications and engagement with First Nations to document potential effects associated with traffic, emissions and noise along the Freegold Road corridor.	• General cultural effects related to ambience	18.4.2 & Table 18.4-4
129	Mine employees and contractors will be restricted from harvesting within the mine site footprint and while on	General cultural effects related to loss of plant/animal resources	18.4.2 & Table 18.4-4

Number	Commitment	Adverse Residual Effect	Proposal Section
	shift at any time.		
130	To minimize effects associated with employment at the mine CMC will include: • Shift flexibility, when possible, to accommodate subsistence harvesting and participation in cultural activities/events • Supporting efforts to revitalize Northern Tutchone language and incorporate Northern Tutchone language into mine signage in consultation with the SFN and LS/CFN; • Incorporating Aboriginal ceremonies at the mine site in consultation with the SFN and LS/CFN; • Providing support for community cultural events based on input from SFN and LS/CFN and other local communities; and • Conduct cultural awareness training for all employees and contractors working at the mine site.	General cultural effects related to opportunities to participate in cultural activities	18.4.2 & Table 18.4-4
Land Use and Tenure			
131	CMC will limit the mine footprint; implement appropriate best management practices and reclamation and closure measures; ensure ongoing communication with FN and local stakeholders.	• Loss of available area for FN traditional land use activities • Loss of available area for quartz and placer mining • Loss of available area for trapping and outfitting	
132	To mitigate against changes to access to traditional land, mineral tenures, and recreational lands CMC commits to:	• Changes to access to Traditional Territories, mineral tenures, trapping areas, guide outfit concessions and	

Number	Commitment	Adverse Residual Effect	Proposal Section
	• Working with First Nation and Yukon Government to ensure management of the Freegold Road Extension does not interfere with the rights of other existing tenure holders. • Implement access management measures and associated monitoring and communication plans. • ongoing communication with FN and local stakeholders.	recreational areas	
133	CMC will • limit mine footprint; • implement appropriate EMPs (e.g., Air Quality Management Plan) and reclamation and closure measures; • maintain ongoing communication with local stakeholders.	• Reduced wilderness experiences for First Nations, trappers, outfitters and recreational land users	
134	CMC will limit this potential cumulative effect by: • Implementing a no public access policy unless directed by the Yukon and First Nations Governments • Manned access at control points • Explore a cooperative approach to management of access to the Freegold Road Extension involving the Casino Mining Corporation, the Yukon government, Selkirk First Nation and Little Salmon/Carmacks First Nation.	• Overall increase in existing and future permitted placer and quartz exploration and mining activities along the Freegold Road Upgrade	

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