CASINO

Supplementary Information Report

Response to Request for Supplementary Information

to the Proposal for the Casino Project

submitted by Casino Mining Corporation

on January 3, 2014

Pursuant to the Yukon

Environmental and Socio-economic Assessment Act

YESAB Registry # 2014-0002

December 18, 2015

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APPENDICES

Appendix B.1A Concordance Table to the Executive Committee's Request for Supplementary Information

Appendix B.4A Guide to the Management of the Casino Tailings Facility

Appendix B.4B Mine Waste Management Alternatives Assessment

Appendix B.4C Tailings Management Facility Dam Breach Inundation Study

Appendix B.4D Tailings Management Operation, Maintenance and Surveillance Manual

Appendix B.4E 2014 and 2015 Geotechnical Testing of Leach Ore

Appendix B.4F Ore Characterization

Appendix B.4G Review and Updates to the Conceptual Wetland Water Treatment Design

Appendix B.6A Fluvial Geomorphology report (Appendix 6E) missing Tables and Figures

Appendix B.7A Updated Baseline Water Quality Statistics

Appendix B.8A Air Quality Results (Digital Files)

Appendix B.18A Heritage Resource Management Plan

ABBREVIATIONS

AAH .... annual allowable harvest
ANFO .... ammonium nitrate/fuel oil
ARR .... Adequacy Review Report
BB .... burbot
BC .... Province of British Columbia
BLEVE .... boiling liquid expanding vapor explosion
BMP .... Best management practices
CCG .... slimy sculpin
CCME .... Canadian Council of Ministers of the Environment
CCRP .... Conceptual Closure and Reclamation Plan
CDA .... Canadian Dam Association
CH .... juvenile Chinook salmon
CMC .... Casino Mining Corporation
CMHC .... Canadian Mortgage and Housing Corporation
CO .... carbon monoxide
CO_2 .... carbon dioxide
COI .... Communities of Interest
COSEWIC .... Committee on the Status of Endangered Wildlife in Canada
CPUE .... catch per unit effort
CRA .... commercial, recreational and Aboriginal
CTFN .... Carcross Tagish First Nation
CWBI .... Community Well-Being Index
dBA .... A-weighted decibel (sound pressure)
DEM .... Digital elevation models
DFO .... Department of Fisheries and Oceans Canada
EMR .... Yukon Government Department of Energy, Mines and Resources
EMS .... Emergency Medical Services
EOR .... Engineer of Record
EPA .... U.S. Environmental Protection Agency
ERP .... Emergency Response Plan
FHOP .... Fish Habitat Offsetting Plan
FHWA .... United States Federal Highways Administration
FMEA .... Failure Modes and Effects Analysis
FN .... First Nations
GHG .... Greenhouse Gases
GIS .... Geographic information system
GMA .... Game management area
GMS .... game management subzone
GPR .... Ground penetrating radar
GR .... Arctic Grayling
HDPE .... high density polyethylene
HEP .... Habitat Evaluation Procedure

HLF .... Heap leach facility
HLF .... heap leach facility
HPW .... Highways and Public Works
ICMC .... International Cyanide Management Code
ICOLD .... the International Commission of Large Dams
IDF .... inflow design flood
IERP .... Independent Engineering Review Panel
ISSMGE .... International Society for Soil Mechanics and Geotechnical Engineering
ITRC .... Interstate Technology Research Council
KCB .... Klohn Crippen Berger
KCH .... Klaza caribou herd
LDRS .... Leak Detection and Recovery System
Leq .... Average weighted sound levels
LLDPE .... Linear low-density polyethylene
LNG .... Liquefied natural gas
LNG .... liquefied natural gas
LSA .... Local Study Area
LSCFN .... Little Salmon/Carmacks First Nation
MAA .... Mutual Aid Agreement
MAC .... Mining Association of Canada
MDE .... maximum design earthquake
MEND .... Mine Environment Neutral Drainage Program
MiHR .... Mining Industry Human Resources Council
MMER .... Metal Mine Effluent Regulations
MOE .... BC Ministry of Environment
MSDS .... material safety data sheets
NAG .... Non-Potentially Acid Generating
NFC .... No fish caught
NFPA .... National Fire Protection Association
NMP .... Northern mountain population
NOx .... nitrogen oxide compounds
NP/AP .... Neutralization Potential/Acid Production Potential
NPR .... neutralization potential ratio
NRCan .... Natural Resources Canada
NS .... Not sampled
NWT .... Northwest Territories
OBE .... operating basis earthquake
OGC .... British Columbia Oil and Gas Commission
OM&S .... Operating, Maintenance & Surveillance Manual
P&ID .... process and instrumentation diagrams
PAG .... Potentially acid generating
PAG .... potentially acid generating
PDA .... Potential Disturbance Area
PFD .... process flow diagrams
PHABSIM .... Physical Habitat Simulation
PM10 .... inhalable particulate

PM2.5 .... respirable particulate
PMF .... probable maximum flood
PMP .... Permafrost Management Plan
PSL .... permissible sound level
PTDRLGRR ....
Provincial and Territorial Departments Responsible for Local Government, Resiliency and Recovery Project Committee
QA/QC .... Quality Assurance/Quality Control
QML .... Quartz Mining License
QP .... Qualified Professional
QP .... Qualified Professional
RIC .... Resource Inventory Committee
RoW .... right of way
RSA .... Regional study area
RSF .... resource selection analysis
RSPF .... resource selection probability function
SARA .... Species at Risk Act
SEMP .... Socio-Economic Management Plan
SFN .... Selkirk First Nation
SIA .... Social Impact Assessment
SIR .... Supplementary Information Report
STI .... Sexually transmitted infection
the Project .... Casino Project
THFN .... Tr'ondëk Hwëch'in First Nation
TK .... Traditional Knowledge
TLU .... Traditional land use
TMF .... Tailings Management Facility
TPM .... total particulate matter
TSF .... Tailings storage facility
TSP .... total suspended particulate
UBC .... University of British Columbia
VC .... Valued Component
WMMP .... Wildlife Mitigation and Monitoring Plan
WMP .... Water management pond
WQG .... Water quality guidelines for the protection of aquatic life
WRFN .... White River First Nation
WSC .... Water Survey of Canada
YCDC .... Yukon Conservation Data Centre
YESAA .... Yukon Environmental and Socio-Economic Assessment Act
YESAB .... Yukon Environmental and Socio-Economic Assessment Board
YG .... Yukon Government
YG .... Yukon Government
YISC .... Yukon Invasive Species Council
ZOI .... Zone of Influence

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B.1 – INTRODUCTION

B.1.1 PROJECT ASSESSMENT TIMELINE

Casino Mining Corporation (CMC) submitted a Project Proposal under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) to the Yukon Environmental and Socio-economic Assessment Board (YESAB) on January 3, 2014. The Project Proposal contained five volumes and 25 chapters of documentation to support the assessment of the Project under the YESAA regulations. As production capacity of the proposed Project is greater than 300 tonnes per day, the Project is subject to an Executive Committee Screening for the proposed construction, decommissioning and closure activities.

On May 23, 2014, CMC requested that YESAB place the review of the Project on hold for up to 180 days to enable CMC to continue engagement with affected First Nations. YESAB granted the request on June 2, 2014. The hold period was lifted on November 27, 2014, and YESAB issued the *Adequacy Review Report: Project Assessment 2014-0002, Casino Mine* on January 27, 2015.

CMC submitted a response to that Adequacy Review Report on March 16, 2015, in the form of a Supplementary Information Report (SIR-A) for evaluation by YESAB. After review of the SIR-A, YESAB issued *Adequacy Review Report Information Request No.2: Project Assessment 2014-0002, Casino Mine* (ARR-2) on May 15, 2015.

This Supplementary Information Report (SIR-B) has been written to respond to ARR-2. The information contained in SIR-B supplements information previously provided in the Project Proposal, and in Supplementary Information Report (SIR-A) submitted on March 16, 2015. There have been no changes to the conclusions of potential effects and determinations of significance presented in the Proposal.

B.1.2 STAGES OF PROJECT DEVELOPMENT

CMC urges the Executive Committee to allow the environmental assessment to begin. CMC has made every effort to involve stakeholders in the development and evolution of the Casino Project over the 8 year project development process. Almost $70 million dollars have been spent and considerable effort has been made, all with a view to responsibly develop the Casino Project. These efforts commenced in 2008 and have continued throughout the environmental assessment and include:

- Early and frequent meetings with identified First Nation Governments;
- Three Cooperation Agreements signed between CMC and the Selkirk First Nation, Little Salmon/Carmacks First Nation, and Tr'ondëk Hwëch'in and commitments to ongoing engagement;
- Pre-submission meetings with YESAB;
- On-going Project Updates with Yukon Government and Federal Government; and
- Regular updates to the public and land tenure holders on Project development.

The Casino Project has consequently evolved over the duration of these consultations to take into consideration the concerns and feedback of these stakeholders to refine the Project components to be the most acceptable from an environmental and socio-economic perspective. These refinements include:

- Positioning the road route to avoid areas of importance to First Nations;
- Minimizing the Project footprint to avoid impacts to the Yukon River;

- Placement of all Project infrastructure in a single watershed with zero discharge during operations and a single, controlled point of discharge during closure;
- Mine waste disposal in a single facility to minimize impacts to fish bearing aquatic systems;
- Subaqueous co-disposal of tailings and waste rock in accordance with metal leaching/acid mine drainage prevention best management practices;
- Incorporation of proven treatment systems to ensure environmental protection in perpetuity; and
- Advancing project engineering to a feasibility study level prior to the Submission of the Project Proposal to ensure that the proposed project is technically viable.

CMC has also committed to the on-going incorporation of environmental and socio-economic oversight beyond the environmental assessment phase through the following initiatives:

- **Independent Engineering Review Panel** (IERP): The purpose of IERP is to provide independent expert advice on the engineering design, construction, operations and closure planning stages of the tailings management facility (TMF) and heap leach facility (HLF). While CMC has voluntarily created the IERP for the Casino Project, independent tailings dam review boards have become mandatory for ***operating*** mines in British Columbia, and guidance for independent audits or assessments are outlined by the Mining Association of Canada in their *Guide to the Management of Tailings Facilities*, also intended for operating facilities.
- **The International Cyanide Management Code** (ICMC): As a signatory, CMC will comply with the Principles and Standards of Practice that make up with ICMC. Once operational, CMC will seek certification in compliance with the ICMC, which will require meeting performance goals and objectives as detailed by the International Cyanide Management Institute.
- **The Mining Association of Canada** (MAC): As a member, CMC will meet the guiding principles of the Towards Sustainable Mining (TSM) initiative, thereby obtaining the highest level of environmental and social commitments for modern mining companies in Canada. Through the TSM initiative, CMC will provide communities with valuable information on how its operation is faring in important areas, such as community outreach, tailings management, and biodiversity.
- **Stakeholder engagement:** CMC will initiate working groups for the continued involvement of affected First Nations, Territorial and Federal Governments and communities of interest throughout the detailed design, construction, operations and closure phases, including:
  - **TMF Working Group**: a working group to engage in technical review and discussion relating to the design and operation of the Tailings Management Facility;
  - **Wildlife Working Group**: a working group to review and provide advice on all aspects of the Wildlife Mitigation and Monitoring Plan; and
  - **Other Groups:** CMC will initiate other working groups, as required, to review and provide insight on key components of the Project.

The process of corporate and regulatory review, approval, and oversight is illustrated in Figure B.1.2-1.

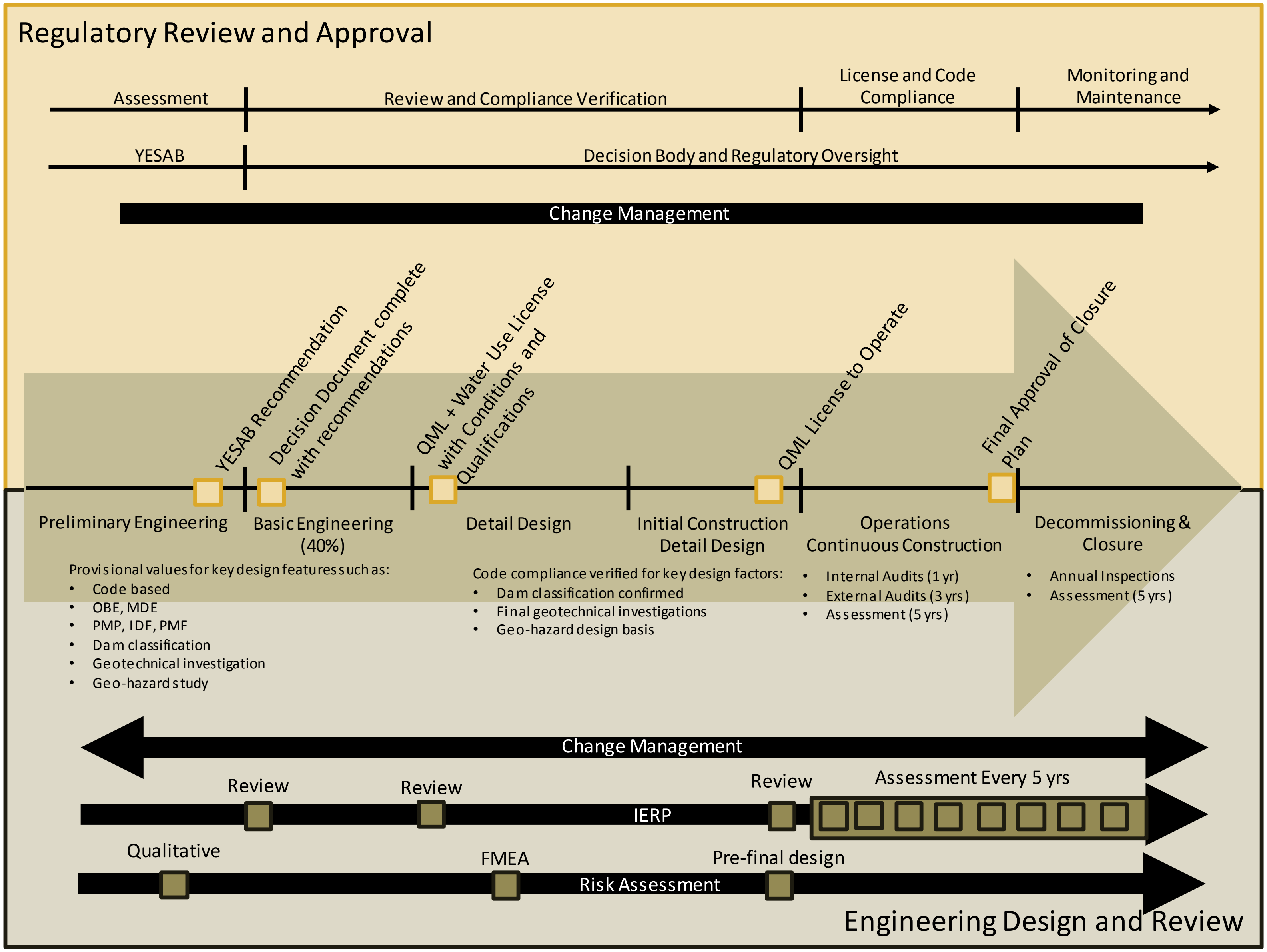

Figure B.1.2-1 Corporate, Regulatory and Engineering Review throughout Mine Life

B.1.3 GENERAL PRINCIPLES OF THE ASSESSMENT PROCESS

CMC recognizes and values the YESAB assessment process and the importance of this process in protecting the environmental and socio-economic values of all residents of the Yukon. The process provides valuable input to CMC for consideration as the project moves through successive stages of development.

A common understanding of what constitutes assessment and what information is required to support the assessment process is essential for this process to be effective for the proponent, YESAB, the Yukon Territory, and more broadly, Canada.

The general purpose and intent of the assessment process, as described in various jurisdictions, is an early stage project development process that is intended to predict the potential environmental impacts, environmental impact mitigation strategies, and socio-economic benefits of a given project to assess the trade-offs and balancing of interests to arrive at a judgement as to the overall merit of the proposed project in the interest of the community at large and to make a recommendation that the project, on its merits, should or should not proceed to subsequent detailed regulatory reviews and potential development.

This general assessment philosophy mirrors the principles expressed to CMC by YESAB, portrayed on the YESAB website, and conveyed in documents such as *Dam Guide: Design Expectation and Required Information* (YESAB and Yukon Environment, 2012) and the *Proponents Guide to Information Requirements for Executive Committee Project Proposal Submissions* (YESAB, 2005). It is clear from these documents and communications that there is an understanding and recognition within YESAB that projects undergo an evolution from the conceptual or preliminary design phase through basic and detailed engineering, course of construction verification and modification, and finally documentation of the as-built project. It is also evident that the information needs and the availability of information pertinent to the operational phase and post-operational phase have a timeline distinct from the design and construction phases. *The Dam Guide: Design Expectation and Required Information*, for example, recognizes that the level of design, data, and supporting information available and required for review varies at each distinct stage. The assessment process is part of a broader regulatory review framework.

B.1.4 REGULATORY REVIEW FRAMEWORK

CMC recognizes that project review and approval requires meeting the requirements of a multi-stage regulatory process (as illustrated in Figure B.1.2-1), including:

- **Environmental Assessment:** After screening and/or review (during which there are additional information request opportunities), the Project would only be allowed to proceed subject to specified terms and conditions to mitigate any adverse environmental or socio-economic effects. A conceptual level of design information is generally appropriate for the environmental assessment stage (see *Dam Guide – Design Expectations and Required Information* discussed below).
- **Decision Bodies:** The decision bodies must consider the recommendations resulting from the environmental assessment under the YESAB and issue a Decision Document determining whether the project should be allowed to proceed, subject to meeting terms and conditions for the mitigation of any potential adverse environmental or socio-economic effects. If the decision bodies allow the project to proceed under the terms and conditions of a Decision Document, then regulatory agencies such as the Yukon Water Board (YWB) and the Yukon Government Department of Energy, Mines and Resources

(EMR), and CMC, as the proponent, will be required to implement the terms and conditions of the Decision Document in any licences or other regulatory authorizations.

- **Application for a Quartz Mining Licence (QML) under the Quartz Mining Act:** *The Plan Requirement Guidance for Quartz Mining Projects*, August 2013, is applicable to applications for a QML. While a public hearing is not required, the application for a QML will be reviewed and considered in detail by EMR. Again, more detailed design information will be required from CMC, as the proponent, to support the application for a QML.
- **Application for a Type A Water Licence to the YWB:** Under the terms of the Waters Act, the YWB must not issue a Water Licence unless the proponent satisfies the YWB that any waste that would be produced will be treated and disposed of in a manner that is appropriate to the maintenance of water quality standards, and effluent standards considered acceptable by the YWB for the protection of water quality. The YWB must hold a public hearing for a Type A Water Licence. More detailed design information will be required from CMC, as the proponent, to support the application for a Water Licence.

The Water Licence and the QML, if issued, will each include detailed terms and conditions requiring submission of final design drawings and as-built drawings for review before commencing construction and operation of a project.

Guidelines and information requirements issued in relation to the YESAB process, the licencing application processes under the Waters Act and the Quartz Mining Act, and the terms of Quartz Mining Licences and Water Licences, provide for increased levels of design information as a project moves through the process.

One such example, is *The Dam Guide – Design Expectations and Required Information*, issued by YESAB and Yukon Environment, which indicates as follows with respect to design information:

- Generally, a conceptual level of design information is appropriate for the assessment stage. The greater the potential effects/risks of a dam, or effects related to its potential failure, the more detailed the information will need to be (Dam Guide, page 4). We acknowledge that the dam proposed for the Casino Project is a significant structure, but its design will be subject to detailed review at the licence application stage and the regulatory compliance stage, we ask that YESAB take into account the progression from conceptual design, to preliminary design, and ultimately to final design, within the regulatory processes and authorities in Yukon.
- Regulatory agencies (such as the YWB or the MEMR) require more detailed design information. The YWB and the EMR will require preliminary designs of infrastructure as part of licence applications (Dam Guide, pages 5 and 6).
- The Quartz Mining Licence and the Water Licence will include terms and conditions requiring the filing of final design drawings and as-built design drawings for review prior to construction (Dam Guide, page 6).

EMR states as follows (website) with respect to the relationship between the environmental assessment process and the regulatory process:

> *"The Yukon Government works with the proponent and YESAB on the integration of the assessment and regulatory requirements."*

Coordination between YESAB, EMR and the YWB should result in the appropriate level of engineering design being required at each stage of the environmental assessment, licencing, and regulatory compliance phases of the process.

Under the *Plan Requirement Guidance for Quartz Mining Projects*, August 2013, issued by the YWB and EMR, a Tailings Management Plan is required, including "design details for all facilities related to tailings storage and management", including tailings dams, tailings handling facilities and equipment, contaminated water management facilities, water treatment facilities, and surface water management facilities. Section 14.3 of the *Plan Requirement Guidance* specifies that:

> *"Design and construction plans must account for site-specific conditions including adverse geotechnical conditions and extreme climatic events. Designs must demonstrate how the proposed facilities will meet the design criteria and that they will be stable both during construction and in the long term."*

Designs for all tailings storage facilities must include, among others: foundation conditions; site preparation; construction quality assurance/quality control; stability and settlement analyses; construction schedules; surface water management; liner systems; borrow sources; soil storage; and access management.

The *YWB Information Package for Applicants for Type A and B Quartz Mining Undertakings*, February 2012, provides guidance with respect to the information requirements of the Water Board with respect to Type A Water Licences. These include, in Section 5.8:

> *5.8 submit preliminary designs of site-specific project components of relevance to water use and waste deposition, including mining and mineral processing infrastructure, water management infrastructure, and mine waste emplacements. For clarity the Board considers that the preliminary design stage builds upon feasibility and/or conceptual studies required to determine the desirability of proceeding with a particular project. The objectives of preliminary designs submitted to the Board are:*
>
> *i. to provide evidence that the proposed project component can satisfy its desired function in the normal and extreme operational and environmental conditions it will be exposed to throughout the life cycle of the component; and*
>
> *ii. to show compliance with relevant standards or guidelines, including hazard or risk classifications that may apply to that class of infrastructure, whether that is for human health and safety or environmental protection.*

In our discussions with staff of YESAB, we have emphasized that the review process in Yukon, from environmental assessment through licence applications and into regulatory compliance under the terms of licences, contemplates that the design of project components will progress from conceptual design, to preliminary design, to final design.

Additionally, the Project will be subject to detailed regulatory review and conditions. As an example, with respect to fish and aquatic resources, compliance with the Fisheries Act, and DFO authorizations, will be required for activities such as watercourse crossings which may affect fish or fish habitat. Details respecting the protection of fish and fish habitat and the appropriate mitigation measures will be addressed at the regulatory stage to ensure protection. Similarly, the YWB has a mandate to ensure protection of water quality, and both the YWB and EMR have mandates to review and regulate structural components of the project.

As such, in our responses to certain information requests in SIR-A, and again in SIR-B, we have responded to certain requests for design information by indicating that preliminary designs and final designs will only be available at the licence application stage and the licence compliance stage, and those designs will be subject to extensive review by the YWB and EMR, which each have regulatory authority and oversight.

B.1.5 RESPONSES TO INFORMATION REQUESTS

In the process of responding to YESAB's requests for additional information, CMC has identified the following trends in those requests:

- **Consideration for the stage of project development:** CMC is providing information representative of the planned Casino Mine Project commensurate and appropriate with the stage of review. The purpose for presenting preliminary design information is to allow assessors to determine if the presented design meets the necessary environmental and socio-economic protection objectives of the YESAA and meets the expectations of the decision bodies with respect to modern mining operations. Detailed engineering needs to be based on the optimized design outcomes of the environmental and socio-economic assessment process.

  In many instances, requests submitted in the ARR-2 require information that can only be developed in later stages of project development, such as detailed engineering or during the course of construction. As the project progresses through design, construction and into operations, it will undergo a number of reviews by regulatory agencies. Significant facilities, such as the HLF and TMF, will also be subject to review by external independent entities. These reviews will be detailed and continuous.

  YESAB must take into consideration that the information to respond to certain requests is simply not available and cannot be obtained at this stage of project development.

- **Legislative over-reach and duplication:** There are many examples in the ARR-2 where information requested is a requirement for permitting and licensing of a particular facility or system subsequent to assessment under YESAA and will be provided at the appropriate time. The design, construction, and operation of such facilities or systems are the responsibility of other regulatory agencies and will be subject to separate regulatory review at a later stage of project development. The assessment stage should focus on the conceptual design and should assume the project will comply with the pertinent regulation.

  CMC will provide the detailed requirements under all applicable Territorial and Federal Acts and Regulations when it submits the application for specific permits or licences. The final designs will be consistent with the Project design and environmental protection measures recommended by YESAB at the culmination of the YESAA process.

Information provided to date by CMC is based on conceptual and preliminary designs, information from test work or field investigations, and is consistent with early stage project development. There are many instances where the level and extent of the information provided goes well beyond what is typically provided for assessment purposes.

We ask that the Executive Committee take these regulatory stages into account in finding the appropriate balance and integration of the information required in the environmental assessment and subsequent regulatory requirements respectively.

In light of the above, CMC has attempted to respond to ARR-2 in the most fulsome manner, with the details and data available at this phase of project development. CMC will continue to provide information as requested throughout the Screening phase of the YESAB assessment to fulfill the needs of YESAB, decision bodies and interested persons participating in the assessment and looks forward to commencing the assessment process in a timely manner.

B.1.6 ORGANIZATION OF THE SIR-B

The SIR-B consists of four volumes of information, 17 sections and numerous detailed technical appendices. In order to simplify the review process, the SIR-B has been laid out using the same structure as the Project Proposal and the SIR-A. The section names in the SIR-B have remained consistent (e.g., Section 7 – Water Quality) with the other submissions, but the letter “B” has been added as a prefix to all section numbers and appendices. By comparison, section numbers and appendices in the SIR-A were prefaced with the letter “A”.

The purpose of the SIR-B is to provide supplementary information to support the initial risk assessment, and not to re-conduct the risk assessment process. Conclusions made regarding the significance of effects made in the Project Proposal are still applicable to the proposed Project.

For additional clarity, below is a Document Map of the SIR-B, which offers an “at a glance” directory of the material found in each section, within each volume, with their pertinent appendices. In addition, cumulative document maps which summarize the submissions for each volume throughout the Project Proposal, SIR-A and SIR-B are also provided below to help simplify the review process.

B.1.7 SUMMARY OF CHANGES TO THE PROJECT PROPOSAL

No changes to the Project Proposal have been made based on the information provided in the SIR-B.

VOLUME B.I: PROJECT INTRODUCTION & OVERVIEW

- **B.1** Introduction
  - **B.IA** Concordance Table to the Executive Committee's Request for Supplementary Information
- **B.2** First Nations and Community Consultation
- **B.4** Project Description
  - **B.4A** Guide to the Management of the Casino Tailings Facility
  - **B.4B** Mine Waste Management Alternatives Assessment
  - **B.4C** Tailings Management Facility Dam Breach Inundation Study
  - **B.4D** Tailings Management Operation, Maintenance and Surveillance Manual
  - **B.4E** 2014 and 2015 Geotechnical Testing of Leach Ore
  - **B.4F** Ore Characterization
  - **B.4G** Review and Updates to the Conceptual Wetland Water Treatment Design

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  - **B.6A** Tables and Figures from Appendix 6E
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  - **B.8A** Air Quality Results (digital)
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- **B.11** Rare Plants and Vegetation Health
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- **B.14** Employability
- **B.15** Economic Development and Business Sector
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- **B.18** Cultural Continuity
  - **B.18A** Heritage Resource Management Plan

VOLUME B.IV: ADDITIONAL YESAA REQUIREMENTS

- **B.21** Accidents and Malfunctions
- **B.24** Conclusions
- **B.25** References

PROJECT INTRODUCTION & OVERVIEW

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(January 2014)

- **1** Introduction
- **2** First Nations and Community Consultation
  - **2A** Consultation Log
  - **2B** Consultation Materials
- **3** Project Location
- **4** Project Description
  - **4A** Conceptual Closure Plan
  - **4B** Freegold Road Report
  - **4C** Water Management Plan
- **5** Effects Assessment Methodology
  - **5A** Project Components & Activities List
  - **5B** Cumulative Effects Assessment List

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VOLUME A.II:
(March 2015)

- **A.1** Introduction
  - **A.1A** Concordance Table to the Executive Committee's Request for Supplementary Information
- **A.2** First Nations and Community Consultation
  - **A.2A** Traditional Knowledge Bibliography
- **A.3** Project Location
- **A.4** Project Description
  - **A.4A** Tailings Management Facility Construction Material Alternatives
  - **A.4B** Information on Alternative Access Road Alignments
  - **A.4C** Feasibility Design of the Heap Leach Facility
  - **A.4D** Report on the Feasibility Design of the Tailings Management Facility
  - **A.4E** Results of Additional Lab Testing of Leach Ore
  - **A.4F** Waste Storage Area and Stockpiles Feasibility Design
  - **A.4G** Updated Hydrometeorology Report
  - **A.4H** Cold Climate Passive Treatment Systems Literature Review
  - **A.4I** Open Pit Geotechnical Design
  - **A.4J** Laboratory Evaluation of the SO_2/Air and Peroxide Process
  - **A.4K** Metal Uptake in Northern Constructed Wetlands
  - **A.4L** Revised Tailings Management Facility Seepage Assessment
  - **A.4M** Processing Flow Sheets
  - **A.4N** Scoping Level Assessment of Casino Property
  - **A.4O** Advanced Metallurgical Assessment of the Casino Copper Gold Project
  - **A.4P** Production of Environmental Tailings Samples for the Casino Deposit
  - **A.4Q** Mine Site Borrow Materials Assessment Report
  - **A.4R** Report on Laboratory Geotechnical Testing of Tailings Materials
- **A.5** Effects Assessment Methodology

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VOLUME B.I:
(December 2015)

- **B.1** Introduction
  - **B.IA** Concordance Table to the Executive Committee's Request for Supplementary Information
- **B.2** First Nations and Community Consultation
- **B.4** Project Description
  - **B.4A** Guide to the Management of the Casino Tailings Facility
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  - **B.4C** Tailings Management Facility Dam Breach Inundation Study
  - **B.4D** Tailings Management Operation, Maintenance and Surveillance Manual
  - **B.4E** 2014 and 2015 Geotechnical Testing of Leach Ore
  - **B.4F** Ore Characterization
  - **B.4G** Review and Updates to the Conceptual Wetland Water Treatment Design

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(January 2014)

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  - **6A** Surficial Geology, Terrain and Soils Baseline
  - **6B** Terrain Hazards Assessment for Proposed Access Roads and Airstrip
  - **6C** Preliminary Geotechnical Study
  - **6D** Terrain Hazards Assessment for Proposed Mine Site
  - **6E** Fluvial Geomorphology Hazard Assessment for Proposed Access Roads
- **7** Water Quality
  - **7A** Water and Sediment Quality Baseline
  - **7B** Baseline Hydrology Report
  - **7C** 2012 Baseline Hydrogeology Report
  - **7D** Geochemistry Reports
  - **7E** Numerical Groundwater Modelling
  - **7F** Water Balance Report
  - **7G** Water Quality Model Report
  - **7H** Project Effects on Water Quantity
- **8** Air Quality
  - **8A** Baseline Climate Report
  - **8B** Met, Dustfall, and Noise Data Summary Report 2011
  - **8C** Air Quality Baseline 2013
- **9** Noise
- **10** Fish and Aquatic Resources
  - **10A** Fish and Aquatic Resources Baseline Report
  - **10B** Freegold Road Fish and Aquatic Baseline
  - **10C** Preliminary Fish Habitat Compensation Plan
  - **10D** Freegold Road Extension S&EC Risk Assessment
- **11** Rare Plants and Vegetation Health
  - **11A** Vegetation Baseline Report
- **12** Wildlife
  - **12A** Wildlife Baseline Report
  - **12B** Bird Baseline Report

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  - **A.7B** Water Quality Predictions Report
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  - **A.7F** The Effect of Acid Rock Drainage on Casino Creek
  - **A.7G** Toxicity Testing Reports
  - **A.7H** Appendix A2 to Casino Waste Rock and Ore Geochemical Static Test Assessment Report: Cross-Sections
  - **A.7I** Casino Kinetic Testwork 2014 Update for Ore, Waste Rock and Tailings
  - **A.7J** Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage
  - **A.7K** Casino Mine Site Borrow Sites ML/ARD Potential
  - **A.7L** Casino Geochemical Source Term Development: Appendix B
  - **A.7M** 2013-2014 Groundwater Data Report
  - **A.7N** Extension of Numerical Groundwater Modelling to include Dip Creek Watershed
- **A.8** Air Quality
  - **A.8A** Emissions Inventory for Construction and Operations
- **A.9** Noise
- **A.10** Fish and Aquatic Resources
  - **A.10A** Updated Fish Habitat Offsetting Plan
  - **A.10B** Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study
- **A.11** Rare Plants and Vegetation Health
- **A.12** Wildlife
  - **A.12A** Wildlife Mitigation and Monitoring Plan V.1.2.
  - **A.12B** Wildlife Baseline Report V.2.
  - **A.12C** Moose Late Winter Habitat Suitability Report

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  - **18A** Stage 1 Archaeological Mitigation
  - **18B** Historic Resource Impact Assessment of the Freegold Road
- **19** Land Use and Tenure
  - **19A** Land Use and Tenure Baseline Report

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  - **A.13A** Economic Impacts of the Casino Mine Project
- **A.14** Employability
- **A.15** Economic Development and Business Sector
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- **A.17** Community Infrastructure and Services
- **A.18** Cultural Continuity
  - **A.18A** Heritage Resources Assessment Areas
  - **A.18B** Heritage Sites Summary
- **A.19** Land Use and Tenure

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VOLUME B.III:
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(January 2014)

- **20** Effects of the Environment on the Project
  - **20A** Climate Change Report
- **21** Accidents and Malfunctions
  - **21A** Regulatory Setting
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- **22** Conceptual Environmental Management Plans
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B.2 – FIRST NATIONS AND COMMUNITY CONSULTATION

B.2.1 INTRODUCTION

As summarized in Section 2 of the Proposal, CMC has shared information and consulted with potentially affected 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.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 4 requests for supplementary information related to Section 2 and Section A.2 First Nations and Community Consultation of the Project Proposal and SIR. These requests are outlined in Table B.2.1-1.

Table B.2.1-1 Requests for Supplementary Information Related to First Nations and Community Consultation

Request #	Request for Supplementary Information	Response
R2-207	Provide a record of discussions and concerns raised by all affected trapline concession holders. The discussion shall include an assessment of potential impacts and any proposed mitigations for all trapping concessions, focusing on concessions #150 and #408.	Section B.2.2.1.1
R2-208	Provide a record of discussions and concerns raised by all affected outfitting concession holders. The discussion shall include an assessment of potential impacts and any proposed mitigations for all outfitting concessions.	Section B.2.2.1.2
R2-209	A description of any contact or discussions between CMC and mineral rights holders in relation to the road. Also include a description of how many mineral claim holders have been contacted and a summary of the concerns raised.	Section B.2.3.1.1
R2-210	Assessment of effects, and potential mitigations if required, on the Yukon Quest.	Section B.2.4.1.1

B.2.2 TRAPPING AND OUTFITTING

B.2.2.1.1 R2-207

R2-207. Provide a record of discussions and concerns raised by all affected trapline concession holders. The discussion shall include an assessment of potential impacts and any proposed mitigations for all trapping concessions, focussing on concessions #150 and #408.

CMC has continued to consult with land tenure holders (i.e., concession holders, quartz and placer claim holders, etc.), and will continue to do so throughout the assessment process. In June 2015 letters were sent to all trapline concession holders within 500 m of the Project (Figure B.2.2-1) to invite direct communication with CMC as well as invite the land tenure holders to participate in the YESAB process. The updated consultation log, to reflect the activities in 2015 is provided in Table B.2.2-1. Letters were received from the holders of concessions #116 and #121, and echoed concerns expressed previously, including:

- The potential loss and decrease of available area for trapping and outfitting during construction, operations and closure and decommissioning of the Project;
- Easier access to area for others whose activities may conflict with trappers and outfitters (due to the Freegold Road Upgrade);
- Easier access to permitted concession areas for trappers and outfitters (due to the Freegold Road Upgrade);
- Reduced wilderness experience for trappers and outfitters utilizing the area;
- Negotiated road access to areas for existing trappers and outfitters (Freegold Road Extension); and
- Reduced access to trapping and outfitting concession areas due to Project traffic during construction, operations and closure and decommissioning.

As described in the response to R405, CMC considered the above in the Proposal, and the subsequent mitigation measures and assessment of effects.

Both concession holders expressed interest in continued meetings with CMC. CMC will continue this engagement in 2016 and throughout the assessment and Project development processes.

Specifically to the Executive Committee’s request for consideration of concessions #150 and #408, concession holder for concession #150 has been contacted multiple times (Table B.2.2-1), and will continue to be contacted with requests for meetings once the Project progresses into the Screening phase of the YESAB assessment. Concession #408 is a closed concession, due to the proximity to Carmacks (i.e., closed “Community Radius Area”) and therefore there is no owner to be contacted.

Table B.2.2-1 Consultation for Trapline Concession Holders – 2015 update

Concession #	Date and Event Type	Event Summary
116	April 15, 2013 Phone call	Left a voicemail requesting a call back to discuss his trapline and the Project
	May 10, 2013 Meeting	Trapper outlined the importance and scope of his trapping activities in the project area and stated concerns about the environmental effects the project is likely to result in including a reduced amount of wildlife within his trapline area. Suggested he would like to find an amicable solution with CMC.

Concession #	Date and Event Type	Event Summary
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
	June 30, 2015 Letter	Response from trapline holder re: June 9 letter. Request to meet to discuss impacts to trapline from freshwater pipeline and access road.
	June 30, 2015 Email	Response to above letter from CMC committing to set up a meeting.
121	May 22, 2012 Letter	CMC extended an invitation to attend a community meeting on the project in Carmacks on 12/05/28 or in Whitehorse on 12/05/30.
	Sept 25, 2012 Email	CMC Socio-economic consultant requested a meeting to discuss the Project and the stakeholder's trapline; stakeholder agreed. Stakeholder provided the name of another trapper who should be consulted.
	Oct 3, 2012 Meeting	Socio-economic data collection. Trapper provided information on his trapline, including access, use and harvest information. Noted that access could be an issue unless it is controlled. Requested regular updates and communication on the Project. Concerns: (a) access of others to the trapline; (b) open communication.
	Oct 15, 2012 Email	Socio-economic data collection. Discussed trapping and potential project effects on his tenure. Project will have limited effects on his tenure as long as it is confined to the upper portion. Concern: (a) project effects on trapping in portions of the tenure.
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
	June 22, 2015 Phone Call	Response from trapline holder re: June 9, 2015 letter. Request to continue engagement.
122	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
131 & 147	unassigned	
146	Multiple dates	Trapline owned by Chief McGuinty of the Selkirk First Nation. Numerous consultation events have been held with the Chief and he is fully aware of CMC's planned activities.
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
148	May 22, 2012 Letter	CMC extended an invitation to attend a community meeting on the project in Carmacks on 12/05/28 or in Whitehorse on 12/05/30.
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
149	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
150	May 22, 2012 Letter	CMC extended an invitation to attend a community meeting on the project in Carmacks on 12/05/28 or in Whitehorse on 12/05/30.
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
151	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
408	Community Radius Area (closed)	

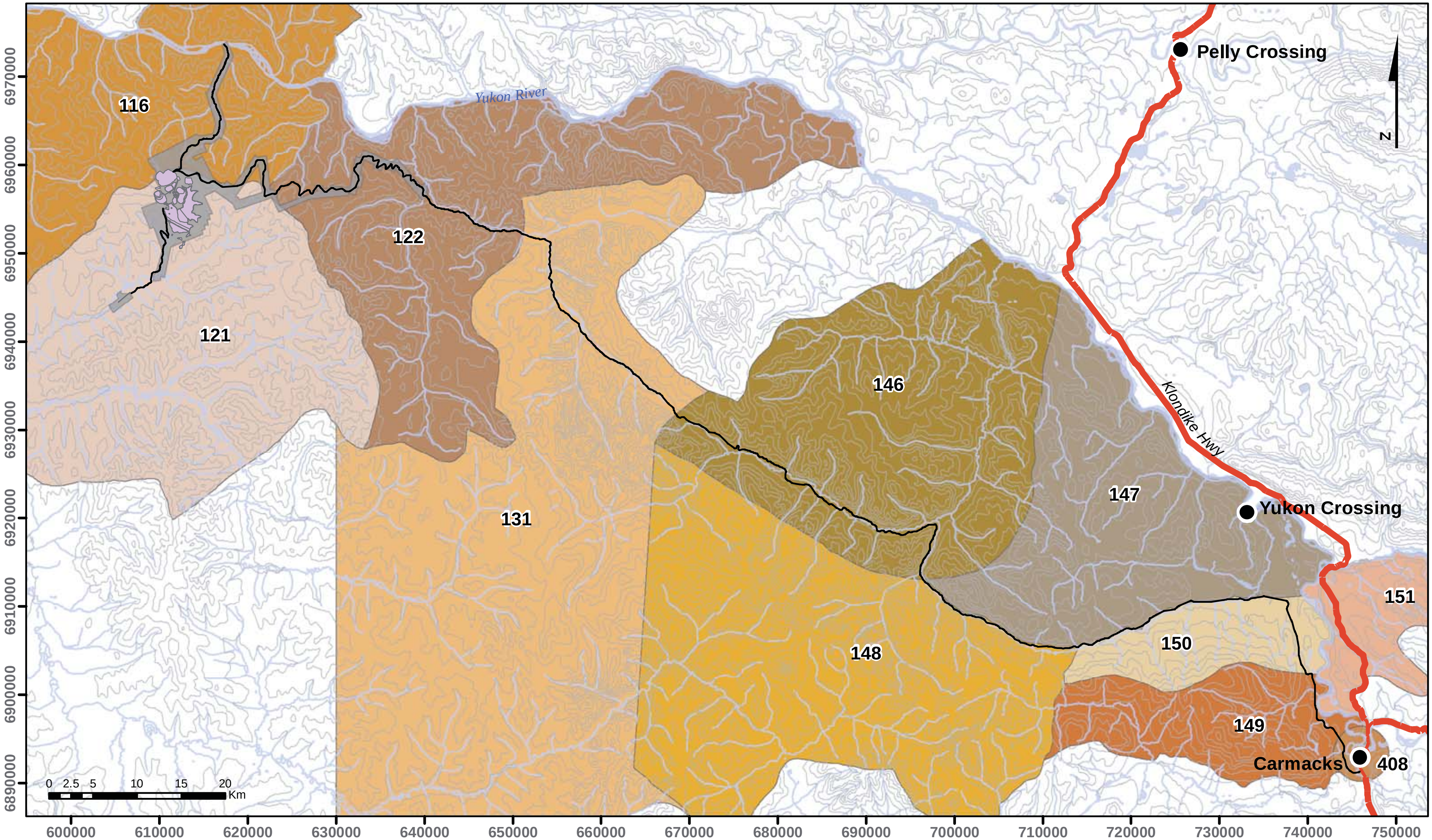

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Figure B.2.2-1

Trapping Concessions within 500m Buffer Zone

Trapping Concessions

- 116
- 121
- 122
- 131
- 146
- 147
- 148
- 149
- 150
- 151
- 408

- Proposed Mine Facilities
- Casino Claims
- Proposed Freegold Road Upgrade and Extension

Date: 09/06/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

Effects of the Project on trapping and outfitting are summarized in Table B.2.2-2.

Table B.2.2-2 Summary of Effects on Trapping and Outfitting

Residual Effect	Direction	Project Proposal Section
Loss of area for recreational or subsistence harvesting	Adverse	p. 18-30
Improved access for recreational and harvesting	Adverse and Beneficial	p. 18-30
Increased noise, emissions, and traffic	Adverse	p. 18-30
Loss of area for trapping and outfitting activities	Adverse	p. 19-36
Increase in access and activities conflicting with traditional land use activities	Adverse	p. 19-36
Reduced access to permitted tenure	Adverse	p. 19-36
Negotiated access for existing trappers / outfitters	Adverse / Neutral	p. 19-36
Easier access for existing trappers and outfitters (Freegold Road Upgrade)	Beneficial	p. 19-36
Reduced access to trapping and guide outfitting concession areas from construction and traffic (Freegold Road Upgrade)	Adverse	p. 19-37
Easier access for activities that may conflict with trappers and guide outfitters	Adverse	p. 19-37
Reduced wilderness experience for trappers and guide outfitters	Adverse	p. 19-37

Mitigations for effects on trapping and outfitting primarily involve restriction of access and protection of wildlife. Proposed mitigations, as summarized in Section A.24 of SIR-A are outlined in Table B.2.2-3.

Table B.2.2-3 List of Commitments Related to Mitigation of Effects on Trapping and Outfitting

Number	Commitment	Adverse Residual Effect	Section
3	CMC intends to continue to engage with First Nations to discuss topics of interest.	• Consultation with Selkirk First Nation regarding access points for the project. • Effects on increased access on subsistence hunting, fishing and harvesting.	2
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
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
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	N/A	22.3 Appendix A.22E Road Use Plan

Number	Commitment	Adverse Residual Effect	Section
	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.		
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 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.	• Loss of wildlife habitat • Restrict wildlife movement • Increased wildlife mortality	12.3
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
123	Access Mitigation - A Road Use 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 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 ensure concerns are identified and addressed.	General cultural effects related to access as the result of the use of the Freegold Road Extension.	18.4 22 Appendix A.22E Road Use Plan
124	A traffic communication bulletin /update will be circulated in local communities and to key stakeholders on a routine basis to inform	General cultural effects related to access	18.4 Table 18.4-

Number	Commitment	Adverse Residual Effect	Section
	users of current road status.		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
132	To mitigate against changes to access to traditional land, mineral tenures, and recreational lands CMC commits to: • 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.	Changes to access to Traditional Territories, mineral tenures, trapping areas, guide outfit concessions and recreational areas	19.4.2
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	19.4.2
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	19.4.2

B.2.2.1.2 R2-208

R2-208. Provide a record of discussions and concerns raised by all affected outfitting concession holders. The discussion shall include an assessment of potential impacts and any proposed mitigations for all outfitting concessions.

The Project falls within Outfitting Concessions 11 (Prophet Muskwa Outfitters), 13 (Mervyn's Yukon Outfitting Ltd.) and 14 (Trophy Stone Outfitting Ltd.) (Figure B.2.2-2). CMC has continued to consult with concession holders, and will continue to do so throughout the assessment process. In June 2015 letters were sent to all outfitting concession holders within 500 m of the Project to invite direct communication with CMC as well as invite the land tenure holders to participate in the YESAB process. No response was received from any of the three outfitting concession holders. The updated consultation log, to reflect the activities in 2015 is provided in Table B.2.2-4.

Through previous consultation, areas of concern raised by outfitting concession holders include:

- The potential loss and decrease of available area for trapping and outfitting during construction, operations and closure and decommissioning of the Project;
- Easier access to area for others whose activities may conflict with trappers and outfitters (due to the Freegold Road Upgrade);
- Easier access to permitted concession areas for trappers and outfitters (due to the Freegold Road Upgrade);
- Reduced wilderness experience for trappers and outfitters utilizing the area;
- Negotiated road access to areas for existing trappers and outfitters (Freegold Road Extension); and
- Reduced access to trapping and outfitting concession areas due to Project traffic during construction, operations and closure and decommissioning.
- Nuisance wildlife kill resulting in fewer animals in the area, potentially affecting animals available for outfitting hunting (e.g., bears).
- Emphasise on the importance of continued consultation.

CMC considered the above in the Proposal, and the subsequent mitigation measures and assessment of effects.

Effects of the Project on trapping and outfitting are summarized in Table B.2.2-2. Mitigations related to outfitting concessions are summarized in Table B.2.2-3.

Table B.2.2-4 Consultation for Outfitting Concession Holders – 2015 update

Concession #	Date and Event Type	Event Summary
11	Nov 23, 2012 Email	CMC Socio-economic consultant requested a meeting with the stakeholder to discuss the project and potential effects on his guide-outfitting business.
	Nov 26, 2012 Email	Stakeholder responded to CMC Socio-economic consultant's request to discuss the Project and potential effects on his guide-outfitting business.
	Nov 28, 2012 Phone Call	CMC Socio-economic consultant met with the stakeholder and discuss the Project, potential effects on the guide-outfitting business
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
13	Oct 2, 2012 Meeting	Meeting with YG Tourism and Culture. Identified that Mervyn Outfitters has expressed concerns during the assessment of the Carmacks Copper Project.
	Nov 20, 2012 Meeting	CMC Socio-economic consultant met with the stakeholder and discussed the Project, potential effects on the guide-outfitting business.
	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.
14	June 9, 2015 Letter	CMC extended a request to meet to discuss the Casino Project and opportunities for involvement in the YESAB process.

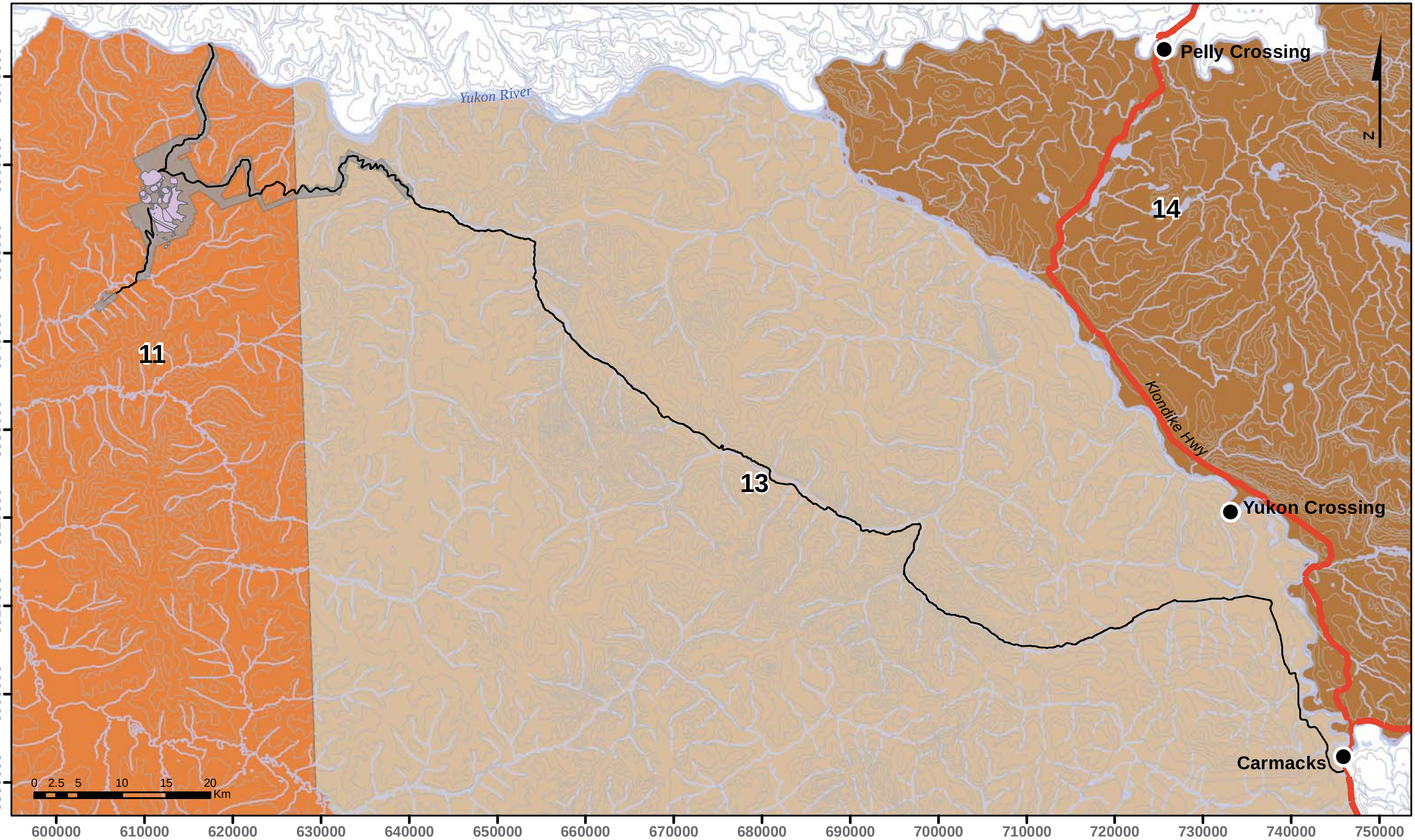

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Figure B.2.2-2

Outfitting Concessions within 500m Buffer Zone

Outfitting Concessions

- 11
- 13
- 14
- Proposed Mine Facilities
- Casino Claims
- Proposed Freegold Road Upgrade and Extension

Date: 08/06/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

B.2.3 QUARTZ AND PLACER CLAIM HOLDERS

B.2.3.1.1 R2-209

R2-209. A description of any contact or discussions between CMC and mineral rights holders in relation to the road. Also include a description of how many mineral claim holders have been contacted and a summary of the concerns raised.

CMC has identified 31 full or partial owners of placer claims or leases within 500 m of the Freegold Road upgrade and extension and the mine infrastructure (Figure B.2.3-1). In relation to the road, there are 17 placer claim owners with active claims. All 17 of these claim owners were contacted via phone, letter or email by the consultant for CMC, as described in the response to R408. Of these 17, 6 owners were engaged in follow up discussions with the consultant, and one owner passed away during the active consultation period. Three owners engaged in multiple conversations with the consultant. These 6 owners represent 91% ownership of the placer claims along the Freegold Road. As such, the views expressed by these owners are felt to be indicative of placer claim owners in general.

As described in the response to R408, key observations from the consultations were:

- No owners/operators interviewed or corresponded with were against the extension or upgrade of the Freegold Road, all felt that they could benefit from an improved surface on the existing Freegold Road Upgrade or possibly from the proposed new extension into the Hayes Creek area;
- All of the miners were grateful to receive the photo-mosaic maps of their claim areas;
- Most owner/operators in the Big Creek area mine upstream (south) of Big Creek and would not have potential mine areas covered with the new alignments of the Freegold Road;
- Some owners/operations had concerns regarding the potential isolation of placer by the Freegold Road;
- No owners/operators expressed opposition to the proposed Freegold Road; and
- Some placer owners/operators provided helpful local knowledge with respect to hydrology and permafrost that will assist in the detailed engineering design of the Freegold Road.

Further, in June 2015 letters were sent to 31 placer claim/lease owners within a 500 m buffer of the Freegold road and proposed mine infrastructure (i.e., Canadian Creek) to invite direct communication with CMC as well as invite the land tenure holders to participate in the YESAB process (Figure B.2.3-1). One responding email one received, which CMC responded to and indicated that future engagement would occur.

As described in R408, a specific study and engagement of quartz claim holders was not warranted because no mineral leases were identified along the proposed Freegold Road Upgrade or Freegold Road Extension. As well, the quartz claim holders have long-established rights and interests in the area and are familiar with the Casino Project, including the proposed development of the Freegold Road Extension and Freegold Road Upgrade. However, in June 2015 letters were sent to 19 quartz claim/lease owners within a 500 m buffer of the Freegold road and proposed mine infrastructure to invite direct communication with CMC as well as invite the land tenure holders to participate in the YESAB process (Figure B.2.3-1). Three responses from quartz claim owners were received, which CMC responded to and indicated that future engagement would occur.

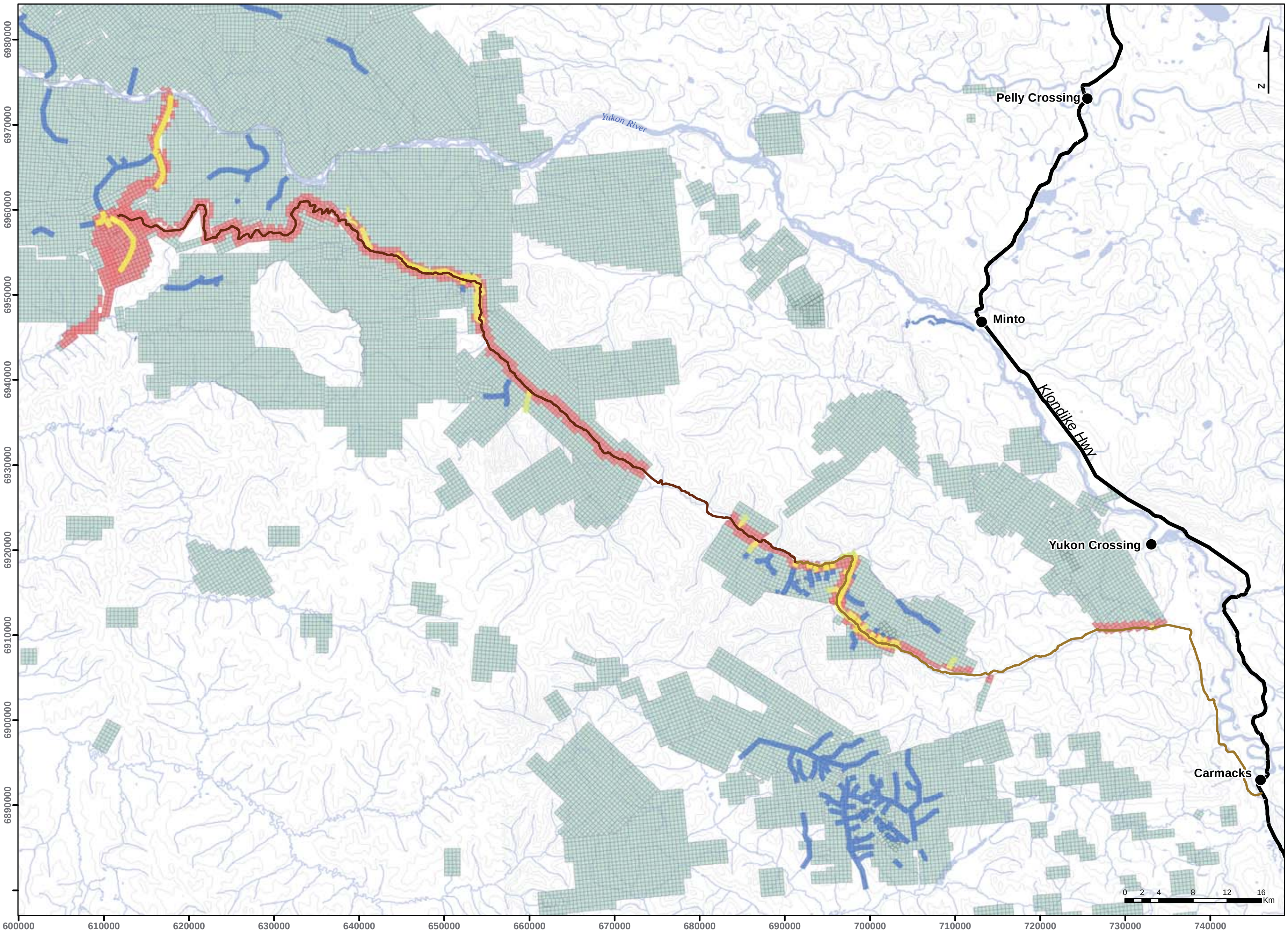

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Figure B.2.3-1

Placer and Quartz Claims within 500m Buffer Zone

Placer Claims/Leases (contacted by CMC)
Placer Claims/Leases (all)
Quartz Claims/Leases (contacted by CMC)
Quartz Claims/Leases (all)
Klondike Highway
Freegold Road Extension
Freegold Road Upgrade

Date: 18/11/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

B.2.4 OTHER LAND USERS

B.2.4.1.1 R2-210

R2-210. Assessment of effects, and potential mitigations if required, on the Yukon Quest.

The Yukon Quest International Sled Dog Race (Yukon Quest) is a 1,000 mile race between Whitehorse, Yukon and Fairbanks, Alaska and is held every February. The race lasts 9 to 14 days depending on weather, trail conditions and team speed (Yukon Quest, 2015). A portion of the Yukon Quest trail travels along the Freegold road from Carmacks then north along the Yukon River bank, crossing Williams Creek approximately 150 m upstream of the Yukon River confluence. The Project may impact the Yukon Quest dog sled race if the race is disrupted by increased traffic using the Freegold Road during the running of the race.

The effect of the increased use of the Freegold Road on land users, including the Yukon Quest International Sled Dog Race (Yukon Quest) was detailed in the Carmacks Copper Project Proposal (YOR 2006-0050). Concerns raised by the Yukon Quest International Association (YOR 2006-0050-110-1) included:

- The Association would like to promote the recreational/tourist use of the trail during the winter (by snowmobilers, mushers, etc.) and possibly during the summer season (by cyclists, hikers, ATV-users, etc.).
- The Yukon Quest Trail overlaps with the Freegold Road north of Carmacks, a Race Checkpoint, for approximately 15 miles, to the point where the Freegold Road veers westward and departs from the Dawson Overland Trail routing. Road maintenance of the Freegold Road to support the proposed Project is a serious concern for the Association because of the potential impacts on the Race.
- The chief concern is that mushers would be unable to stop along a graded road, because brakes on the sleds require a solid layer of hard-packed snow to function. This poses a serious risk to safety of mushers and dogs.
- Abrasion to sleds or dogs' feet is secondary concern. Measures such as additional and/or thicker booties would reduce impacts.
- Another concern is that mushers often camp along this portion of the road for 3-6 hours during years when the race starts in Whitehorse (teams usually do not camp along this portion of the Road during the years when the Race starts in Fairbanks). Apart from these ad hoc temporary campsites, there are no staging/stopping points along this portion of the Road.
- Race support snowmachines traveling that section of the road in advance of the dog teams would also experience difficulties running on a surface graded to gravel.
- Trail breaking/clearing starts in the beginning of January (usually the first weekend) and is usually completed in three weeks.
- The Race begins on the second Saturday in February, runs for two weeks, followed by roughly two weeks of followup/ decommissioning work to permit adequate trail clearing (removal of trail markers, debris, etc.).
- When the teams start from Whitehorse, it takes approximately 3-4 days following the race start to clear the Freegold Road.
- It is unlikely that the Project and the Race can share the Freegold Road safely, should the road be required to be graded to gravel, and should the road be required to support Project vehicular traffic during

Race activities. The development of an alternate route for the Race may be the only solution. The Association would prefer an alternate route to be adjacent to the Freegold Road to preserve the historical connection. The route should not cross the Freegold Road, due to the risk of vehicle accidents with the dog teams.

- It was suggested the Proponent and/or YG Highways create a snow-packed trail, and a campsite pullout along the Road for the duration of the Race. It would require a lot of work to prepare such a trail (1- 2' of snow settled in specific cold conditions), and that sharing the road in this way would still pose a safety risk to the dogs and mushers from accidents with vehicular traffic.
- There was general agreement that shutting down mine-related use of the Road for the duration of Race activities each year *or* coordinating mine-related traffic to avoid interference with dog teams or support snowmobiles on the Road would not be feasible given the duration of Race activities and the trail conditions required.
- The Association asserted that it does not want to impede the mine's development, only that it wants to protect the interests of the Race and the potential for the expansion of the use of the Yukon Quest Trail.

Subsequent assessment of the Carmacks Copper project by the Executive Committee considered the following alternatives with representatives of the Yukon Quest, but deemed them all to be unfeasible for the reasons provided:

- *Shutting down Project related traffic for the duration of Yukon Quest activities*. This alternative was deemed unfeasible because of the duration of Yukon Quest activities from trail preparation to post-race clean-up (January to mid-March). Closing the road for this length of time would significantly affect Project activities and potentially worker safety.
- *Coordinating mine related traffic to avoid interference with dog teams and/or support snowmobiles on the road during the race activities* (via radio contact, for example). This alternative was deemed unfeasible because of the duration of Yukon Quest activities and because of the incompatibility of road conditions required for the Yukon Quest versus the Project (i.e., snow-packed versus graded to near-gravel).
- *Sharing the Freegold Road by creating a snow-packed trail parallel to a graded strip and a campsite pullout for the duration of the Yukon Quest*. This alternative was deemed unfeasible primarily because the road is too narrow to allow for a snow trail for the Yukon Quest and a graded strip for Project trucks and equipment, posing a serious safety risk to the dog teams and mushers, as well as Project personnel and equipment.

During assessment of the Carmacks Copper Project the Executive Committee found that the creation of an alternate trail/route was the only feasible measure to effectively mitigate the adverse effects to the Yukon Quest and other existing winter users that would result from the Project use of the Freegold Road each winter.

Mitigation measure #99 of the Executive Committee Screening Report and Recommendation (YESAB, 2008), stated that "*Due to the opening of the Freegold Road during the winter months, safe routing for the Yukon Quest shall be established. The route shall follow existing linear disturbances (e.g., Freegold Road right-of-way, trails and cutlines) where possible, or result in the cutting of new trail less than 1.5 metres in width.*" This measure was then accepted by the Yukon Government in the YESAA Decision Document (Yukon Government, 2008).

CMC suggests incorporating the same recommendation into the Casino Project Proposal to mitigate effects to users who travel the Freegold Road in the winter. CMC further suggests that, in accordance with the Carmacks Copper Screening Report (YESAB, 2008), "since establishment of a multi-use trail is a measure required to mitigate potential adverse effects on current land use practices, the development of the trail" be scoped into the assessment of the Casino Project. And that "*Potential environmental and socio-economic effects associated with development of the trail were anticipated to be minimal. There will be minimal effects to users who currently travel the Freegold Road during the winter, since the multi-use trail will be appropriate for off-road vehicles or dogsleds exclusively, as the Freegold Road currently is. With the application of the mitigative measures outlined in the following section, significant environmental effects associated with development of the trail are not anticipated.*" (YESAB, 2008).

Additionally, as suggested in the Carmacks Copper Project assessment, CMC will contact the Yukon Quest in early January of each year to establish a process for safe crossing of the Freegold Road during the race.

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APPENDICES

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Appendix B.4C Tailings Management Facility Dam Breach Inundation Study
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Appendix B.4E 2014 and 2015 Geotechnical Testing of Leach Ore
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Appendix B.4G Review and Updates to the Conceptual Wetland Water Treatment Design

B.4 – PROJECT DESCRIPTION

B.4.1 INTRODUCTION

Section 4 of the Proposal provided an overview of the principal Project, related components and activities and accessory activities that make up Casino Project (the Project). Section 4 detailed the principal project components and activities; related components and activities and accessory activities.

The anticipated schedule of the Project, including Project phases and anticipated duration, was also presented as well as detailed information on Project components and activities for the construction, operation, closure and decommissioning and post-closure phases of the Project.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2.

The Executive Committee has had substantial requests for information on Section 4 (i.e., 146 of 449 requests in ARR No.1 and 90 of 224 requests in ARR No.2) as concerns voiced by reviewers have revolved around the access road, tailings management facility and reclamation and closure, all contained within this Section. The information provided in the Project Description section and subsequent supplementary information reports, is based on conceptual and preliminary designs, limited information from test work or field investigation and is consistent with early stage project development. There are many instances where the level and extent of the information provided goes well beyond what is typically provided for assessment purposes. Project assessment must be made within reasonable limits appropriate to the project's stage of development by experienced, qualified individuals exercising professional and reasonable judgements.

The responses contained herein reflect an attempt by CMC to respond to ARR-2 in the most fulsome manner, with the details and data available at this phase of project development. CMC will continue to provide information as requested throughout the Screening phase of the YESAB assessment to fulfill the needs of YESAB, decision bodies and interested persons participating in the assessment. CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening and looks forward to commencing the assessment process in a timely manner.

The Executive Committee has 90 requests for supplementary information related to Section 4 Project Description and Section A.4 of the Project Proposal and SIR. These requests, and the sections in which the responses are provided, are outlined below in Table B.4.1-1.

Table B.4.1-1 Requests for Supplementary Information Related to Project Description

Request #	Request for Supplementary Information	Response
R2-1	A framework and associated details for the establishment of the IGRP including its structure, scope and timing. The framework shall include relevant details such as expert reviewers' qualifications, their roles and continued involvement over the mine life. This framework will demonstrate a commitment to those aspects of the Project where external review from the IGRP will be obtained. At a minimum the IGRP will provide oversight for the following: a. alternatives assessment for tailings and waste rock management; b. risk assessment for the chosen method for tailings and waste rock management; c. design of tailings and waste rock management infrastructure; d. change management framework; e. technical review framework; f. hazard classification and rationale for the proposed TMF dam; and g. dam breach/inundation study. The Proponent will provide outcomes from the IGRP's work prior to entering the screening process.	Section B.4.2.1.1
R2-2	Frameworks for a change management procedure and an associated technical review procedure which will define processes for making and approving changes to designs or operating plans, such as may occur when conditions encountered in the field during construction or operations differ from design assumptions. Describe aspects of the project design for which engineering design changes will be overseen by the IGRP. These frameworks will also describe how regulators, First Nations, and other interested parties will be involved in the review processes.	Section B.4.2.2.1
R2-3	A detailed description and assessment of alternatives to or alternative ways of undertaking the Project with respect to tailings and waste rock management. This alternatives assessment should be comprehensive, provide transparent rationale and give consideration to the following: a. Full life-cycle costs and all phases of the proposed TMF dam (i.e. in perpetuity); b. Risks of the proposed TMF dam (i.e. as per risk assessment); c. Potential significant adverse effects of the proposed TMF dam to environmental values (i.e. wildlife, water and aquatic resources) and socio-economic values (i.e. health, social, heritage and economic); d. Identification and comparison of best practices and best-available technologies for tailings management; e. Options for managing water balance to ensure safety and reduce probable risks of structural and/or non-structural TMF dam failure (i.e. as determined by the risk assessment); f. Technically-sound engineering solutions that mitigate potential significant adverse effects based on actual site conditions (e.g. permafrost, climate change, construction challenges); and g. A clear and transparent evaluation of the factors that support the proposed TMF dam.	Section B.4.3.1.1
R2-4	A risk assessment for the TMF dam.	Section B.4.3.2.1
R2-5	Describe the involvement of independent professional engineers in: the ongoing review of monitoring data; the evaluation of site infrastructure performance with respect to design parameters; and any necessary adaptive response measures.	Section B.4.3.2.2

Request #	Request for Supplementary Information	Response
R2-6	Information on the feasibility and limitations of using “on-stream analyzers” on a continuous basis to monitor sulphur removal from the NAG tailings stream.	Section B.4.4.1
R2-7	Discussion on the implications related to the estimate that 25 percent of the processed supergene ore would produce non-PAG rougher tailings.	Section B.4.4.2
R2-8	One of the following: a. Responses to previous Adequacy Review Report requests as they relate to the Freegold Road upgrade and Carmacks by-pass: • R13 and R14 (in relation to the camp for the upgrade), • R18 (including safety, wildlife, and maintenance), • R27 (in relation to traffic in Carmacks and the by-pass), • R297 (in relation to clear span bridges for the upgrade), • R298 (in relation to decommissioning of abandoned structures along the alignment), • R299 (in relation to the Nordenskiold River bridge and pier), • R300 (in relation to available habitat at the Nordenskiold River bridge) • R410 (in relation to a cabin near the project footprint), or b. A modified project proposal that excludes the Freegold Road upgrade and Carmacks by-pass but includes a revised description of activities, transportation plan, and effects assessment.	Section B.4.5.1.1
R2-9	Camp details including: a. Information regarding surface water within the camp footprint and any diversions, b. Supporting information on the appropriateness of a septic system, c. Details for reclamation of camp site, and d. Volumes of vegetation to be cleared and disposal methods.	Section B.4.5.1.2
R2-10	A description and assessment of the two possible scenarios for the Freegold Road extension: a. Road closure and reclamation including methods, objectives, and timelines, b. Continued road use including management, access, and effects.	Section B.4.5.1.3
R2-11	Clarification if project traffic predictions and the project effects assessment include empty vehicles, and if not, updated predictions and corresponding effects assessments.	Section B.4.5.1.4
R2-12	An analysis of potential effects along the Klondike Highway, for all affected sections.	Section B.4.5.1.5
R2-13	An assessment of and mitigations for potential effects due to traffic in Carmacks and Carcross.	Section B.4.5.1.6
R2-14	Additional analysis regarding the appropriate PMP value for the design of the mine facilities. Specifically, utilize the full period of rainfall record as discussed by EcoMetrix (YOR 2014-0002-399-1), discuss the PMP contours presented in TP-47, and utilize other available methods of predicting PMP such as more recent publications regarding PMP estimates for eastern interior Alaska.	Section B.4.6.1.1
R2-15	Typical cross-sections and design drawings of alignments for diversion ditching across the project site with particular focus around the HLF including:	Section

Request #	Request for Supplementary Information	Response
	a. confining embankment; b. access road section; and c. event ponds area.	B.4.6.1.2
R2-16	Details and rationale on the selection of return period design criteria for all the WMP components during all phases of the Project, including long-term closure. Details should include calculation of the failure probabilities.	Section B.4.6.2.1
R2-17	Additional supporting evidence to demonstrate the sufficiency of a 30 cm thick soil liner based on the actual conditions at the mine site (e.g. shear strength, slope stability, stack height, bedrock conditions).	Section B.4.7.1.1
R2-18	An outline of plausible mitigation strategies (e.g. intermediate liners; additional and/or higher standard liners) to ensure performance objectives of the HLF are achieved.	Section B.4.7.1.2
R2-19	Clarification on how one portion of the pad versus another portion will be isolated if a leak is detected. In addition, please provide a full detail design diagram of the components used in the heap leach facility including placement of the LDRS components and how they interact.	Section B.4.7.2.1
R2-20	Details on the maintenance and repair of LDRS sumps.	Section B.4.7.2.2
R2-21	Details on the pipelines, pumps, and related infrastructure connecting the components of the HLF including SART, cyanide, and gold extraction facilities. Include details on pipeline alignments and leak detection measures.	Section B.4.7.3.1
R2-22	Clarify whether CMC intends to seek certification under the International Cyanide Management Code and conduct independent third-party auditing of its conformance with the cyanide management standards of practice. If so, clarify whether results of independent audits would be made available for review by interested stakeholders.	Section B.4.7.3.2
R2-23	Indication when results are expected from the additional test work and how these results will be provided in a timely manner iteratively throughout the screening process.	Section B.4.7.4.1
R2-24	An updated TMF dam hazard classification that is informed by the IGRP-overseen risk assessment and related dam breach/inundation study. Where relevant, also include details regarding the impacts to dam design and mitigation strategies as a result of this additional work.	Section B.4.8.1.1
R2-25	Additional comparison information about natural analogies within similar environments. Include estimates of the hydraulic gradient(s) for the TMF dam, throughout its lifecycle (i.e. in perpetuity), and include a discussion that reflects on the findings of the Bjelkevik (2005) report (i.e. compare the estimated hydraulic gradient of the TMF with the hydraulic gradient of natural analogies that have demonstrated long-term stability).	Section B.4.8.1.2
R2-26	Additional information regarding the factor of safety including: a. The factor of safety under pseudo-static condition, since the minimum factor of safety for slope stability under seismic loading is 1.0 and not less than 1.0 (refer to Table 6-3 of Canadian Dam Safety Guideline, 2007). b. Was the excess pore pressure during the construction period and before the embankment rise considered?	Section B.4.8.1.3

Request #	Request for Supplementary Information	Response
	c. Confirmation that the stability analysis during different stages of construction and impounding meets the minimum factor of safety proposed by CDA such that: the minimum factor of safety of 1.3 "Before the reservoir feeling" and FOS of 1.5 at the "normal reservoir level".	
R2-27	A conceptual operations, maintenance and surveillance (OM&S) plan to demonstrate how the TMF will be managed in both the operational and closure periods. At a minimum, this plan will meet the current Mining Association of Canada's (MAC) guidance material for tailings management facilities. The OM&S plan must: a. Comprehensively address how custodial transfer will occur for all liability associated with this project. This aspect of the plan will include criteria for custodial transfer (e.g. to whom; timing; security funding; other obligations) and consider scenarios such as abandonment and end-of-mine life transfer. Provide examples of successful custodial transfer of comparable projects. b. Include supporting information that addresses monitoring and remediation activities that may be required during closure including the extent of remediation required in event of a maximum design earthquake. The plan must also consider response to multiple maximum design earthquakes that may occur considering the TMF is proposed to remain in perpetuity. c. Evaluate the potential effects of climate change on the Project through all phases, in perpetuity.	Section B.4.8.1.4
R2-28	Detail on the care and maintenance costs in perpetuity. This estimate will be supported by the OM&S plan, which will document the ongoing care and maintenance requirements during the closure and post-closure period. This estimate must consider costs for all liability associated with the mine site infrastructure including accidents and malfunctions	Section B.4.8.1.5
R2-29	Demonstrate how the TMF dam will be able to achieve a steady state condition for passive care during the post-closure of this project (i.e. in perpetuity).	Section B.4.8.1.6
R2-30	A dam breach analysis with water/tailings inundation modeling. Include information related to the IGRPs oversight and review of this work. The analysis must be consistent with the Canadian Dam Association's (2007) dam safety guidelines and include: a. probable maximum flood inundation map showing the maximum extent of flooding relating to a sudden full storage embankment breach extending to when expected flooding is within the natural water channels; b. an assessment of environmental and human impacts associated with a release of tailings; c. an assessment of potential impacts to First Nation Settlement Lands; d. an assessment of impacts to downstream infrastructure; e. mitigation measures in the event of a tailings breach; and, f. for each proposed breach scenario, a cross section of the critical TMF embankment, proposed loading factors, and each scenario's factor of safety.	Section B.4.8.2.1
R2-31	Detailed information on the sources and quantities for all borrow materials that are required for all mine site infrastructure, the airstrip and airstrip access road, and the Freegold road upgrade and extension, throughout all phases. This information will be based on site investigations and will include: confirmation of the depth and areal extent of the proposed aggregate borrow sources; and, characterization of the physical and chemical variability of materials (i.e. quality and suitability for intended use) required for mine site infrastructure.	Section B.4.8.3.1

Request #	Request for Supplementary Information	Response
R2-32	An explanation on the likelihood and implications of saturation of the TMF dam's foundation, drains, and lower portions.	Section B.4.8.4.1
R2-33	The references used to guide the factor of 1.5 and a discussion about the applicability of the reviewed cases to this project.	Section B.4.8.4.2
R2-34	The measured shear wave velocity for the foundation material.	Section B.4.8.4.3
R2-35	Mean PGA as derived from EZ-FRISK.	Section B.4.8.4.4
R2-36	Information regarding PMP and the IDF including: a. An updated PMP estimate using more robust storm expansion techniques. This modelling must be done by a trained meteorologist with a background in PMP derivation; b. Justification for using the 100 year snowpack combined with the PMP for computing the PMF instead of a more conservative return period; and c. Evidence demonstrating that the IDF represents the worst case in terms of volume of inflow.	Section B.4.8.5.1
R2-37	Following an updated dam hazard classification as requested in section 2.7.1 include a description of how the IDF design will protect the TMF dam from overtopping.	Section B.4.8.6.1
R2-38	Further discussion on the implications of ice build-up in the spillway and how this will be monitored and managed. In addition to ice build-up, describe how the spillway will be monitored and maintained in perpetuity post-closure – this must consider any changing circumstances and/or conditions that may compromise the function of the spillway.	Section B.4.8.6.2
R2-39	Mitigations, with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, both in the spillway channel and downstream water bodies.	Section B.4.8.6.3
R2-40	Ensure that the risk assessment requested in section 2.2.2 considers the likelihood and consequence of an HLF failure that results in displacement of water in the TMF.	Section B.4.8.7.1
R2-41	An expansion of CMC's response related to core and filter thickness by providing a review of comparable designs. Also, provide a detailed analysis that describes the deformation response of the core and the downstream filter during different stages of construction.	Section B.4.8.8.1
R2-42	A comprehensive description of the tailings beach design including but not limited to: beach length, width, slope, deposition strategies, construction QA/QC and monitoring/maintenance requirements in perpetuity.	Section B.4.8.8.2
R2-43	Quantification of the reduction of seepage and hydraulic gradient throughout the various phases of the TMF dam based on the chosen design. Provide an estimate of how the seepage and hydraulic gradient may change in perpetuity.	Section B.4.8.8.3
R2-44	The results of laboratory tests conducted to assess whether 12 percent fines sand would be free-draining including under the very high stresses in the proposed dam and frost susceptible of this material. Additionally, if applicable, provide the implications of the 12 percent fines sand not being free-draining or being frost	Section B.4.8.9.1

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	susceptible.	
R2-45	Information regarding sand properties including: a. Explanation why the more conservative 30° angle of internal friction for angular sands was not selected for the Casino dam design; b. Explanation why the same value can be assumed to apply to the tailings generated from processing of all of the three ore types; and, c. Implications if the more conservative value of 30° is applied to the tailings generated from processing of all of the three ore types. d. Confirmation whether the maximum anticipated stress for placed cyclone sand is supported by completed testing.	Section B.4.8.9.2
R2-46	Identification the actual source of the discrepancy present in the specific gravity values for the tailings sand products through repeat testing. If repeat testing is not possible, describe the implications of this discrepancy using conservative assumptions.	Section B.4.8.9.3
R2-47	A response to the concerns articulated by EcoMetrix regarding 2 m lifts.	Section B.4.8.9.4
R2-48	Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity. Specifically: a. Confirm whether lidar data has been collected to determine the presence or absence of young faults near the tailings dam; b. Provide the detailed joint surveying along the dam foundation and the abutments and update the seepage analysis report; and, c. Provide a geostatistical model that represents the permeability characteristics of the bedrock below the dam foundation.	Section B.4.8.9.5
R2-49	Additional drill results and associated foundation characterization (e.g. packer testing, trenching), with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification of fault/shear zones within the embankment foundation.	Section B.4.8.9.5
R2-50	A description of how grouting can be successfully performed given the challenges presented by permafrost. Also, update the responses for R89 a – e of the ARR in accordance with the response to R2-49.	Section B.4.8.9.5
R2-51	The rationale behind “the material is assumed to be isotropic” knowing the horizontal permeability is greater than vertical permeability in embankment dams that is constructed in several stages. Also assuming an isotropic permeability for the rock, will not be a valid assumption due to preferential seepage in the rock mass.	Section B.4.8.9.5
R2-52	The justification on why no seepage barrier is proposed for the dam foundation despite the calculated seepage rate.	Section B.4.8.9.5
R2-53	The anticipated seepage problems surrounding the storage area.	Section B.4.8.9.5
R2-54	Details regarding permafrost and permafrost conditions in relation to the TMF, including: a. confirmation that an assessment of the hydraulic properties of the permafrost under the embankment structures studies will be conducted during the detailed design; b. a winter construction execution plan that details measures and procedures for	Section B.4.8.9.5

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	embankment placement of fill that ensures the fill soils are not frozen at the time of placement and compaction; c. QA/QC plan for construction during the cold season; d. details on permafrost conditions of the foundation materials before the construction and during the embankment raise; e. a discussion regarding the potential segregation of solids and water fractions, with the formation of discrete ice lenses within the tailings mass and its implication for tailings management; and, f. a discussion regarding the integrity implications of the potential frozen and unfrozen fill co-existing within the structure.	
R2-55	A detailed schedule for the works required to construct the TMF before and during operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays and freezing conditions.	Section B.4.8.9.5
R2-56	QA/QC measures during the lifetime of the embankment to ensure the effectiveness of insulation and the core structure will not be affected by the action of freezing. Please also provide confirmation regarding if permafrost aggradation potential has been considered into the TMF containment structure? If permafrost aggradation has not been considered, provide a discussion regarding the potential of permafrost aggradation into the TMF.	Section B.4.8.9.5
R2-57	Additional detail to understand the implication of shorter than expected construction windows for the TMF dam and specifically: a. Describe the implications of suspensions in fill placement operations if CMC is unable to operate in November and/or March. Also consider the implications of not being able to operate for additional months should they prove too cold. Describe how CMC will manage these implications. b. Clarification if the likelihood of one or more very cold years for the construction window has been evaluated. If so, describe the implications. Describe how CMC will manage these implications.	Section B.4.8.9.6
R2-58	Further detail on the referenced examples provided in response to R94. Demonstrate how these examples are applicable to this project and how they support the proposed construction schedule and methodology. Include details regarding the equipment and infrastructure required to facilitate winter construction.	Section B.4.8.9.7
R2-59	Discuss the implications of potentially incorporating frozen layers within the embankment (e.g. discrete ice lenses within the tailings mass; layers of frozen and unfrozen fill) to the stability and integrity of this infrastructure.	Section B.4.8.9.8
R2-60	Provide comprehensive characterization of the depth, extent and nature of permafrost where the TMF is to be constructed. Based on this characterization, confirm that excavation of all permafrost soils will be practical and how this excavation will successfully be achieved.	Section B.4.8.10.1
R2-61	Details regarding: a. A clear definition of ice-rich soils and rock; b. Characterization of the ice content of the near surface soils and rock to assess the potential volume of ice-rich materials to be excavated and disposed; c. A well-defined and rational methodology and decision making process to identify and characterize permafrost soils and rock that can be used to guide all excavation and stripping work;	Section B.4.8.10.2

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	d. A detailed permafrost hazard map (predictive) and associated methodology that identifies type, nature, and magnitude of permafrost related hazards in the study area; e. If the TMF is situated on permafrost soils that are too deep to excavate, consideration of creep deformation of those permafrost soils resulting from placement of the TMF; and, f. Based on the map above, identification of specific risks to the Project (i.e. minesite infrastructure and the Northern Freegold Road) from identified permafrost hazards. The map should include consideration of climate change, as well, over the life of the Project.	
R2-62	Based on the risk identified in response to the questions above, please provide general options and considerations for engineering design to mitigate the identified risks.	Section B.4.8.10.3
R2-63	Provide a comprehensive assessment of how groundwater flow may be affected due to changing thermal conditions (i.e. melting permafrost). Consideration should be given to all stages of the Project, including in perpetuity for post-closure.	Section B.4.8.10.4
R2-64	Provide further justification of the validity of the baseline model calibration and its potential impact on groundwater flows in the Mine Effects models ensuring permafrost is considered in the calibrations.	Section B.4.8.10.5
R2-65	Confirm how the dam core will be insulated during construction and include comprehensive details (e.g. properties and characteristics of insulation; methodology for installing insulation; objectives and adaptive management). Provide relevant examples to support the proposed methodology.	Section B.4.8.11.1
R2-66	An explanation on how the additional transition zones can affect the current analysis.	Section B.4.8.12.1
R2-67	Identification of potential hazards of wildfire to LNG facilities at the Casino Mine site and a quantitative assessment of the related risk to those facilities. Ensure that risks and procedures associated with forest fires are discussed.	Section B.4.9.1.1
R2-68	For the diesel facilities and fueling stations, provide: a. a detailed description for all facilities related to diesel including location, design, construction, operation and closure; b. measures for the safety of project personnel including separation distances from office and living areas; and c. design measures and operating procedures to prevent a cascading accident.	Section B.4.9.2.1
R2-69	Further analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks. The options analysis should include: a. open pit; b. tailings management facility; c. heap leach facility; d. stockpile areas; and e. water management and treatment.	Section B.4.10.1.1
R2-70	Discussion and, if necessary, an update to the conceptual closure plan to take into account the most recent Government of Yukon Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013). Details should include:	Section B.4.10.1.2

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	a. additional closure methodology that demonstrates that the open pit water can passively flow to the TMF without continued intervention; and b. identification of closure methodologies that have been demonstrated effective in northern environments, and that clearly meet the objectives described in Section 5 of the guidance document.	
R2-71	In relation to examples of successful similar treatment systems provided in Appendix A.4H (Cold Climate Passive Treatment Systems Literature Review), a discussion on flow rates relative to those for the proposed project.	Section B.4.10.2.1
R2-72	In relation to plans on field studies to support and refine the effectiveness of the wetland water treatment system, details on: a. what benchmarks (e.g. CCME WQO or SSWQO identified in proposal) will serve as the performance objectives for the overall passive treatment system; b. what performance triggers (i.e. clear indication that the current strategy will not achieve treatment objectives) will be used during the development of the passive treatment system to identify when contingency treatment methods, such as development of bioreactors in the case of the HLF, will need to be investigated.	Section B.4.10.2.2
R2-73	Contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required. Details should include: a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information; b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed; and c. a full alternatives assessment to demonstrate how alternative treatment technologies (that do not include wetland systems) were considered.	Section B.4.10.2.3
R2-74	In order to evaluate the potential effects related to the worst case scenario of an ineffective passive treatment, prediction of a worst case scenario of downstream water quality assuming no treatment system. Predictions should extend as far downstream as necessary to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME).	Section B.4.10.2.4
R2-75	A discussion and rationale on how the design of the north end of the tailings management facility wetlands will accommodate a range of possible flows from the pit lake. Identify how residence time can be controlled when flows are expected to be so highly variable, and how the proposed control valves could be relied upon in such a remote area.	Section B.4.10.2.5
R2-76	Details and design considerations for the remotely operated solar powered decant valves. Details should include: a. contingency planning related to malfunctions, inappropriate feedback and interaction; and b. examples where such systems are effectively used in similar northern or cold climate conditions.	Section B.4.10.2.6
R2-77	Details regarding potential impacts to pit water quality, and demonstrate water treatment capabilities in the TMF are sufficient, if a pit wall fails and there is a spike in	Section B.4.10.3.1

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	metals and/or acidity in pit water.	
R2-78	Examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.	Section B.4.10.4.1
R2-79	A description how the liner in the HLF will be perforated following completion of the rinsing stage. Include a description of how drainage flowing from the HLF through the perforated liner will be captured by the TMF.	Section B.4.10.4.2
R2-80	Details on the design of the HLF cover. Details should include: a. details of construction materials and methods being proposed (e.g. on-site borrow material and/or geosynthetic liner) and supported by on-site characterization; b. consideration of other mine-site facility requirements for low-permeability material; and c. stability and long-term maintenance requirements if incorporating a geosynthetic liner.	Section B.4.10.5.1
R2-81	Feasibility level design details for the water management pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed. Details should include: a. details on how CMC will ensure that all groundwater seepage is collected in the water management pond as designed and modelled; b. what monitoring will be set up to ensure that the water management pond is performing as predicted, including groundwater and seepage monitoring; and c. contingencies for all project phases, in case the water management pond does not perform as expected, including if groundwater/seepage is found to by-pass the water management pond.	Section B.4.10.6.1
R2-82	Additional details about the water management pond dam should include: a. cross-sections; b. construction materials; c. consequence of failure classification; d. detailed foundation characterization; and e. monitoring and maintenance requirements.	Section B.4.10.6.2
R2-83	Contingency measures or alternatives that may be required in the event of early closure if passive treatment system field trials have not been completed or are shown to be unsuccessful. Details should include: a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information; b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed.	Section B.4.10.7.1
R2-84	Update the CCRP and security estimates based on the Government of Yukon's updated guidance document: Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).	Section B.4.10.8.1
R2-85	Additional justification and discussion on security estimates based on new information generated by questions throughout this report. Details should include: a. all major mine components;	Section B.4.10.8.2

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	b. all reclamation and closure stages; c. consideration of temporary or early closure; d. consideration of accidents and malfunctions, including the implications of structural and non-structural failures of the TMF dam; and e. consideration of effects of the environment.	
R2-86	Location, size, volume, and hydrology of the landfill site	Section B.4.11.1
R2-87	Anticipated volume of landfill space required for different waste streams.	Section B.4.11.2
R2-88	A description of the liner and/or leachate collection system proposed, including details for maintenance, operation, and closure.	Section B.4.11.3
R2-121	Clarification on how the design for the TMF accounts for climate variation in perpetuity, beyond the construction and operation phases of the mine.	Section B.4.12.1
R2-122	After the application of a maximum 25 percent increase in flow to all relevant baseline information, a comprehensive description of resulting changes to the tailings management facility, open pit, water management pond, heap leach facility, and diversion ditches. This should include consideration of project effects, and mitigations.	Section B.4.12.2

B.4.2 OVERSIGHT OF DESIGN, CONSTRUCTION, OPERATION, AND CLOSURE

B.4.2.1 Independent Geotechnical Review Panel

B.4.2.1.1 R2-1

R2-1. A framework and associated details for the establishment of the IGRP including its structure, scope and timing. The framework shall include relevant details such as expert reviewers' qualifications, their roles and continued involvement over the mine life. This framework will demonstrate a commitment to those aspects of the Project where external review from the IGRP will be obtained. At a minimum the IGRP will provide oversight for the following:
a. alternatives assessment for tailings and waste rock management;
b. risk assessment for the chosen method for tailings and waste rock management;
c. design of tailings and waste rock management infrastructure;
d. change management framework;
e. technical review framework;
f. hazard classification and rationale for the proposed TMF dam; and
g. dam breach/inundation study.
The Proponent will provide outcomes from the IGRP's work prior to entering the screening process.

Casino Mining Corporation has voluntarily established an Independent Engineering Review Panel (IERP) for the Casino Project to review and consider the Project's Tailings Management Facility (TMF) and Heap Leach Facility (HLF) with a focus on their structural stability and integrity. In the SIR-A, the IERP was called the "Independent Geotechnical Review Panel", however, as the fundamental criteria of waste and water management at the Casino

Project is to achieve a management strategy that is considered most geochemically conservative, CMC has changed the name to the IERP.

While CMC has voluntarily created the IERP for the Casino Project, independent tailings dam review boards have become mandatory for *operating* mines in British Columbia (BC Ministry of Energy and Mines, 2015), and guidance for independent audits or assessments are outlined by the Mining Association of Canada (MAC) in their Guide to the Management of Tailings Facilities (MAC, 2011), also intended for operating facilities. The MAC guidelines have been incorporated into CMC's preliminary Guide to the Management of the Casino Tailings Facility (Appendix B.4A), which includes guidelines for independent review of site selection and design, and construction of a tailings facility.

Scope

The role of the IERP is to provide independent expert advice and oversight on the design, construction, operations, and planned closure of the TMF and HLF. The responsibilities of the IERP include:

- Review of existing design concepts and alternatives previously considered to confirm that the proposed facilities incorporate the most appropriate site specific technologies for responsible development.
- Periodic reviews of the design, construction, operations and closure planning of the TMF and HLF in accordance with "international good practice". This can be considered to include guidelines or regulations specific to the Yukon as well as standards set by the International Commission of Large Dams (ICOLD), the Canadian Dam Association (CDA), as well as the Mining Association of Canada (MAC) for the TMF, and guidelines from the State of Nevada for the HLF (Nevada has the most heap leaching operations in the world).
- Provision of advice and guidance to CMC and its design consultants and construction contractors in relation to geotechnical, geochemistry, hydrogeological, hydrological and environment matters for the TMF and HLF.
- Provision of independent and updated opinions to CMC as to whether the TMF and HLF are being designed, constructed, operated, and planned for closure in accordance with current international good practice.
- Provision of input on design, construction, and operational activities that may have long-term stability or other critical performance implications.
- Provision of technical support to CMC for design and implementation of corrective measures or other activities, if required.

Composition

CMC has invited four experts to serve on the panel. Three are internationally recognized geotechnical experts each with over 40 years of experience in the design, construction, operation and closure of cyclone sands tailings dams. All three are presently serving or have recently served on independent tailings dam review boards. The fourth member is an internationally recognized expert in the field of geochemistry. A geochemical expert is included as the design of the TMF has a strong geochemical focus as well as a geotechnical one and the two aspects cannot necessarily be considered in isolation. Contracts have been signed with all members to participate on the panel, and the members' qualifications are described below. Due to the extended duration of the project, the experts presently on the panel may be replaced by other independent experts as the project progresses.

Peter Lighthall, M.Sc., P.Eng., FEIC

- Peter Lighthall is an independent geotechnical consultant with over 40 years of experience, specializing in tailings dams and tailings impoundments, mine waste and mine water management. He has a broad understanding of geotechnical aspects of mining projects, having participated in scoping studies, due diligence assessments, pre-feasibility and feasibility studies, detailed engineering, project development, operation and closure planning. Peter has worked throughout the world, including South and North America, Eastern and Western Europe, Russia and former Soviet Union states, China, the Middle East and Australia, as well as extensively within Canada and USA. He is experienced in tailings dam design in high earthquake risk areas. He has worked in development and implementation of leading edge technologies for tailings management, including thickened and paste tailings and filtered dry stack tailings. He has been active in recent years on review and/or technical advisory roles on numerous major mine developments.
- Mr.Lighthall has been involved in the design, construction, operation and review of several large cyclone sand tailings dams, most recently consulting on Pelambres Copper Mine Mauro cyclone sand dam in Chile, permitted to a height of 190m. He also has extensive northern experience in Yukon Territory, Alaska and Far East Russia. He served as technical advisor to Yukon Energy, Mines & Resources for the Minto Copper Mine.

James Obermeyer, M.Sc., PE

- Principal and Senior Vice President with MWH based in Denver, Colorado. His technical focus has been on engineering, design, construction, operation, and closure of tailing dams and on design and construction of water supply dams.
- Mr. Obermeyer has worked in the United States and internationally on over 500 dam projects. He serves as MWH Energy and Industry's Global Practice Leader for Tailing Dams and Water Storage Dams. In this role he provides technical review and quality assurance / quality control for all tailing dam planning, design and construction projects for MWH's global mining sector. Mr. Obermeyer also serves on Boards of Consultants for dams and other geotechnical projects for mining companies, other engineering companies and governmental entities responsible for dam design.
- Mr. Obermeyer has managed numerous tailing dam projects involving the full life cycle of the mine including site selection, scoping level studies, pre-feasibility studies, feasibility studies, detailed design, construction management, commissioning and start-up, operations, closure planning and implementation, and post-closure. Many of these projects have been located in seismically active areas, requiring special considerations to address seismic stability and liquefaction issues. He has extensive experience with tailing dams that are built using deposition of both cycloned and whole tailing materials.

- Mr. Obermeyer is the Engineer of Record for the Quebrada Enlozada Tailing Storage Facility (TSF) at the Cerro Verde Mine, near Arequipa Peru. This sand dam is constructed with compacted cyclone sands and will have an ultimate height of 260 meters at the centerline. Mr. Obermeyer participated personally for four and a half months during start-up of the TSF at this 120,000 tonne per day facility and has continued his involvement managing MWH's ongoing Quality Assurance and Operations Support to Cerro Verde during subsequent operation of the facility. A 170 meter tall starter dam for a second TSF at the Cerro Verde Mine is currently under construction. Commissioning of this facility, which will have an ultimate height of 310 meters at the centerline and will receive tailing at 240,000 tonnes per day, is scheduled for late 2015. Mr. Obermeyer is the Principal-in-Charge for this project.

Luis Valenzuela, M.Sc.

- Experience in large industrial, mining and infrastructure projects, mainly in Chile and Brazil but also in other Latin American countries.
- Experience includes feasibility studies, engineering design and construction supervision and operational experience through his participation in the Brazilian companies HIDROSERVICE and THEMAG Engenharia and as a co-founder and partner of GEOTECNICA Consultores in Chile in 1981, now known as ARCADIS Chile and part of the international engineering company ARCADIS. This experience includes tailings and water management facilities including large cyclone sands dams.
- Mr.Valenzuela is an active participant in international and Chilean learned societies including member and past president of Institution of Civil Engineers of Chile (IICH), Vice President for Central and South America chapter of International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), active member of the Chilean Chapter of International Commission on Large Dams ICOLD.
- Extensive experience includes participation, individually or as part of a review board in many mining and infrastructure projects including Antamina (Teck, Rio Tinto); Quellaveco (AngloAmerican), La Colosa (AngloAshantiGold), Caserones mine (Lumina Copper, a Mitsui company), El Mauro (Los Pelambres mine, Antofagasta Minerals), Laguna Seca (Escondida mine, BHP Billiton).
- At present, acting as the Engineer of Record for the three tailings dams at Las Tortolas, Chile (AngloAmerican).

Stephen Day, M.Sc., P.Geo,

- Mr.Day is the SRK Corporate Consultant in Geochemistry and North America Practice Leader. He has 25 years of experience in development of waste management plans to address acid rock drainage and leaching of mine wastes in general. He has particular expertise in the selection of appropriate prediction methods for mine planning and modeling of leachate chemistry.
- Mr.Day's project experience includes numerous new mine developments, operating mines and mine closures in western, northern and central Canada, arctic and temperate regions of the USA, southeast Asia and South America. For these projects, he has been involved in waste characterization, selection of control and prevention technologies, and predictions of drainage chemistry for input into water quality impact assessments and selection of water treatment approaches. His clients have included mining companies, utilities, professional associations, Canadian provincial and federal government departments, including the Yukon Government and US state departments.

Structure and Timing

1. The first step for the IERP is to have an initial meeting at the Project Site and conduct a review of the existing design. This is proposed to occur following the Adequacy determination by YESAB, so as to provide the IERP with the same information as provided to Federal, Territorial and First Nations reviewers. This timing is intended to enable feedback from the IERP in preparation of basic design, required by regulatory agencies for Quartz Mining License and Water Use License applications.
2. The IERP will meet and report on their findings at three stages during the development of the detailed design. Meetings will be scheduled when the design is approximately 30%, 60% and 90% complete.
3. The IERP will meet at appropriate intervals (3 - 4 times) during the construction phase.
4. The IERP will meet at regular intervals (approximately every 5 years) during operations and report on their findings.
5. The IERP will meet during the closure phase at intervals to be determined in the latter stages of mine operations.
6. The IERP will review any significant changes to the design and operation of the TMF, as required, throughout all phases of the project.

The purpose of the IERP is to inform, guide, and provide independent oversight to CMC on the design, construction, operation and planned closure of the TMF and HLF. The results of the IERP reviews will be incorporated into the tailings management framework, including the Operations, Maintenance and Surveillance Manual, and Audit and Assessment Frameworks for the Casino TMF, as described by MAC, on a regular basis. CMC will make all reports from the panel available to assessors, regulators and governments, as appropriate, when the reports are available.

B.4.2.2 Change Management and Technical Review Procedures

B.4.2.2.1 R2-2

R2-2. Frameworks for a change management procedure and an associated technical review procedure which will define processes for making and approving changes to designs or operating plans, such as may occur when conditions encountered in the field during construction or operations differ from design assumptions. Describe aspects of the project design for which engineering design changes will be overseen by the IGRP. These frameworks will also describe how regulators, First Nations, and other interested parties will be involved in the review processes.

The design, construction, operation, and ultimately, the closure and reclamation of key facilities at the Casino Project (e.g., TMF and HLF) is complex. It may be necessary to modify the design and operating practices at each stage because of new information or advances in technology, changes in regulation, climate change, or a variety of other reasons. Proposed modifications to the TMF and HLF will be identified and designed by the Engineer of Record (EOR). Significant changes will be reviewed by the Independent Engineering Review Panel (IERP). The modifications will then be submitted to the appropriate regulatory body for review and approval. These steps complement the regular independent reviews by the IERP and the regulators and ensure that the final designs are consistent with the conclusions of the Project screening throughout the detailed design, construction and operation of the Project.

Some examples of factors or influences that may result in changes during the design and initial construction phases include, but are not limited to:

- Changes in standards and regulations;
- Changes in operating/production requirements over time;
- Changes or advances in technology;
- Changes in ore and waste characteristics;
- Climate change;
- Unforeseen conditions (geotechnical, other);
- Personnel changes;
- Changes requested by the construction contractor;
- Availability of materials for construction; or
- Changes in the environment at or near the site.

The general framework that governs changes to engineering design is outlined in Figure B.4.2-1, providing an overview of the inputs and possible change management outcomes during the conceptual design, engineering design, construction, operations and closure phases of the Project. Independent oversight by the EOR, the IERP, and the regulators plays an important role in all phases of project development.

Change management framework

When a change occurs or is expected to occur it is necessary to evaluate the effect of the change on the current design and operation of the TMF and when necessary make revisions to the design and operating practice to accommodate the changed condition. The EOR has design responsibility for the life of the facility (Figure B.4.2-1) unless and until that responsibility is assumed by another Engineering entity. To implement a design change the EOR issues revised design criteria, revised design specifications, revised drawings, or other design document as appropriate, duly signed off by the individual with responsibility for the design within the EOR organization, for action to be taken by CMC. CMC has the responsibility to document that the design change has been effected in accordance with the EOR's direction. The EOR must take appropriate measures to verify to its own satisfaction that the necessary change has been implemented.

Subsequent changes during operations and through the on-going construction must maintain the change control management exercised during design and initial construction. All changes requested by operations or by the construction contractor must be referred to the EOR for evaluation and disposition. No change in design or operating practice (that impact on the design or quality control) is allowed without specific direction from the EOR and signed-off by the appropriate authority within the EOR organization. Both the EOR and CMC will maintain complete records of the original design documentation and all subsequent approved design or operating procedure changes that take place over the life of the facility.

Under all conditions, CMC will comply will all requirements for inspection and review of the TMF as required by the most up-to-date guidelines issued by the Territorial and Federal regulators, and the Canadian Dam Association. Further conceptual details of management of the TMF are provided in the Casino Project Guide to the Management of the Casino Tailings Facility (Appendix B.4A).

Internal and Independent Audit Process

CMC will conduct on-going internal audits of the operations, performance, QA/QC program, and change control management for project facilities. Periodically, an independent audit of the operation will be conducted which will include, among others, a review of the internal audit program. Analysis of the information provided by the independent audits may provide valuable insights into opportunities to enhance the operation of the facilities. The audit results will be made available to the EOR, the IERP, and the Territorial, Federal and First Nations governments.

At some interval after commencement of initial operations (possibly every 5 years), the facilities will undergo an assessment by CMC, the EOR, and the IERP. This assessment will review the current design basis and operating practice, performance to-date, current state of best available technologies and practices, advances in technology relevant to the facility design & operation, changes in the community and environment, and effects or anticipated effects of climate change. The assessment will result in a report that recommends specific actions that need to be actioned for sustained operation of the TMF.

Regulatory Oversight

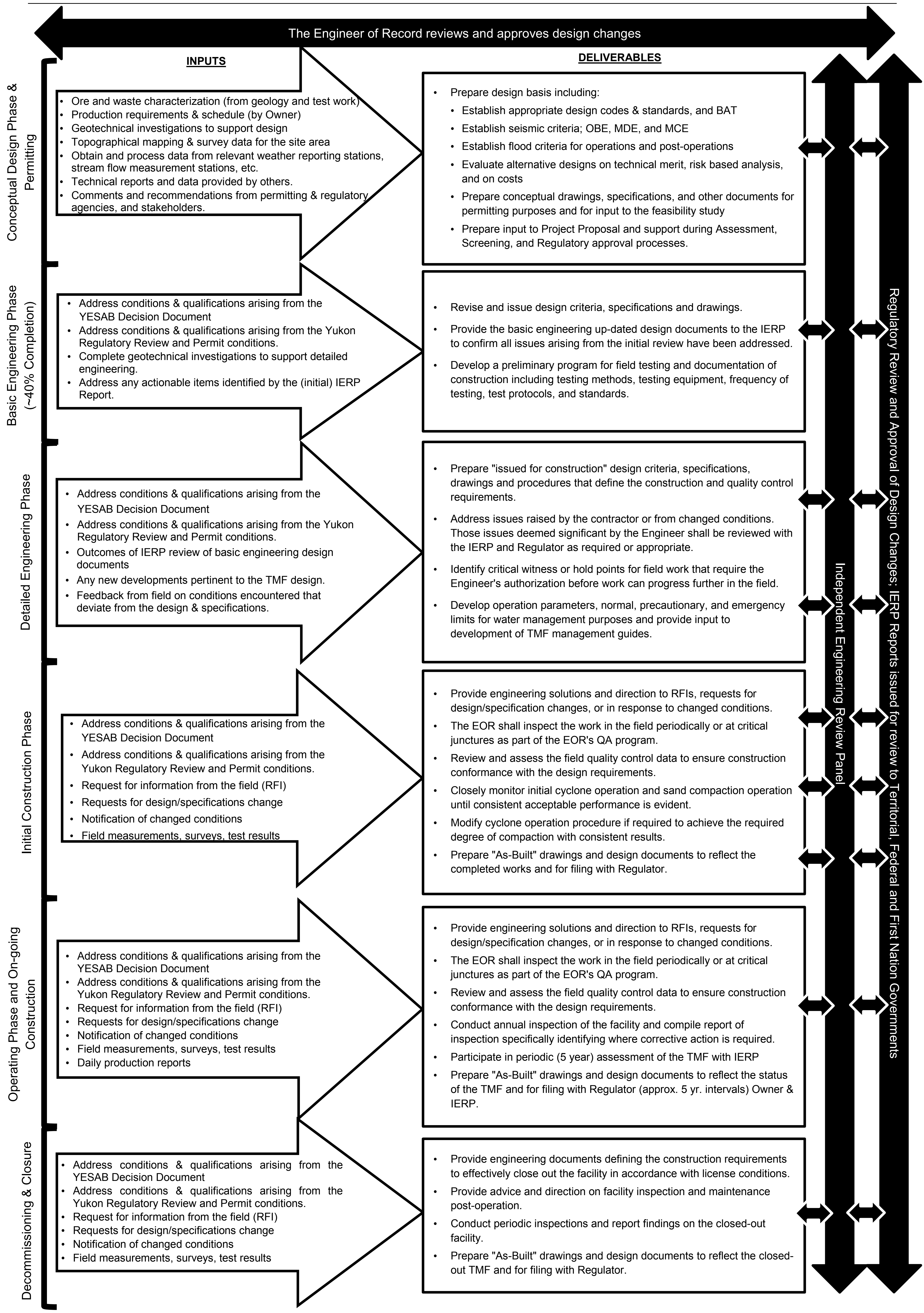
CMC will comply with all requirements of Territorial and Federal regulations, including conditions within permits and licences issued to the Project. CMC will provide Regulators documentation on changes made by the EOR, as required by licences and permits, and as requested. The results of the 5 year assessment will be filed with Regulators and any significant changes to the design and operation of the facility will be subject to review and approval (Figure B.4.2-1).

IERP Oversight

A full description of the role of the IERP is provided in the response to R2-1. Significant changes to the design or operating procedures must be conveyed to the IERP and any outcomes from the IERP must be addressed and documented. The results of the independent audit and the 5 year assessment will be made available to the IERP for review and feedback, as will any other documentation the IERP requires to complete its review.

First Nations

CMC will have continuous dialogue with affected First Nations and any significant changes to the design or operating procedures will be communicated on a timely basis. Should multiple options be available to modify the Project as a result of updated information, CMC will present the options and the comparative analysis to affected First Nations for their review and feedback. The results of the 5 year assessment will also be made available to the affected First Nations.



QA = Quality Assurance; EOR = Engineer of Record; RFI = Request for Information from the Field; BAT = Best Available Technologies; OBE = Operating Basis Earthquake; MDE = Maximum Design Earthquake; MCE = Maximum Credible Earthquake

Figure B.4.2-1 Inputs, Deliverables and Review of Design Refinements over the Mining Life Cycle

B.4.3 ALTERNATIVES

B.4.3.1 Tailings Management Facility

B.4.3.1.1 R2-3

R2-3. A detailed description and assessment of alternatives to or alternative ways of undertaking the Project with respect to tailings and waste rock management. This alternatives assessment should be comprehensive, provide transparent rationale and give consideration to the following:
a. Full life-cycle costs and all phases of the proposed TMF dam (i.e. in perpetuity);
b. Risks of the proposed TMF dam (i.e. as per risk assessment);
c. Potential significant adverse effects of the proposed TMF dam to environmental values (i.e. wildlife, water and aquatic resources) and socio-economic values (i.e. health, social, heritage and economic);
d. Identification and comparison of best practices and best-available technologies for tailings management;
e. Options for managing water balance to ensure safety and reduce probable risks of structural and/or non-structural TMF dam failure (i.e. as determined by the risk assessment);
f. Technically-sound engineering solutions that mitigate potential significant adverse effects based on actual site conditions (e.g. permafrost, climate change, construction challenges); and
g. A clear and transparent evaluation of the factors that support the proposed TMF dam.

CMC has completed an alternatives assessment to evaluate several options for mine waste (tailings and waste rock) management, including slurried tailings, thickened tailings, dry stack tailings, surface waste rock disposal and co-disposal of waste rock and tailings, provided in Appendix B.4B. The initial evaluation indicated that conventional slurry tailings disposed of subaqueously is the preferred option, and subsequently multiple TMF locations were evaluated, considering economic, environmental, technical and socio-economic parameters. The assessment was conducted in accordance with Environment Canada's guidance on alternatives assessment (Environment Canada, 2011) and gives consideration to the following:

a. Full life-cycle costs: The alternatives assessment contained in Appendix B.4B identified the most appropriate option for mine waste management at the Casino Project based on a number of technical, environmental, socio-economic, and economic factors. While the economic parameters were considered in the analysis, they were not given greater weight than the others. The economic portion of the analysis focused on capital and operating costs only, but cost was not the most important factor in the selection. Other factors, such as technical feasibility and site disturbance, were key in the determination of the most appropriate option for mine waste management at the Casino Project.

b. Risks of proposed TMF: The risks associated with the proposed TMF are described in the alternatives assessment contained in Appendix B.4B.

c. Potential significant adverse effects of the proposed TMF to environmental and socio-economic values: The potential significant adverse effects relating to the TMF are described in the alternatives assessment contained in Appendix B.4B.

d. Identification and comparison of best practices and best-available technologies for tailings management: Alternative disposal methods are compared in the alternatives assessment contained in Appendix B.4B.

e. Options for managing water balance: The TMF water balance was assessed for a range of climatic conditions (Appendix A.7A). The water balance is expected to be in deficit during operations and in surplus in closure, even during extremely dry conditions.

During operations, when no spillway is in place, the TMF water balance is managed by the amount of water pumped from the Yukon River. Should conditions be significantly different than expected, CMC has the option to stop, reduce, or increase the amount of water pumped from the Yukon River.

During closure, water balance surplus is managed through the spillway. The spillway is sized for a probable maximum flood, and can manage a great surplus. In the unlikely scenario that the facility will be in a deficit during closure, pumping of water from the open pit lake or even the Yukon River are other options available to CMC to keep the waste flooded.

f. Engineering that mitigates potential significant adverse effects based on actual site conditions: All aspects of engineering design are aimed at mitigating potential adverse effects based on site-specific conditions. Further site investigations completed to meet the requirements of regulatory bodies for application for the QML and YWL will drive many of the detailed design and construction decisions. On-going QA/QC measures and the change management framework will ensure the TMF is built in accordance with terms and conditions of licenses. These on-going controls are discussed throughout this SIR-B, and include:

- General risks and mitigation strategies are discussed in the response to R2-4;
- TMF design and construction considerations are discussed in responses to R2-57 through R2-66; and
- QA/QC and change management procedures are discussed in R2-2.

g. Evaluation of the factors supporting the proposed TMF: The detailed evaluation that supports the proposed TMF is included in the Mine Waste Management Alternatives Assessment in Appendix B.4B.

B.4.3.2 Risk Assessment

B.4.3.2.1 R2-4

R2-4. A risk assessment for the TMF dam.

Section 21 of the Project Proposal provided a determination of the significance of any environmental or socio-economic effects resulting from accidents or malfunctions. This included a qualitative risk assessment associated with *credible* hazard scenarios. Potential hazards related to the tailings management facility (TMF) included a TMF embankment failure or overtopping; tailings distribution pipelines failure and a reclaim water line rupture (Section 21.3.4.1). Below, CMC has provided the results of a more comprehensive risk assessment specific to the TMF. In addition, CMC proposes to conduct a Failure Modes and Effects Analysis (FMEA) assessment at discrete stages in the project development as follows, as shown on Figure B.4.2-1:

- A FMEA will be completed during the early regulatory review phase informed by advanced engineering, final geotechnical investigations, review of key design basis by the Independent Engineering Review Panel (IERP), input from the YESAB Decision Document, input from the regulator, territorial, federal and First Nations governments, and Communities of Interest (COI). The intent is that this FMEA together with other project documents will support the Quartz Mining License (QML) application leading to a provisional QML with attendant conditions and qualifications that are to be addressed to obtain an operating license.

- The FMEA will be re-evaluated during later stages of detail design when the final design basis has been vetted by the IERP and comments and recommendations of the first FMEA participants have been addressed.
- The final FMEA, prior to start of operations, will be conducted during the later stages of construction and will reflect any design changes or developments in the field since the previous FMEA and will be informed by the actual foundation conditions encountered at the site. The conditions and qualifications attached to the provisional QML will have been addressed at this juncture and the FMEA will reflect any design or procedural changes arising from the provisional QML conditions.
- During operations and in post-closure the TMF facility will undergo an assessment every five (5) years which will include a review of the effects of climate change and an updated risk assessment.

Tailings Management Facility Design

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 and potentially reactive waste rock and overburden materials. The TMF will be developed starting in the construction phase in Year -4 and will be utilized throughout the mine life and will be a permanent landform in the post-closure phase.

The TMF will be comprised of:

- Two earth-rockfill-cyclone sand zoned embankments constructed by a centerline raise construction method, with the downstream shells constructed from dozer compacted cyclone sand and other suitable borrow materials;
- Cyclone plant to generate clean sand from the bulk NAG (Non-Potentially Acid Generating) tailings for embankment construction and tailings distribution pipelines (bulk NAG tailings, PAG tailings, cyclone sand, cyclone overflow);
- Supernatant (surface water) pond;
- 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;
- Tailings storage area in the downstream portion of the TMF impoundment for storage of PAG tailings and the portion of NAG tailings not used for embankment construction;
- A NAG tailings beach above water, separating the supernatant pond from the embankments;
- Water management system (seepage collection ditches and pond, and seepage recycle system);
- A closure spillway and downstream channel near the right abutment of the West Saddle Embankment terminating at an erosion protected plunge pool into Casino Creek; spillway will pass a 24-hr probable maximum flood event; and
- Wetland treatment for the removal of contaminants at closure.

The TMF Main and West Saddle Embankments have been designed in accordance with the 2007 CDA Dam Safety Guidelines, and based on site-specific geotechnical, hydrogeological, hydrometeorological, and seismic information (Appendix A.4D). Considering the incremental consequences of failure including loss of life, environmental and cultural values and economic loss, the Casino TMF was classified as "High" according to the 2007 CDA Dam Safety Guidelines, and the feasibility level design was completed in accordance with those design criteria.

Components of the Casino TMF have been over-designed to an "Extreme" level for earthquake events and a 24 hour PMF storm event, despite a "High" rating. Dam classification is used to determine design criteria for earthquakes and flood events. Although classified as "High", conservatively, the Casino TMF design incorporates an evaluation of embankment design to a seismic loading of the 1 in 10,000 year earthquake. The CDA guidelines recommend the 1 in 10,000 year earthquake event for the design of dams classified as "Extreme". The predicted embankment deformations resulting from the 1 in 10,000 year earthquake are less than 0.5 m, and there is no significant impact on the embankment freeboard (minimum 2 m) and no loss of embankment integrity. Static and post-earthquake stability is also satisfactory. Therefore, the TMF meets the CDA Dam Safety Guideline seismic design criteria corresponding to an "Extreme" dam class.

Additionally, the TMF design for flood events requires *storage* for that flood event during operations, and *conveyance* of the flood event within the spillway during closure. The definition of the flood event varies depending on the dam classification. The updated 2014 guidelines define return periods as follows:

Dam Class	Annual Exceedance Probability (AEP) - Inflow Design Floods	
	Construction, Operation and Transition Phases	Closure - Passive Care
Low	1/100	1/1,000
Significant	Between 1/100 and 1/1,000	1/3 between 1/1,000 and Probable Maximum Flood
High	1/3 between 1/1,000 and Probable Maximum Flood	2/3 between 1/1,000 and Probable Maximum Flood
Very High	2/3 between 1/1,000 and Probable Maximum Flood	Probable Maximum Flood (PMF)
Extreme	Probable Maximum Flood (PMF)	Probable Maximum Flood (PMF)

However, the guidelines do not specify flood *duration*. The Casino TMF has been designed for an inflow design flood (IDF) of 1/3 between the 1/1,000 and Probable Maximum Flood (PMF) for a 72 hour storm duration during operations (equivalent to a 9 Mm^3 flood volume) and the PMF for a 24 hour storm during closure (or peak flow). These events are again equivalent to a dam classification of "Extreme" for 24 hour storm events, or 6.1 Mm^3 flood volume during operations and peak flow during closure.

Therefore, while classified as "High", the Casino TMF meets the main criteria for a dam classification of "Extreme" according to the updated CDA Dam Guidelines (CDA, 2014).

Further details of the TMF design can be found in Appendix A.4D.

A guide to the management of the Casino Tailings Facility and an Operating, Maintenance & Surveillance Manual (OM&S) are currently under development by CMC. These guides are based on the latest issues of MAC guidelines for management of tailings facilities and OM&S manuals. For example, MAC is currently undergoing a review of the tailings management guides. CMC will follow the guidelines of MAC to compose its tailings management system in accordance with the most up-to-date MAC guidelines. When fully developed, these manuals will be submitted to the decision bodies in support of the Quartz Mining License and Yukon Water Use License applications. Early drafts of these manuals are included in Appendix B.4A and Appendix B.4D for information purposes only at this time to indicate the comprehensive scope and content of the guides under development. The completed manuals will provide management and operations personnel an effective tool for the training of operating personnel and contractors. They will also provide a means to manage, control and document operations and to develop an awareness and ability to recognize and respond to conditions that deviate from design or approved operating procedures. The manuals will also be provided to the IERP for review and input, to ensure they reflect current industry practice.

Risk Assessment Methodology

Risk is typically defined as the product of the likelihood and the consequence of an event. The risk assessment presented here is on the Project Proposal basis. 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 (Table B.4.3-1). Consequence is assigned based on the spatial and temporal context of the Project (Table B.4.5-1).

Table B.4.3-1 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 B.4.3-2 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 also provided. 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.

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), as shown in Table B.4.3-3. 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. 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.

Table B.4.3-3 Risk Matrix

Likelihood	Consequence			
	Very Low	**Low**	**Moderate**	**High**
Likely	Low	Moderate	High	High
Possible	Low	Low	Moderate	High
Rare	Non-actionable	Low	Low	Moderate
Unlikely	Non-actionable	Non-actionable	Low	Low

Risk Identification

Potential accidents and malfunctions and hazards assessed for the TMF are described in Table B.4.3-4, but fit into the following main categories:

- Failure of retaining embankments (coffer dam during construction or tailings embankment during operations and closure);
- Failure of associated infrastructure (e.g., HLF, waste storage area, distribution pipelines); and
- Failure of the water management and treatment system.

In addition to the mitigations and management measures described in Table B.4.3-4, CMC will have a rigorous program of internal monitoring and management subject to extensive auditing and quality assurance and quality control procedures. These include:

- Robust QA/QC program during construction, verified by the engineer of record.
- Comprehensive sampling, testing, and documentation regime to demonstrate effectiveness of material quality control and placement.
- Managing operations to meet or exceed MAC guidelines, including the incorporation of Towards Sustainable Mining initiatives and compliance with the various protocols and frameworks, including the Tailings Management Protocol and the:
    - Guide to the Management of Tailings Facilities;
    - Operation, Maintenance and Surveillance Manual; and
    - Audit and Assessment of Tailings Facilities Management Manual.
- Compliance with the International Cyanide Code and the inherent auditing required for compliance with the Code.
- On-going monitoring of site infrastructure and receiving environment to ensure compliance with model predictions.
- Scheduled Dam Safety Reviews in accordance with CDA Guidelines.
- Annual review of major facilities operations by Chief Operating Officer.
- Annual audit of operation.
- IERP review of design and operations.
- External (independent) audit of operations every 3 years.
- Assessment of the facilities including consideration of climate change every 5 years.
- Review and approval of issued-for-construction reports by the Yukon Government.
- Submission of as-constructed design drawings and reports to the Yukon Government and the Yukon Water Board.
- Regular Inspections by Yukon Government regulators.

Regardless of these mitigations, the assessment of potential accidents and malfunctions are discussed further below.

1. Embankment Failure

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.

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 (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).

In lieu of TMF embankment failure likelihoods, the probability of occurrence of the design earthquakes and floods can be considered. The 1 in 10,000 year earthquake is an earthquake having a 0.01% probability of occurrence being exceeded in any year. 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. By definition a PMF event is so improbable that a probability of occurrence is *not assigned*.

Assessment of embankment failure evaluated in Table B.4.3-4 includes the following, discussed further below:

- Failure of coffer dam or temporary construction measures;
- Failure due to a seismic event;
- Failure due to piping;
- Slope-stability foundation failure; and
- Failure due to overtopping.

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 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.

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 requirements for factors of safety for short term (initial construction phase) and long term operations and post-closure stability (1.3 and 1.5, respectively) (Appendix A.4D). 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 (Appendix A.4D).

Based on these design measures using the site specific geotechnical, hydrogeological, hydrometeorological, and seismic information, the likelihood of failure has been rated as **Rare**.

To evaluate the consequences of a hypothetical dam breach, a dam breach inundation study was conducted (Appendix B.4C). However, the study does not evaluate the likelihood of occurrence as discussed above. The modelled dam failures are hypothetical and should not occur if the TMF is designed, constructed and operated following standard engineering practices. However, it is prudent to understand the potential consequences of failure, and the results of this study can be used to aid in the development of emergency planning. The CDA guidelines (2007) suggest that causes of earth dam failures include overtopping and seepage, piping and internal erosion, embankment instability and slides. Overtopping is a common mechanism for failure during a flood induced breach. As the TMF has the capacity to contain the IDF under normal operating conditions, the initial pond level was raised from operational limits for the study, in order to cause the dam to overtop during the 24-hour PMF.

The dam breach inundation study was structured to estimate the potential inundation limits that would result from a hypothetical dam breach at its maximum height, resulting in the largest potential consequences. Impacts to aquatic and terrestrial ecosystems, as well as to socio-economic indicators are also provided in Appendix B.4C.

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.

2. Failure of associated infrastructure

   Assessment of associated infrastructure evaluated in Table B.4.3-4 includes:

   i) failure of the HLF embankment and release of leach solution into the TMF; and

   ii) failure of distribution facilities.

Water can only be impounded in the HLF prior to closure, as the Events Pond will be removed and the liner of the confining embankment will be perforated after the rinsing stage, and the HLF will drain freely into the TMF.

i) Failure of the HLF embankment and release of leach solution into the TMF

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 (Appendix A.4C). 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. 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 to the Events Pond.

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 (Appendix A.4C). 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 (Appendix A.4C). 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. 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.

ii) *Failure of distribution facilities*

Three tailings streams will discharge into the TMF: PAG tailings, bulk NAG tailings and the cyclone overflow (the fine fraction of bulk NAG tailings). 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. 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 equivalent of each year, since cyclone operations may become more problematic as the temperature decreases during the winter months. 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 within the impoundment facility 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 (Appendix A.4D):

- 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. Any significant pipeline failure on the downstream side of the dam would be addressed by bypassing the cyclone plant and routing the bulk tailings directly into the TMF. Rupture of the tailings fines from the cyclone overflow discharge lines would result in deposit of NAG tailings onto the beach of the TMF and contained within the impoundment.

Based on the design measures the likelihood of a tailings line rupture is rated as **Rare** and the consequence is rated as **Very Low**.

Failure of the PAG tailings pipeline between the main plant and the TMF would result in release of material into the terrestrial environment. An uncontrolled release of the PAG tailings may travel downhill and in any case will remain within the confines of the TMF catchment area. Localized impacts uphill of the TMF will be mitigated by cleaning up any spill that occurs during operations.

Failure of the NAG tailings distribution system would result in release of tailings onto the downstream side of the embankment to be captured within cells and/or by the seepage return system 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. Tailings seepage water could have elevated concentrations of total suspended solids and some metals. Seepage and runoff collected in the water management pond will be pumped back into the TMF.

3. Failure of the water management and treatment system

   Assessment of the various components that would impact downstream water quality evaluated in Table B.4.3-4 include the following:

   i) PAG tailings mistakenly identified as NAG and used in construction;
   ii) Unexpected metal leaching from the NAG and overburden material;
   iii) TMF seepage collection failure;
   iv) Unpredicted seepage volumes; and
   v) Failure of wetland treatment system.

   These failures are discussed further below.

i) *PAG tailings mistakenly identified as NAG and used in construction*

To ensure the accurate characterization of tailings and waste rock materials, and identify the metal leaching and acid generating potential of that material, a broader monitoring and control process is used to monitor and manage the quality of the NAG tailings reporting to the cyclone station. Measures include:

- Mine production planning and scheduling documents that characterize the ore to be fed to the coarse ore stockpile ahead of the processing facility
- Sampling of the drill cuttings prior to blasting of a bench so that the ore can be tested in advance of processing for sulphide sulfur and carbonate to determine the initial neutralization potential ratio (NPR);
- On-stream analyzers, supported by check assays, installed at strategic points in the processing plant to collect data from the various plant input and output streams to inform operations personnel on plant performance, allowing them to manage the facilities efficiently and effectively;
- The tailings stream at the cyclone plant is assayed multiple times per day to confirm the material is NAG and suitable for dam construction; and
- Tests to confirm the tailings coarse fraction meets the specified size distribution criteria.

ii) *Unexpected metal leaching from the NAG and overburden material*

Thresholds for acceptable construction material (e.g., NAG tailings) will be set sufficiently low to be conservative, and allow for some variance. Through testing of several different composites from the Casino ore body, the ability of the flotation process to reduce the sulfur content to achieve a NP/AP > 2.0 was proven. The NP/AP criterial of 2.0 is also very conservative and a NP/AP = 1.5 is likely more appropriate for the low-sulphur desulphurized tailings as shown by the low sulphide oxidation rates in the tailings kinetic tests and liberation of carbonate minerals in the finely ground tailings. Testwork on individual ore types defines the specific sulphide sulphur requirements to maintain a conservative NP/AP > 2.0, which was provided in Table A.4.5-2. Operational monitoring will be conducted to confirm the non-PAG characteristic of hypogene tailings used for the construction of the embankment or the final tailings cover that will be placed on the upper surface of the TMF.

iii) *TMF seepage collection failure & iv) unpredicted seepage volumes*

As discussed in the TMF failure section, the core zone will include a seepage cut-off key into competent rock in the foundation. Additionally, the Water Management Pond will be located downstream of the TMF main embankment, in the Casino Creek valley to collect embankment seepage and runoff. Seepage and runoff collected in the water management pond will be pumped back into the TMF. Monitoring wells will be constructed downstream of the collection system to ensure the water management pond is working as predicted. A wetland treatment system may also be constructed in the area downslope of the water management pond, if required (see the response to R2-73).

v) *Failure of wetland treatment system*

Failure of the wetland treatment system may occur due to failure of the wetland itself (e.g., not performing as predicted) or through failure of the infrastructure on which the wetland is built (e.g., TMF embankment). The phased design and optimization program for the wetland treatment system is intended to be an adaptive and responsive program, allowing for the systems to be effectively developed to treat water for the ranges of contaminant loads, flows, and climate at the Casino site, for successful treatment in perpetuity. As with any water treatment system, an assessment of the uncertainty associated with the performance of the proposed passive treatment systems will be conducted as part of the design and testing process. Uncertainties will be evaluated and integrated into the phased research program in order to identify their scope and develop contingencies to address them. The phased approach being undertaken in the design and optimization of the passive treatment systems has been developed specifically to address uncertainties associated with such systems, allowing for optimizations, design revisions, and contingency options to be integrated through the process. While some uncertainty remains with the currently proposed systems, all foreseeable uncertainty will be addressed through the execution of appropriately planned laboratory, bench- and field-scale experiments and subsequent monitoring of the installed systems. Additionally, the conservative nature of the water quality model predictions and the treatment systems proposed will result in discharge water quality that will be protective of the receiving environment.

Table B.4.3-4 Tailings Management Facility Risk Assessment

Potential Issue of Concern	Potential Effect(s)	Project Phase	Design Measures	Risk Assessment			Rationale	Mitigation / Management	Risk Level	Significance
				Likelihood	Consequence	Confidence				
Failure of coffer dam or temporary construction measures	Discharge of non-contact water and natural materials	Construction	• Designed to manage runoff from the 10-year, 24-hr rainfall event for the construction period. • Backup equipment and procedures to relieve problem by controlled (pumped) discharge. •	Possible	Very Low	Moderate	• Limited exposure due to short construction period. • Any water released is non-contact. • Backup capability comparatively simple to provide.	• Awareness of snowpack condition ahead of freshet enables ability to take proactive measures. • Monitoring of freeboard. • Can raise coffer dam or pump out water if required.	Low	Not significant
Erosion from construction areas during runoff events.	High suspended solids and sediment loading to the downstream environment	Construction	• Use appropriate erosion control measures as required by project construction specification.	Possible	Low	High	• Best management practices will be incorporated into the construction procedures. Sediment control measures will be inspected and maintained to ensure they are effective. • Silt, sediment and erosion control plan will be implemented.	• Additional measures may be incorporated into the plan if the planned measures are shown to be insufficient.	Low	Not Significant
Severe weather impact on construction	Failure to meet design specification and quality control standards	Construction & operations	• Provide detailed design and specification requirements including quality control measures for construction with specific measures for cold weather conditions.	Unlikely	Moderate	High	• Practices and procedures for cold weather construction are known and understood by construction contractors, engineers, and EPCM contractors. All qualified contractors have relevant experience dealing with these issues. • Weather susceptible construction activities scheduled outside of colder season.	• EOR provides detail specifications and QC requirements. Construction contractor provide work plan to demonstrate compliance & his QC program. EPCM & EOR provide QA of QC program. • Contractor required to re-perform unacceptable work.	Low	Not significant
Failure of tailings embankment and release of tailings from a Seismic event	Discharge of deleterious substances to environment arising from a seismic event	Construction, operations, closure, and post-closure	• The embankment has been over-designed in consideration of seismic loading for the 1 in 10,000 year earthquake, which is comparable to a hazard rating of “Extreme” and more robust than the recommended CDA Guidelines for a "High" classification of a 1 in 2,500 year earthquake.	Rare	High	High	• Embankment raises constructed by a centerline raise construction method as per design results in a stable structure that does not rely on the strength of the deposited tailings solids; selected because of its superior seismic and static stability as compared to upstream construction methods. • Experience at other comparable operations in similar cold climates demonstrates that cyclone sand operation produce construction material with consistent properties and that required levels of compaction can be reliably obtained.	• Emergency Response Plan. • Scheduled Dam Safety Reviews in accordance with CDA Guidelines. • IERP review of design and operations. • Regulatory inspection	Low	Not significant
Seismic event continued.	Leading to failure of the tailings dam and loss of water and solids to the downstream environment.	Construction, operations, closure, and post-closure	• Per the above.	Unlikely	High	High	• Appropriate design standards. Surveillance, maintenance and monitoring. • Good operating practice (beach widths and freeboard) to accommodate potential deformations. • Using good operating practice allows	• Per the above.	Low	Not Significant

Potential Issue of Concern	Potential Effect(s)	Project Phase	Design Measures	Risk Assessment			Rationale	Mitigation / Management	Risk Level	Significance
				Likelihood	Consequence	Confidence				
							quality construction to continue even in adverse weather conditions. • Operator and Contractor training. .			
Failure of tailings embankment and release of tailings due to a precipitation event	Discharge of deleterious substances to environment arising from flood event	Construction, operations, closure, and post-closure	• The embankment has been designed in consideration of an appropriate IDF per CDA guidelines for each stage in the life of the facility.	Unlikely	High	High	• The IDF criteria is per CDA guidelines and the design provides a minimum of 2 m freeboard over the requirement to store or route the flood event.	• Emergency Response Plan. • Scheduled Dam Safety Reviews in accordance with CDA Guidelines. • IERP review of design and operations.	Low	Not significant
High runoff event leading to dam overtopping.	Failure of the tailings dam and loss of water and solids to the downstream environment.	Operations	• Design includes 2 m freeboard over and above storage required for design flood events occurring at maximum operating level.	Unlikely	High	High	• Designed to a high standard with abundant flood storage. • Regular inspection and maintenance.	• Emergency Response Plan. • Scheduled Dam Safety Reviews in accordance with CDA Guidelines. • IERP review of design and operations.	Low	Not significant
Piping failure of the dam	Failure of the tailings dam and loss of water and solids to the downstream environment.	Construction, operations, closure, and post-closure	• Design includes substantial core and filter zones.	Unlikely	High	High	• Conservative embankment filters design. • Surveillance, maintenance and monitoring. • Good operating practice (beach widths).	• Maintain a stockpile of material for a downstream filter.	Low	Not significant
Slope stability - Foundation failure	Leading to failure of the tailings dam and loss of water and solids to the downstream environment.	Construction, operations, closure, and post-closure	• Extensive geotechnical investigations to support design. • Evaluation of "as excavated" foundation conditions by geotechnical engineer to confirm consistent with design requirements. • Design review by IERP.	Unlikely	High	High	• Appropriate design standards. • Surveillance, maintenance and monitoring. • Good operating practice (beach widths). • Operator training. • Excavation of poor (ice-rich) foundation materials.	• Emergency Response Plan. • Scheduled Dam Safety Reviews in accordance with CDA Guidelines. • IERP review of design and operations. • Frequent inspection by EOR geotechnical engineer during initial and on-going construction.	Low	Not Significant
Failure of tailings embankment and release of tailings due to overtopping	Discharge of deleterious substances to environment arising from failure to operate the facility within design parameters	Operations	• The embankment has been designed with substantial freeboard. • Detailed procedural and control measures will be co-developed by Owner and the EOR prior to putting facility into operation.	Unlikely	Moderate	High	• Robust design features. • Comprehensive monitoring and control systems included. • Comprehensive operating procedures, QA/QC control measures, and reporting requirements in accordance with MAC guidelines. • Operations subject to internal audits, external audits, and inspections by EOR and Regulatory annually. • Emphasis on training of operating personnel and contracted forces, documentation of all training.	• Annual review by COO of CMC. • Annual audit of operation. • External (independent) audit of operations every 3 years. • Assessment of the facility including consideration of climate change at 5 year intervals. • Operation managed to meet/exceed MAC guidelines. • IERP review of operations. • Emergency Response Plan • Scheduled Dam Safety Reviews	Low	Not significant

Potential Issue of Concern	Potential Effect(s)	Project Phase	Design Measures	Risk Assessment			Rationale	Mitigation / Management	Risk Level	Significance
				Likelihood	Consequence	Confidence				
								in accordance with CDA Guidelines.		
Failure of tailings embankment by overtopping and release of tailings	Discharge of deleterious substances to environment arising from a flood event after operations have ceased and while spillway is being constructed.	Post-closure	• The embankment has been designed in consideration of an appropriate IDF per CDA guidelines for this stage and there are no inflows from operations. Duration of spillway construction will not span more than one spring freshet. • The reclaim water system will remain operational with a modification to the discharge line to allow water to be pumped from the TMF to the pit if required during spillway construction. • No discharge to the receiving environment during transition phase.	Unlikely	High	High	• Embankment raises constructed by a centerline raise construction method as per design result in a stable structure that does not rely on the strength of the deposited tailings solids; selected because of its superior seismic and static stability as compared to upstream construction methods.	• As per the above.	Low	Not significant
Blockage of the spillway (debris, beaver, snow, ice).	Overtopping of the dam leading to failure and loss of tailings.	Post-closure	• Design includes barriers to be installed upstream of spillway to preclude blockage of spillway.	Unlikely	Low	High	• During post-closure period PMF can be contained and routed through the spillway. • Regular surveillance, inspection and maintenance.	• Annual inspections by Owner/EOR and Regulator and per MAC guidelines. • Monitoring of site per closure plan.	Low	Not significant
Failure of tailings embankment and release of tailings	Discharge of deleterious substances to environment arising from flood event	Post-closure	• The embankment has been designed to route a PMF event via the spillway per CDA guidelines.	Unlikely	High	High	• The IDF criteria is per CDA guidelines and the design provides a minimum of 2 m freeboard over the requirement to store or rout the flood event.	• Emergency Response Plan • Scheduled Dam Safety Reviews in accordance with CDA Guidelines. • Annual inspections by Owner/EOR and Regulator and per MAC guidelines. • TMF is assessed every five years including consideration of climate change. • IERP review of design and operations.	Low	Not significant
Failure of HLF embankment and release of leach solution into TMF	Discharge of deleterious substances to the TMF	Operations	• The embankment has been designed to retain a 1 in 100 year flood event. Without discharge to the TMF. • Events pond spillway designed for a 1 in 200 year event. • Appropriate factors of safety for short & long term, 1 in 500 seismic event considered in design.	Unlikely	Low	High	• Robust design features consistent with good practice. • TMF provides secondary containment; no direct discharge to receiving environment. • Maximum volume reporting to the TMF in event of a failure is about 246,000 m3 and is insignificant compared to the TMF storage capacity during operations of 9 Mm3. • Leach solution reporting to the TMF under	• Emergency Response Plan. • Design and operated in accordance with the International Cyanide Code.	Low	Not significant

Potential Issue of Concern	Potential Effect(s)	Project Phase	Design Measures	Risk Assessment			Rationale	Mitigation / Management	Risk Level	Significance
				Likelihood	Consequence	Confidence				
							failure conditions will be rapidly diluted and consumed by water and solids within the TMF. Cyanide is toxic relatively low concentrations but degradable. Any impact will be limited and short.			
PAG tailings mistaken as NAG during construction	ARD and metal leaching in seepage reporting to environment.	Construction, operations	• Monitoring and control measures to characterize ore starting at mine daily production level planning, sampling of drill hole cuttings, in-process monitoring and analysis, sampling and testing at the tailings cyclone facility. • Design provides flexible operation and ability to quickly direct off-specification material directly into the impoundment.	Unlikely	Moderate	High	• Strong geochemistry data base, conservative segregation criteria, operational ARD management plan. On-going testing and monitoring. Seepage collection ditches will capture runoff. • Experience at other operations demonstrates that material control can be consistently maintained.	• Collect and treat affected water. • Comprehensive sampling, testing, and documentation regime to be implemented to demonstrate effectiveness of material quality control and placement.	Low	Not Significant
Unexpected metal leaching from the NAG and overburden.	Leached metals reporting to the environment.	Operations, post-closure	• Surface drainage from TMF is captured by the seepage control system and returned to the TMF. • Sub – surface flow is monitored for water quality by monitoring wells downstream of the seepage collection facility.	Unlikely	Moderate	High	• Significant metal leaching and test work done to date. On-going testing and monitoring including on-site lysimeters. • Seepage collection ditches will capture runoff.	• Collect and treat affected water, provide low permeability cover. • Pump back through monitoring wells as required.	Low	Not Significant
Tailings distribution pipelines failure (bulk NAG tailings, PAG tailings, cyclone sand, cyclone overflow)	Discharge of deleterious substances to environment	Operations	• Bulk NAG, cyclone overflow and PAG tailings will be disposed of in the downstream end of the impoundment. • Discharge will be from valved off-takes located along the main headers of Embankment and from the West Saddle Embankment. • Slurry pipelines will be drained for shutdowns longer than 2 hours to prevent freezing.	Rare	Very Low	High	• PAG tailings will flow by gravity into the TMF; NAG tailings used in embankment construction or discharged to TMF could result in high TSS concentrations and sedimentation in Casino Creek downstream. • Water management pond may intercept NAG tailings.	• Emergency Response Plan. • Spill Contingency Plan. • Bulk NAG tailings will bypass cyclone station and discharge into the impoundment in the event of issues with underflow transport or deposition.	Non-actionable	Not significant
TMF seepage collection failure	Discharge of deleterious substances to environment	Operations, post-closure	• Seepage water losses from the TMF are collected in seepage collection systems constructed downstream of the embankments. The seepage is collected and pumped back into the TMF. • 20m wide low permeability core located in the Main Embankment is surrounded by filter and transition zones constructed from crushed and screened rock; the filter and transition zones function in the	Possible	Low	High	• The NAG tailings provide a low permeability zone downstream of the PAG tailings and the coarse waste rock in the waste storage area. • The NAG beach above water will function as a seepage control measure by keeping the pond at a distance from the dam crest. • Monitoring wells are installed downstream of the collection system; if there is indication of contaminated water flow this early detection will allow remedial action to be taken.	• Emergency Response Plan. • Spill Contingency Plan. • Pump back through monitoring wells as required.	Low	Not significant

Potential Issue of Concern	Potential Effect(s)	Project Phase	Design Measures	Risk Assessment Likelihood	Consequence	Confidence	Rationale	Mitigation / Management	Risk Level	Significance
			prevention of piping and migration of fines, and act as drains. • The seepage collection system remains in operations until the wetlands treatment results in water quality that meets the discharge requirements.							
Greater than predicted seepage volumes	Unacceptable water quality in the receiver.	Operations, post-closure	• Per the above.	Possible	Low	High	• Seepage collection system in place. • Additional groundwater modelling being undertaken. • Additional tailings characterization being undertaken. • Monitoring programs.	• Groundwater recovery systems. • In situ groundwater treatment.	Low	Not Significant
Drought and/or dusting	Cannot maintain tailings water cover resulting in acid generation from the reactive tailings and waste rock affecting downstream water quality.	Post-closure		Unlikely	Low	High	• Waste rock is covered by layer of tailings. Tailings have some buffering capacity so the drought would have to be multi-year. In the long term sediments and organics will cover the tailings further limiting oxygen infiltration.	• Divert water or flows onto the tailings. • Improve the cover.	Low	Not Significant
Failure of Waste Storage Area	Minimal effect as storage is fully contained within TMF	Construction, operations, post-closure	• Contained within TMF pond.	Unlikely	Very Low	High	• Small height difference between tailings and waste rock during construction to increase stability.	• Fully contained within TMF.	Low	Not significant
Rupture of reclaim water line	Discharge of deleterious substances to environment (erosion causing sedimentation)	Operations	• Contained within the TMF pond.	Possible	Very Low	High	• Water discharged from a ruptured pipeline would report to the TMF.	• Sediment and Erosion Control Plan. • Emergency Response Plan. • Spill Contingency Plan.	Low	Not significant
Failure of wetlands treatment systems	Discharge of deleterious substances to the environment	Post-closure	• The wetlands treatment facility is established during operations and fully developed before closure.	Possible	Low	Moderate	• Limited experience with comparable facilities in this climate regime. On-going study and test work to develop design and operating parameters.	• Water treatment technologies can be applied until passive wetland treatment is demonstrated to be effective and reliable.	Low	Not significant

B.4.3.2.2 R2-5

R2-5. Describe the involvement of independent professional engineers in: the ongoing review of monitoring data; the evaluation of site infrastructure performance with respect to design parameters; and any necessary adaptive response measures.

Engineer of Record

As described in Section B.4.2.2.1, and shown in Figure B.4.2-1, the Engineer of Record (EOR) is integral to all aspects of design, construction, operation and closure of all major facilities at the Casino Project. Ongoing site investigations, process data, monitoring data, technical reports, comments and requirements from regulators and First Nation governments, outcomes from IERP reviews, feedback from field conditions, etc. are all accounted for in inputs to the advancement of detailed engineering design and ongoing quality assurance/quality control processes conducted by the EOR.

Internal and Independent Audit Process

CMC will conduct internal audits of the operations, performance, QA/QC program, and change control management for project facilities. Periodically, an independent audit of the operation will be conducted which will include, among others, a review of the internal audit program. Analysis of the information provided by the independent audits may provide valuable insights into opportunities to enhance the operation of the facilities. The independent audit results will be made available to the EOR.

Additionally, periodically (approximately every 5 years) the facilities will undergo an assessment by CMC, the EOR, and the IERP. This assessment will review the current design basis and operating practice, performance to-date, current state of best available technologies and practices, advances in technology relevant to the facility design & operation, changes in the community and environment, and effects or anticipated effects of climate change. The assessment will result in a report that recommends specific actions that need to be actioned for sustained operation of the TMF. The results of the independent audit and the 5 year assessment will be made available to the IERP for review and feedback, as will any other documentation the IERP requires to complete its review. Significant changes to the design or operating procedures must be conveyed to the IERP and any outcomes from the IERP must be addressed and documented.

Regulatory Oversight

CMC will comply with all requirements of permits and licences issued to the Project. CMC will provide Regulators documentation on approved (by EOR) changes, as required by licences and permits, and as requested. The results of the 5 year assessment will be filed with Regulators and any significant changes to the design and operation of the facility will be subject to approval.

B.4.4 FEASIBILITY OF THE SULPHIDES REMOVAL PROCESS

B.4.4.1 R2-6

R2-6. Information on the feasibility and limitations of using "on-stream analyzers" on a continuous basis to monitor sulphur removal from the NAG tailings stream.

On-stream analyzers are used to support the de-pyritization process through which sulphide is removed from the rougher tailings stream. On-stream analyzers are installed at strategic points in the processing plant to collect data from the various plant input and output streams to inform operations personnel on plant performance, allowing them to manage the facilities efficiently and effectively. On-stream analyzers provide information for many purposes, including measuring metallurgical balance. The on-stream analyzer on the tailing stream monitor the tailings composition going out to the TMF.

On-stream analyzers are conventional, well-proven technology commonly used in modern concentrators such as Los Pelambres (Chile – 160,000 tpd), Collahuasi (Chile – 150,000 tpd), Penasquito (Mexico - 100,000 tpd), Thompson Creek (Idaho – 28,000 tpd), and many others. On-stream analyzers are part of a broader monitoring and control process used to monitor and manage the quality of the NAG tailings reporting to the cyclone station. Other measures include:

- Mine production planning and scheduling documents that characterize the ore to be fed to the coarse ore stockpile ahead of the processing facility;
- Sampling of the drill cuttings prior to blasting of a bench so that the ore can be tested in advance of processing for total sulfur and total carbon and the neutralization potential ratio (NPR) can be determined to ensure the material meets specification for use in dam construction;
- The tailings stream at the cyclone plant is assayed multiple times per day to confirm the material is NAG and suitable for dam construction; and
- Tests to confirm the tailings coarse fraction meets the specified size distribution criteria.

The use on-stream analyzers as part of a complete monitoring and control process is standard conventional practice at similar processing facilities around the world. CMC’s detailed process to ensure effective sulphide removal will be developed during the design phase of the project and will be detailed in the Mill Development and Operations Plan, the Tailings Management Plan and the Heap Leach and Process Facilities Plan required for mine construction and operation under the Quartz Mining Act, following the issuance of a Water Use Licence (Yukon Government, 2013).

B.4.4.2 R2-7

R2-7. Discussion on the implications related to the estimate that 25 percent of the processed supergene ore would produce non-PAG rougher tailings.

The amount of supergene (oxide and sulphide) tailings used to produce cyclone sand for the construction of the tailings impoundment embankment has no significant implications the construction of the TMF.

The estimated amount of cyclone sand required for embankment construction is 134 Mm^3, or 221 Mt at 1.65 t/m^3 (Table 5.5 of TMF Design Report Appendix A.4D). The amount of cyclone sand that can be generated from the hypogene ore is projected to be 217 Mt, representing 98% of the total required material. This is just 4 Mt short of the total requirements for dam construction. Some limited amount of NAG tailings may need to be produced from the supergene ore. Any remaining shortfall would be supplemented with NAG rockfill borrow material. The project proposal states that based on analysis of the composition of the supergene ore, and test work conducted to date, approximately 25% of this material, after sulphide removal, would meet the criteria for NAG material for dam construction purposes. However, as per the above, only 5% of the 316 Mt of supergene ore would be needed to produce the additional 4 Mt of sand required for dam construction. The basis for these assumptions is summarized in Table B.4.4-1.

Table B.4.4-1 Assumptions – Cyclone Sand Production Generated from Hypogene Ore

Total hypogene ore milled	649Mt
Recovery rate of cyclone sand from NAG tailings	50%
Cyclone sand production limited to 9 months a year by inclement weather	75%
Cyclone sand plant operational availability	90%
Amount of ore not reporting as concentrate	99%
Total estimated cyclone sand generated from hypogene ore	217Mt

In addition, there are a number of assumptions in the design basis that are appropriately conservative for the project's stage of development in relation to the production of coarse sands. There is additional potential to exceed the design basis assumptions for annual sands production. Should any of the criteria noted below exceed the estimates, the cyclone sand for construction could be met solely through the processing of hypogene ore.

The design basis assumes coarse sands for dam construction is produced for the equivalent of nine months of the year (75%). The equivalent of three months of production is assumed to be lost with the tailings diverted to the impoundment due to inclement weather (i.e. cold weather). Experience at other operations has demonstrated that coarse tailings can be placed and compacted to specification at temperatures down to -40°C (Martin, 2011). The estimated number of days that the Casino site might be expected to see the daily minimum temperature to fall to a more conservative threshold for operations of -30°C is about 40-50 days per year (86%). Should coarse sands production be suspended for only 50 days per year, as opposed to the projected three months, the estimated cyclone sand produced from hypogene ore increases to 250 Mt, well in excess of the design requirements.

The cyclone plant utilization assumed in the design basis is 90 % while experience at other operations has shown that utilization greater than 92% is achievable. Should this prove to be the case at Casino, the estimated coarse sand production from hypogene ore is 222 Mt, meeting the design requirement for 221 Mt.

Finally, the design basis limits the percentage of fines in the cyclone underflow product to 12%. With additional testing and experience in operations there is the potential to raise the allowable fines content to about 15%, thereby increasing the mass of sands available for dam construction.

The amount of supergene ore tailings appropriate for dam construction is not a significant factor to the total material required to build the dam embankment. The amount of cyclone sand generated from hypogene ore should provide 98% of the material (217 Mt) for the construction of the embankment. The remaining 4 Mt of material will be obtained through a combination of appropriate supergene tailings, borrow material, and/or exceeding projected operating parameters.

B.4.5 ROADS, SUPPLY ROUTES AND TRANSPORTATION

B.4.5.1 Freegold Road Extension and Upgrade

B.4.5.1.1 R2-8

R2-8. One of the following:

a. Responses to previous Adequacy Review Report requests as they relate to the Freegold Road upgrade and Carmacks by-pass:

- **R13 and R14 (in relation to the camp for the upgrade),**
- **R18 (including safety, wildlife, and maintenance),**
- **R27 (in relation to traffic in Carmacks and the by-pass)**
- **R297 (in relation to clear span bridges for the upgrade)**
- **R298 (in relation to decommissioning of abandoned structures along the alignment)**
- **R299 (in relation to the Nordenskiold River bridge and pier)**
- **R300 (in relation to available habitat at the Nordenskiold River bridge)**
- **R410 (in relation to a cabin near the project footprint),**

or,

b. A modified project proposal that excludes the Freegold Road upgrade and Carmacks by-pass but includes a revised description of activities, transportation plan, and effects assessment.

Responses to requests R13, R14, R18, R27, R297, R298, R299, R300 and R410 as they relate to the Freegold Road upgrade and Carmacks by-pass are provided below.

R13. Detailed description of the temporary construction camp including:

a. layout of infrastructure such as camp facilities, generators, sewage disposal system, fuel storage, and generators;
b. proximity to surface water;
c. human-wildlife conflict prevention; and
d. fuel storage requirements and capacity of diesel generators.

It is expected that the construction of the Carmacks by-pass, Nordenskiold Bridge and Freegold Road upgrade will be completed by the Yukon Government, Department of Highways and Public Works (HPW). Contractors working on HPW projects have the option of making arrangements with private individuals for the establishment of temporary work camps, or making use of commercial operations or businesses. Alternatively contactors can establish work camps at sites identified by HPW as suitable camp locations.

A conceptual-level description of the temporary construction camp follows:

a. *Camp infrastructure*: Typical work camps can consist of a kitchen and wash-up trailer and possibly 8 - 12 ATCO type trailers to be used for living quarters, laundry and offices. Larger work camps of 40 to 50 people may require upwards of 15 to 20 ATCO trailers. Alternatively, workers and project staff may use self-contained RV units or travel trailers, that are supplemented by ATCO trailers that serve as office, laundry, wash-up and eating facilities. Dependent upon how the upgrade of the Freegold Road and the by-pass work is undertaken, and the location of the work, there will likely be the need for multiple camp locations for the duration of the work. Typically HPW work camps are located in existing or abandoned gravel pits; these are well-drained, level sites that offer sufficient room for camp set-up, possible storage of equipment and if necessary, allow for the easy installation of wells and septic leach fields. Specific camp locations have yet to be determined

b. *Proximity to surface water:* Installation of a well or water purification system for camp water must follow the Guidelines for Drinking Water Systems from YG Environmental Health Services. The contractor may choose to have a septic pump-out system, or install a septic leach field. A sewage disposal system will be installed and used in accordance with the Yukon Sewage Disposal Systems Regulation and a permit will be obtained from YG Environmental Health Services.

c. *Human-wildlife conflict prevention:* Camps will be laid out and operated following the “Guidelines for Industrial Activity in Bear Country”, Yukon Environment. Bear deterrents such as air horns and whistles will be kept on-site. Feeding of wildlife is prohibited. The camp will be kept clean and free of any domestic waste that may attract wildlife. Camp related waste will be disposed of at an approved dump site or incinerated on a regular basis. The camp will be entirely decommissioned after the project is complete.

d. *Fuel storage:* The temporary work camp locations may also include a service, maintenance and an equipment and fuel storage area. Routine maintenance and servicing will be carried out within a designated area on an impermeable liner that is either manufactured or made of natural material. If a liner is created using existing soils it will have a permeability of <1x10-6 cm/s. At the end of the project any soil on the liner will be treated as potentially contaminated and dealt with in accordance with the Yukon Contaminated Site Regulations. Used oil and lubricants may be stored, but will be disposed at the end of the project in accordance with the applicable regulations.

   For fuel storage, contractors typically use double-walled tanks. If double walled tanks are not used, a dyke will be constructed around each stationary fuel container or group of stationary fuel containers where any one container has a capacity exceeding 4,000 litres. The dyke will have a capacity 10% greater than that of the largest storage container within it. Any contaminated (rain/snow) water generated within the dyke will be captured/pumped out on a regular basis and stored in capped containers of an appropriate size. Contents of these containers will then be disposed of on a regular basis, at an approved facility and in accordance with relevant regulations. All refuelling of equipment will occur over drip pans or drip trays; any contaminated or waste water within these trays will be disposed of as stated above, on a regular basis. Fuelling within 30 m of a waterway will only occur with the express permission of the project engineer. HPW Oil and Fuel Best Management Practices will be followed.

   HPW also requires all contractors to submit an Environmental Management Plan (EMP) for its operations and undertaking of all Project related activities. This plan includes details on the storage, handling, and disposal of materials used in the course site activities, site management, waste management, sediment and erosion control, and emergency response protocols. This plan will include a Spill Prevention & Contingency Plan with Oil & Fuel Best Management Practices.

Any temporary construction camps will comply with, and acquire permits for, as necessary, all Yukon and Federal Acts and regulations as they apply to the construction and operation of camp facilities, including those summarized in Table B.4.5-1 (repeat of Table A.4.6-1).

Table B.4.5-1 Required Permits for Construction and Operation of Temporary Construction Camps

Legislation	Permit/License	Requirement	Government Agency
Building Standards Act	Building Permit	Occupancy permit for construction of buildings outside of a municipality	Community Services, Building Safety
Environment Act Consolidated Permit – *Environment Act, Air Emissions Regulation*	Air Emissions Permit	Release of air pollutants	Yukon Environment, Environmental Programs
Environment Act Consolidated Permit – *Environment Act, Special Waste Regulation*	Special Waste Permit	Handling, disposal, generation or storage of special (hazardous) wastes	
Environment Act Consolidated Permit – *Environment Act, Storage Tank Regulation*	Storage Tanks Systems Permit	Storage and handling of petroleum products	Community Services, Protective Services, Fire Marshal's Office
	Application for Operation, Closure, Abandonment or Renovations to Storage Tanks	Use of storage tanks containing petroleum and allied petroleum products	
Public Health and Safety Act	Permit to Install a Sewage Disposal System	Installation and operation of construction phase septic tanks and sewage holding tanks	Yukon Health and Social Services
Waters Act	Notice to Use Water Without a License or Type "B" water license if more than 300 cubic metres per day is required	Water use	Yukon Water Board

R14. Detailed description of activities required for construction of camp including:
a. site preparation such as clearing, grubbing, and disposal of materials;
b. construction material volumes and sources (e.g. granular material requirements); and
c. anticipated timing and duration of the proposed activities.

As indicated in response R13, contractors for the Freegold Upgrade work could establish temporary work camps on private land or at a site identified by HPW or make alternative arrangements with private individuals or commercial businesses. Typical camp locations for HPW projects are in gravel pits near the project site, or on flat and level crown land either in the right of way (RoW) of the Freegold Road or adjacent to the RoW. These sites are often disturbed (e.g. limited vegetation) and offer well-drained level locations for camp set-up and the establishment of wells/septic facilities if required. For camp establishment, the following guidelines as well as the response to R13 above, will apply:

a. *Site Preparation:* Site preparation will be kept to a minimum as the facilities are temporary and designed to be easily transported, erected and dismantled. Camp preparation will consist of clearing trees and brush from the area but little or no grubbing is expected to be necessary. Cleared material will be disposed of by burning.

b. *Construction Material:* Wherever possible the fill material will be native unprocessed material from a local borrow pit. Camp sites are graded to promote the natural drainage of water and prevent inundation of the camp site during periods of high runoff (e.g. during freshet). Drainage channels may be constructed to direct water into natural drainages. Imported granular fill will be used in areas of traffic to provide a suitable driving surface for construction vehicles and heavy equipment.

c. *Timing and Duration:* If camps are required, and dependent upon the work schedule for the Freegold Road upgrade and the Carmacks by-pass, camp construction will be one of the earliest construction activities. Some adjustments may be required to accommodate weather conditions; mobilizing equipment and facilities in winter months provides a solid ground on which to transport goods but performing earthworks at this time of year would not be practical. Establishment of a camp such as this should take no longer than a couple of weeks under ideal conditions; it may be more of a progressive exercise depending on the weather conditions.

Following the completion of access construction activities, the camp will be decommissioned, and all structures, equipment, and facilities will be removed.

R18. A detailed Road Management Plan for the entire Freegold Road. Specific details for the Freegold Road extension should include:

a. description of what other users will have access to the Freegold Road extension; and

b. description of the legal instruments and measures that will be implemented to control access to the Freegold Road extension.

A detailed Road Use Plan will be the outcome of further discussions with Little Salmon Carmacks First Nation, Selkirk First Nation and Yukon Government. CMC expects this to be a regulatory requirement pursuant to the *Territorial Lands (Yukon) Act* and the Quartz Mining License. The Road Use Plan has been updated and is attached in Appendix A.22E. A detailed description of other users of the road will be determined in further discussions with First Nations and Yukon Government and be reflected in the final Plan and cannot be determined at this time.

The Highways Act currently regulates and governs the Freegold Road from km 0 to km 83 (Big Creek) and will continue to do so once the upgrades are complete; this section of the road is considered a public road and open to the general public for use.

a. The principle regarding user access to the Freegold Road is that local use as it exists now will continue.

   i. Industrial activities are subject to licensing which includes review by YESAB for projects beyond the scope of this review;

   ii. Traditional Use is protected under land claims agreements and is expected to continue.

   iii. CMC does not propose access to the Freegold Road by new users and as such, is beyond the scope of the Project.

b. The legal instruments are identified in Section 2 of the Road Use Plan. Further details are provided below:

   Yukon Government

   Territorial lands in the Yukon are administered by the Ministry of Energy, Mines and Resources pursuant to the Territorial Lands (Yukon) Act, SY 2003, c. 17. Section 6 states:

"Subject to this Act, the Commissioner in Executive Council may authorize the sale, lease, or other disposition of territorial lands and may make regulations authorizing the Minister to sell, lease, or otherwise dispose of territorial lands subject to such limitations and conditions as the Commissioner in Executive Council may prescribe."

Yukon Government is working towards developing a new regulation pursuant to the *Territorial Lands (Yukon) Act*. The intent is to manage the construction, operation and maintenance and finally decommissioning and reclamation of access road over the life of the project.

The new regulation is expected to address 6 key issues that are missing in the current regulations:

- Ability to tie the life of the permit to the life of the main project;
- Provide for appropriate security consistent with other policy direction (i.e. mine site reclamation policy);
- Ensure that resource roads do not become public;
- Ensure decommissioning plans are developed;
- Provide compliance and enforcement tools for road management; and
- Ability to manage and restrict access.

It is also expected to include an ability to authorize multiple permit holders and facilitate agreements for multi-use as may be allowed under a management plan.

Yukon Government Highways and Public Works released a document titled *Resource Access Road Framework* (2013). The Framework outlines the "goals and principles that guide decisions around the development and management of resource access roads". Resource Access Roads are defined as "all routes needed by industry to access their properties and move their product to market." The Proposed Freegold Road Extension will be a Mine Haul Road, defined as:

"A new road built to a haul/industrial standard that meets vehicle and employee safety standards and is used to transport minerals from a developed mine or for re-supply and movement of people and goods to and from the mine site. In most cases, mine haul roads connect to a publicly maintained existing road network" (Yukon Government, 2013).

First Nations Governments

Little Salmon Carmacks First Nation (LSCFN) and Selkirk First Nation (SFN) were established in 1997 through Settlement Legislation in Canada and the Yukon that gives effect to their final agreements. LSCFN and SFN are responsible for their settlement lands and resource management on these lands. Under their Self-Government Agreements, LSCFN and SFN have the legislative powers to manage, administer and control the right or benefits of persons enrolled under their final agreements. SFN has established a Constitution for the purpose of protection of its settlement lands and resources, and governing the rights of its citizens on these lands. LSCFN has not established legislation for the management and administration of settlement lands

The statutory authority to enter into an Access Agreement for SFN and LSCFN comes from the *Yukon First Nations Self-Government Act (Self-Government Act).* This is a federal statute that establishes as legal entities those First Nations that are listed in the Act (because they have settled land claims). Both First Nations are listed in the Self-Government Act and have the powers granted under that Act which include law-making authority in relation to their respective Settlement Lands.

Specifically in relation to settlement land, each of the SFN and LSCFN have the authority under s. 11(1) and s. 1 of Part III of the Self-Government Act to enact laws in relation to, among other things, the "use, management, administration, control and protection of settlement land". There are similar provisions in the Final Agreement for each of the SFN and the LSCFN.

Co-Management Structure

As noted above, First Nations governments have the statutory authority to enact laws and enter into agreements with respect to settlement lands and impose conditions, including a requirement for a management plan.

Yukon Government has the statutory authority to impose license terms and conditions for the access road on Crown lands including a requirement for a management plan. The intent is for the Yukon Government to exercise this authority with due regard to First Nations rights and interests with respect to their Traditional Territories, and responsibilities for co-management or management of renewable resources under the land claims agreements.

The Freegold Road Upgrade includes one option that would see some sections of the road impact LSCFN Settlement Land outside of the right-of-way designated in the LSCFN Final Land Claim Agreement. If this option is confirmed in final design, and accepted by LSCFN, then they would become a Decision Body for the project under the YESAA and the ability to exercise their statutory authority.

The Freegold Road Extension includes a proposal that would see one section cross SFN Settlement Land. Casino Mining Corporation has submitted an application to SFN for an access agreement to cross these settlement lands.

While the proposal provides for each government to exercise their statutory authority without being fettered, the objective is to work towards consensus acceptable to all governments and provide for operational requirements for the mine. Essentially co-management between the governments is required between SFN Government, LSCFN Government and Yukon Government.

Yukon Government Department of Energy, Mines and Resources released a Resource Access Road Regulation Discussion Paper in 2014 (Yukon Government, 2014). The discussion paper outlines the scope of new regulatory authorities proposed by the Yukon Government that would apply to the proposed Freegold Road Extension.

The legal instrument currently in place to manage the Freegold Road Extension is through a long-term surface lease and land use permit pursuant to the *Territorial Lands (Yukon) Act*, and agreement with Selkirk First Nation pursuant to Selkirk's internal land use approval process. In the absence of new legislation as proposed by Yukon Government, CMC would seek to license the construction and operation of the road through these existing legal instruments - a long-term lease and land use permit as identified in the proposed Land Use Plan. The long term management of the road would be done through a lease or license. Once a road is built through a land use permit, the lease/license would be the guiding legal instrument and can include authority for maintenance needs or minor realignments.

There are active discussions between CMC and Little Salmon Carmacks First Nation to determine an appropriate approach to authorizing use of that First Nation's settlement lands for the purposes of upgrading the existing Freegold Road.

R27. A traffic management plan for routing traffic through Carmacks prior to the completion of the Carmacks by-pass. Details should include:

a. route through Carmacks;
b timing of transportation activities (e.g. daily, weekly and monthly restrictions);
c. safety of residents with particular focus given to routes with no pedestrian sidewalks;
d. communication with residents within community; and
e. congestion aversion.

As more fully described in the Freegold Road Report (Appendix 4B), the Carmacks by-pass road and bridge over the Nordenskiold River will be completed as preconstruction activities to provide a suitable access route for construction traffic and deliveries of fuel, supplies, and equipment, to avoid traveling through the Village of Carmacks at the earliest possible time.

The by-pass construction would likely be one of the first construction activities completed, and could be completed over the course of one construction season. Therefore, the effects of subsequent construction traffic through Camacks will be negligible, and will be limited to the single construction season when the by-pass is not yet available for use.

a. *Route through Carmacks:* During the construction of the by-pass, the proposed access route for vehicles requiring access to the Freegold Road is outlined in Figure B.4.5-1 and consists of a turn onto Freegold Road from Highway 2, then a left turn onto River Road, which turns into the Freegold Road. The route was chosen as it is the current route for traffic traveling through Carmacks to access the Freegold Road and it minimizes traffic near the school and recreation centre.

b. *Timing of transportation activities:* The timing of the traffic will be during the day only, to minimize disturbance to residents, however, will be 7 days per week, to maximize the construction of the road during the snow-free season. The bypass is expected to be complete by the fall of the year in which the construction began.

c. *Safety of residents:* The additional traffic and its related effects on the town of Carmacks during the by-pass construction is expected to be negligible due to the small number of additional vehicles (4), the chosen route minimizes traffic near the school and recreational centre, vehicles will only travel during the day and road use will be communicated to residents by CMC and the Yukon Government Department of Highways and Public Works (HPW). Vehicles will also comply with all standards and guidelines established in the Traffic Management and Road Use Plans and with local speed limits.

d. *Communication with residents:* As the route will be constructed by the HPW, communication will be closely connected between HPW, the Village of Carmacks, CMC and the construction contractor.

e. *Congestion aversion:* As outlined in Table A.4.4-1, annual average daily traffic is estimated to be 3 “heavy” vehicles and 1 “light” vehicle, for a total of 4 extra vehicles per day. The effect of this traffic on the town of Carmacks is expected to be negligible, and vehicles will comply with all standards and guidelines established in the Traffic Management and Road Use Plans and with local speed limits. The route was selected to minimize traffic near the school and recreational centre.

Figure B.4.5-1 Carmacks By-Pass Route Showing Temporary Route Through Carmacks

R297. Clarification of whether clear-span bridges are proposed for all fish-bearing watercourses. If culverts will be installed on some fish-bearing creeks, please provide rationale, mitigations, and incorporate habitat losses into the habitat compensation plan.

There are 20 crossings along the Freegold Road upgrade that have been identified as being fish bearing (Appendix 10B - Freegold Road Baseline Aquatic Report). Of those, 4 bridge designs have been provided in the Freegold Road Report (Appendix 4B). Two options are proposed for crossing fish bearing streams: short span bridges, and CSP flush passable culverts.

Selection Criteria and Rationale

Short-span bridges are the preferred alternative; however, selection of the appropriate crossing option will be based on site conditions, environmental and fisheries requirements, geotechnical considerations, constructability, schedule and cost. For example, it is expected that culverts will be selected where the proposed road geometry such as high fills or sharp curves would require a longer bridge. Detailed stream crossing evaluations and site specific designs will be completed during the detailed design phase of the Project.

Culvert Installation and Impact Mitigation

The installation of culverts will follow the general best management practices and standard project considerations as outlined by the Province of British Columbia (BC) and Fisheries and Oceans Canada (DFO) for instream works (BC & DFO, 2015a), which include:

- Consultation with a Qualified Professional (QP) or team of professionals;
- Continued monitoring of the project, including an environmental monitor;
- Consider regional timing windows for fish or species at risk and nesting birds, avoid in-channel works in the presence of species at risk and incorporate weather considerations to minimize impacts from sedimentation;
- Prevent the release of silt, sediment or other contaminants;
- Isolate the work area appropriately;
- Complete and fish and amphibian salvage before the start of works;
- Implement erosion and sediment control measures throughout the project;
- Minimize impacts to vegetated areas;
- Restore the site appropriately; and
- Operate temporary diversion systems (e.g., conduits, coffer dams, ditches), in consideration of the best management practices for those systems.

Additionally, removal of culverts will be conducted in accordance with the BC and DFO Standards and Practices for Instream Works – Culverts (BC & DFO, 2015b), including:

- Adequate rip rap or wing walls to protect the road embankment and stream channel from erosion;
- Prevent eroding inlets and outlets through rip rap amoring;
- Materials placed within the average high water mark must be free of silt, overburden or debris; and

- Use proper erosion and sediment control measures to protect exposed areas of the stream channel and culvert.

Details on how site assessments by Qualified Professionals are conducted, and how subsequent recommendations are implemented to comply with the requirements of the *Fisheries Act* are provided in the response to R2-141.

Environmental performance during construction is monitored as part of the project inspection regime. Ongoing monitoring is done as per any permit condition requiring it. The level of monitoring changes and is driven by the permit/licence. All large multiplates >2m and bridges are inspected every two years as part of the HPW bridge/culvert management program.

Habitat Compensation Considerations

Any fish-bearing crossings requiring culverts will be designed to ensure fish passage and habitat losses will be assessed and offset accordingly, in accordance with the *Fisheries Act*.

R298. Details on existing crossing structures no longer used for portions of the Freegold Road upgrade once the road is re-aligned.

The Freegold Road upgrade includes 9 minor stream crossings which will require upgrade or relocation (Appendix 4B - Freegold Road Report). For those crossings that will no longer be required as part of the Freegold Road, CMC will remove the crossing structures and restore the sites.

The removal of the culverts will follow the general best management practices and standard project considerations as outlined by the Province of British Columbia (BC) and Fisheries and Oceans Canada (DFO) for Instream Works (BC & DFO, 2015a), and may include the following:

- Consultation with a Qualified Professional (QP) or team of professionals;
- Continued monitoring of the project, including an environmental monitor;
- Consider regional timing windows for fish or species at risk and nesting birds, avoid in-channel works in the presence of species at risk and incorporate weather considerations to minimize impacts from sedimentation;
- Prevent the release of silt, sediment or other contaminants;
- Isolate the work area appropriately;
- Complete and fish and amphibian salvage before the start of works;
- Implement erosion and sediment control measures throughout the project;
- Minimize impacts to vegetated areas;
- Restore the site appropriately; and
- Operate temporary diversion systems (e.g., conduits, coffer dams, ditches), in consideration of the best management practices for those systems.

Additionally, removal of culverts will be conducted in accordance with the BC and DFO Standards and Practices for Instream Works – Culverts (BC & DFO, 2015b), including:

- Leaving cribbing structures in place if stable and if integrated into the stream banks, unless the cribbing structure constricts the watercourse;
- Isolation of the work area, if required, from flowing water in a manner that does not cut off flow to downstream portions of the stream;
- Removal of structures to a suitable upland disposal site away from the riparian area to ensure materials don't re-enter the watercourse;
- Restoration of the banks to original conditions, where possible;
- Maintain effective erosion and sediment control measures until complete re-vegetation of disturbed areas is achieved.

All required permits will be obtained from DFO, as required to complete the decommissioning of structures along the Freegold Road. Details on how site assessments by Qualified Professionals are conducted, and how subsequent recommendations are implemented to comply with the requirements of the Fisheries Act are provided in the response to R2-141.

R299. Details on when and how the Nordenskiold River bridge pier will be constructed.

Timing

The Carmacks by-pass road and bridge over the Nordenskiold River will be completed as preconstruction activities to provide a suitable access route for construction traffic and deliveries of fuel, supplies, and equipment, to avoid traveling through the Village of Carmacks at the earliest possible time. The by-pass construction would likely be one of the first construction activities completed, and could be completed over the course of one construction season.

Design

As detailed in the Freegold Road Report (Appendix 4B), a detailed site survey of the Nordenskiold River crossing was completed in June 2013. A hydro-technical analysis of the crossing was carried out to establish the bridge height and required hydraulic opening. A bridge concept was then developed based on the site conditions, road geometry, geotechnical conditions, and environmental considerations. The proposed Nordenskiold Bridge is a single lane bridge, with steel girders and precast concrete deck panels. 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. Rip Rap is required at the bridge abutments to provide scour protection. Bridge foundations are assumed to be steel pipe piles and precast concrete pile caps with the steel girders secured to the pile caps. The preliminary design drawings for the Nordenskiold River bridge were provided in Appendix F of the Freegold Road Report (Appendix 4B), and are re-provided below, however, are contingent on approval of the final design HPW.

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CASINO MINE ACCESS

DRAWING LIST			
DRAWING NUMBER	DESCRIPTION	REV.	DATE
20092374-23-3-101	GENERAL ARRANGEMENT	0	2013/09/12
20092374-23-3-102	SITE PLAN	0	2013/09/12

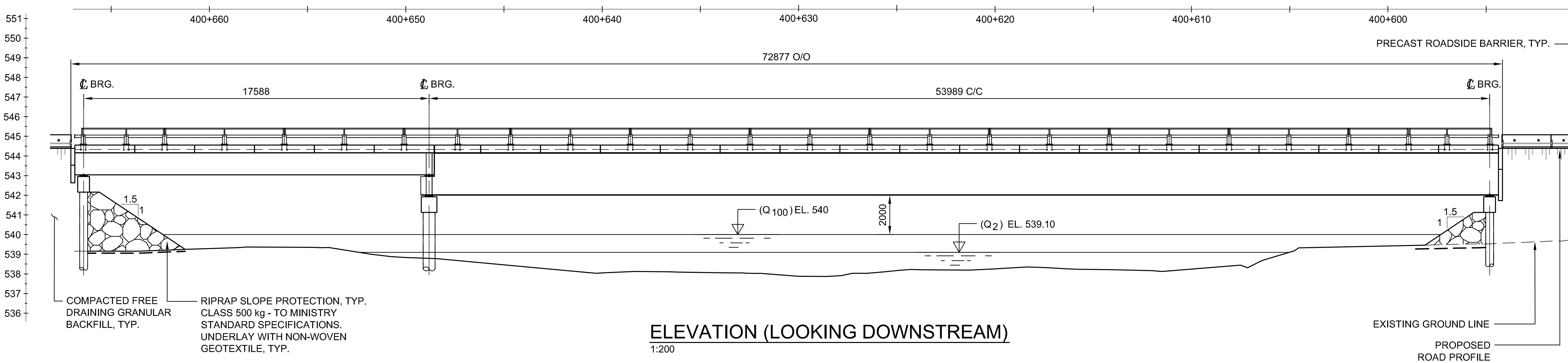
REFERENCE DRAWING LIST			
DRAWING NUMBER	DESCRIPTION	REV.	DATE
20092374-02-3-110	GENERAL NOTES - SHEET 1	0	2011/08/12
20092374-02-3-111	GENERAL NOTES - SHEET 2	0	2011/08/12

NORDENSKIOLD RIVER BRIDGE
NORDENSKIOLD RIVER

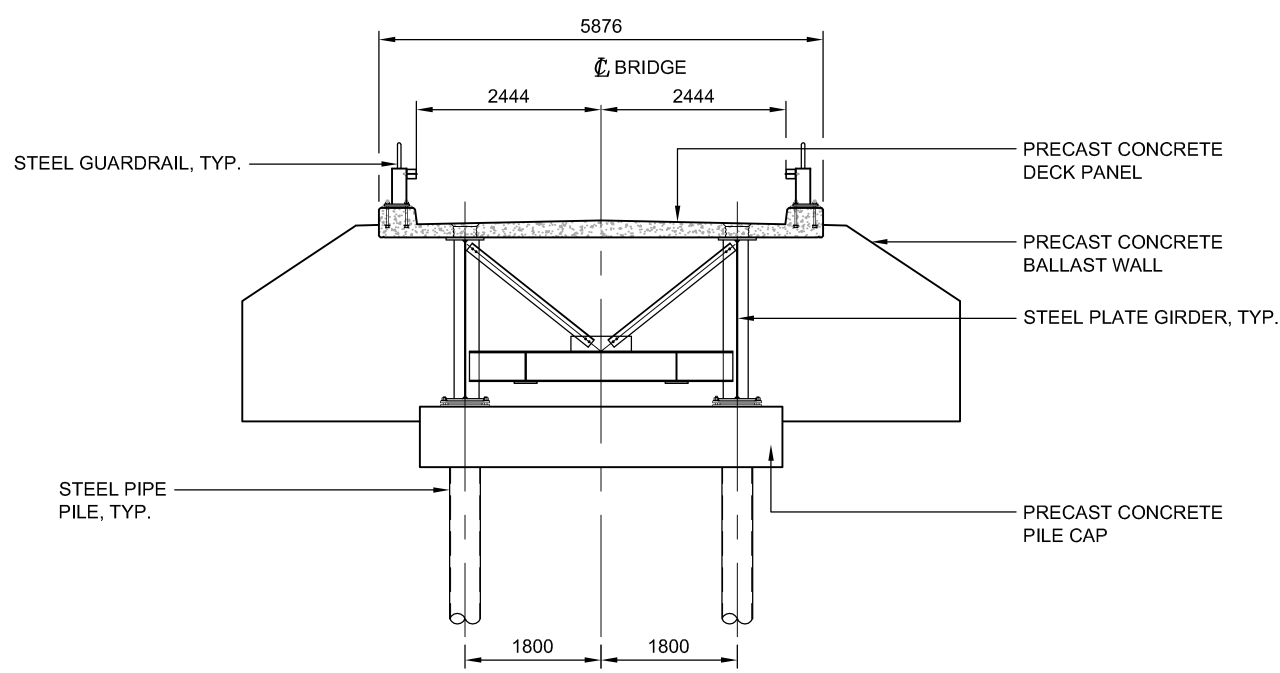
AE Project Number: 20092374-23

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

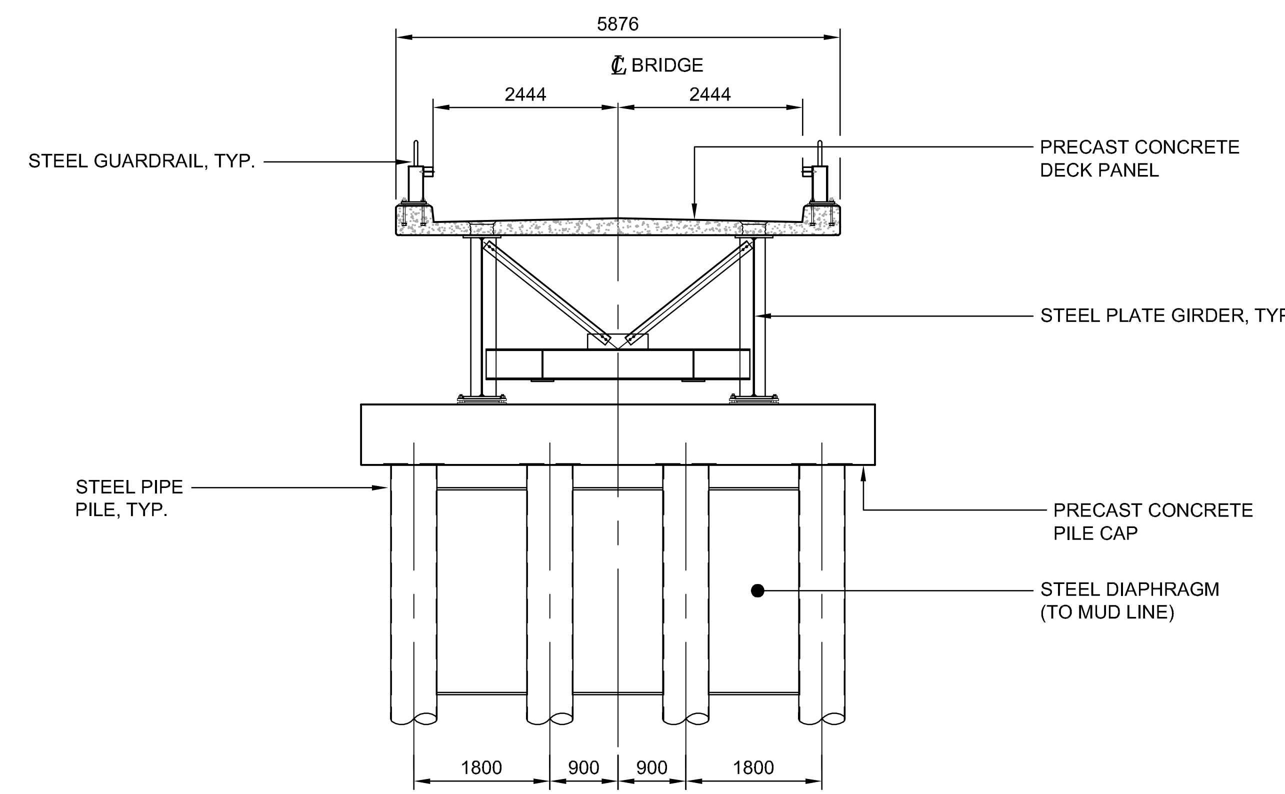
DRAWING NUMBER	REV. NO.	SHEET
20092374-23-3-100	0	- / -



ELEVATION (LOOKING DOWNSTREAM)
1:200



TYPICAL ABUTMENT ELEVATION
1:100



TYPICAL PIER ELEVATION
1:100

NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

western COPPER AND GOLD

PRELIMINARY NOT FOR CONSTRUCTION

DRAFT

Associated Engineering

PROJECT No.	20092374-23		
SCALE	AS SHOWN		
DRAWN	MATTHEW BOWEN		2013/09/12
DESIGNED	MATTHEW BOWEN		2013/09/12
CHECKED	RAY KORPELA		
APPROVED			
DATE		INITIAL	

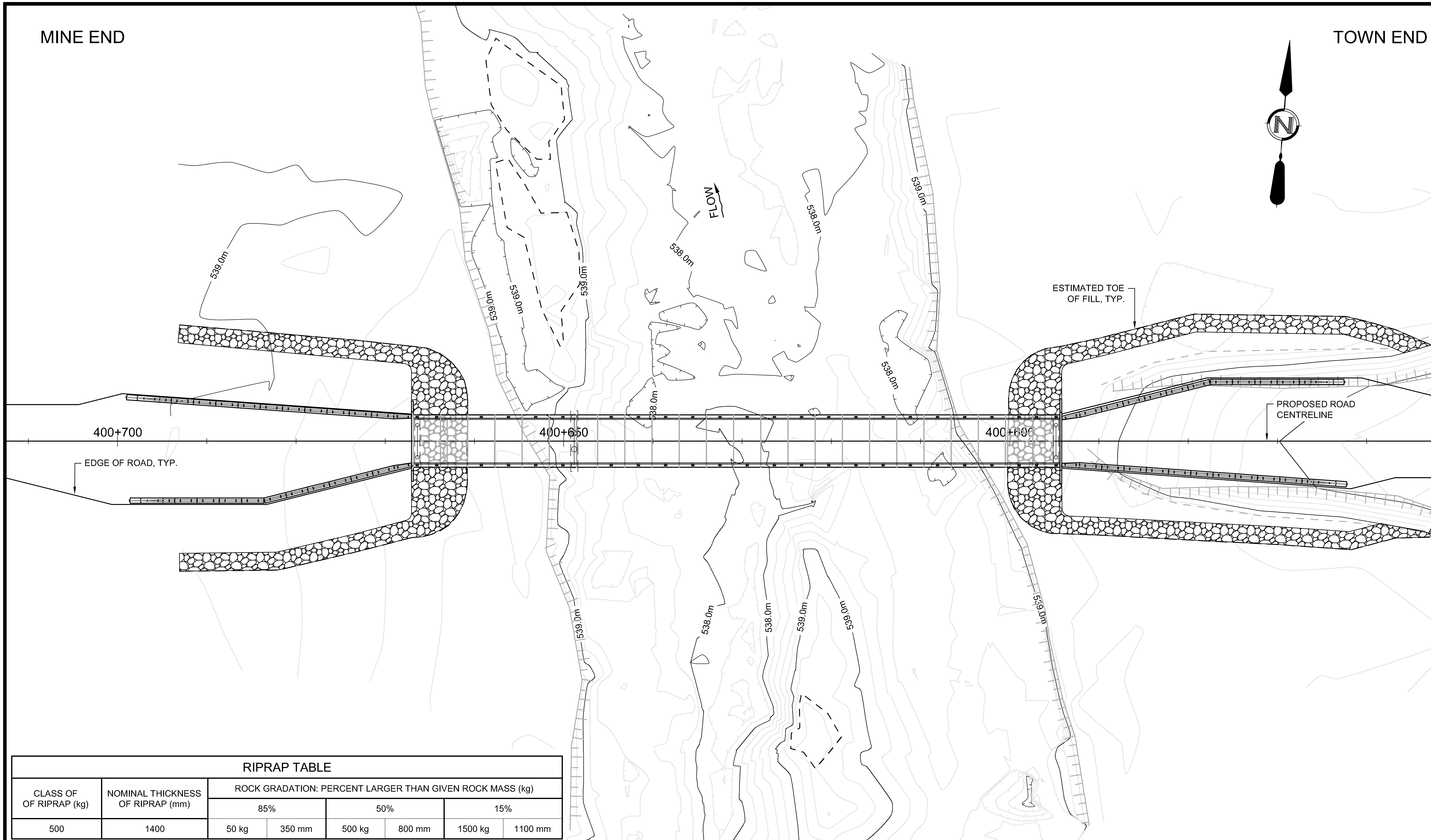
WESTERN COPPER AND GOLD CORPORATION

GENERAL ARRANGEMENT

NORDENSKIOLD RIVER BRIDGE

NORDENSKIOLD RIVER

DRAWING NUMBER	REV. NO.	SHEET
20092374-23-3-101	0	



RIPRAP TABLE

CLASS OF OF RIPRAP (kg)	NOMINAL THICKNESS OF RIPRAP (mm)	ROCK GRADATION: PERCENT LARGER THAN GIVEN ROCK MASS (kg)					
		85%		50%		15%	
500	1400	50 kg	350 mm	500 kg	800 mm	1500 kg	1100 mm

NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

western
COPPER AND GOLD

PRELIMINARY
NOT FOR
CONSTRUCTION

DRAFT

Associated
Engineering

PROJECT No.	20092374-02		
SCALE	1:400		
DRAWN	MATTHEW BOWEN		2031/09/12
DESIGNED	MATTHEW BOWEN		2013/09/12
CHECKED	RAY KORPELA		
APPROVED			
DATE		INITIAL	

WESTERN COPPER AND GOLD CORPORATION

SITE PLAN

NORDENSKIOLD RIVER BRIDGE

NORDENSKIOLD RIVER

DRAWING NUMBER	REV. NO.	SHEET
20092374-23-3-102	0	

R300. The quality and type of fish habitat (e.g. highly suitable spawning and/or rearing habitat, confirmed spawning habitat, and migratory channel) potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier, focusing on potential long-term morphological changes to the river in contrast to natural morphological changes.

The pier is expected to cause very localized and minor changes in morphology, with no adverse effects on fish habitat or fisheries productivity. The pier's only anticipated effect is a deep, yet small pool formed and maintained on the east and downstream side of the pier, which may be attractive to fish species seeking deep water refuge.

Quality and Type of Fish Habitat

No fish sampling was conducted at any site in the Nordenskiold River watershed (Appendix 10B); however, both sites 1 and 1N are considered fish bearing (Figure B.10.2-2). It is known that the Nordenskiold River hosts eleven species of fish (Chinook salmon, chum salmon, lake trout (*Salvelinus namaycush*), Arctic grayling, round whitefish, lake whitefish (*Coregonus clupeaformis*), longnose sucker, burbot, northern pike, Arctic lamprey and slimy sculpin), all of which are common to the Yukon River Basin (Nordenskiold Steering Committee, 2010). Both Chinook salmon and chum salmon utilize the river for spawning and rearing habitat and the river provides suitable conditions for overwintering habitat. No barriers to fish movement where identified as part of this study, however frequent log jams within the Nordenskiold River may restrict salmon movement (Nordenskiold Steering Committee, 2010).

In situ water quality data were collected at sites 1 and 1N (Appendix 10B). The mean temperature as measured on August 9, 2013, for both sites was 15.9°C, which is warm for the Yukon River Basin but not uncommon in large watercourses. The pH, conductivity, and DO for the two crossings averaged, 7.2, 175µS/cm, and 8.6 mg/L, respectively.

It is expected that the proposed bridge site may support spawning and rearing habitat for any of the documented fish species in the river, including Chinook and Chum salmon. As depths are generally less than 1 m, it is unlikely that any overwintering habitat will be lost. As the total footprint of the bridge pier is small (6 m^2) relative to the estimated area of the river mainstem (estimated 1.43 km^2), it is anticipated that any potential impacts on fisheries productivity will be minor.

Morphology

As described in Appendix 10B (p.18-19), the proposed Nordenskiold River crossing has a wetted width of 53 m, an average depth of 1 m and a cobble dominated substrate. In-stream cover was low (<20%) and the channel gradient was low (2%) typical of large watercourses within the study area. A geomorphological impact assessment of the proposed Nordenskiold bridge pier was conducted using the following reference materials:

1. Historical photos of the Nordenskiold crossing;
2. Fluvial Geomorphology Hazard Assessment for Proposed Access Roads (Appendix 6E);
3. On-site field photos from 2013;
4. Google Earth imagery; and
5. Proposed bridge/pier design from *Casino Project Access Overview for Submission to YESAB* (Appendix 4B).

The proposed Nordenskiold River bridge crossing is immediately downstream of a tortuous meander that was cut-off (naturally) sometime between 1994 and 2008. A large, side- to mid-channel gravel bar formed in association with this cut-off as a result of localized erosion of the former meander 'neck'. This gravel bar has migrated and extended downstream slightly since the cut-off event, now forming a very thin bar along the channel centreline immediately upstream of the proposed crossing location. However, the bar has also shrunk appreciably as flows continue to erode its head and flanks. It is expected that continued erosion of the bar, with its current mid-channel position and full exposure to erosive flows, will remove it entirely within the next several years. The bar is thus a short-lived feature formed in direct response to the meander cut-off. Placement of the pier along the downstream limit of this thin, remnant bar is not recommended, from a fluvial geomorphological perspective, as the pier would likely be positioned in the thalweg in several years and be exposed to direct and regular impacts from rafted ice and large woody debris.

The currently proposed pier position is close to the west bank of the river, in a small 'alcove' between the main bank and a small side-channel bar (depositional area) immediately downstream, at a transition between the thalweg (on the east) and slackwater and possible back-eddy flow (on the west). The thalweg is expected to align itself closer to the channel centreline, over time, in response to continued erosion and removal of the mid-channel bar immediately upstream. Currently, the focus of erosion along the west bank, as a result of the meander cut-off and new meander pattern, is approximately 110 m upstream of the proposed pier position. The gradual alignment of the thalweg into the middle of the channel is expected to moderate and ultimately eliminate this western bank erosion, thus posing no risk to the pier position in the long-term.

The pier is anticipated to cause localized scour around and immediately downstream of its base, where flow velocities are concentrated and capable of eroding the gravelly to cobbly bed material. The pier will be constructed to withstand such scour. The head of the small side-channel bar immediately downstream may be 'trimmed' slightly by this localized scour, although the propensity for continued deposition in this point bar-like position is expected to maintain the bar and its role in protecting the west bank from significant erosion. Relatively little scour may occur around the west side of the pier, given how close it is to the west bank and its sheltering from the thalweg by the bar immediately downstream. A deep, yet small pool is expected to be formed and maintained on the east and downstream side of the pier, which may be attractive to fish species seeking deep water refuge. Ultimately, the pier is expected to cause very localized and minor changes in morphology, with no adverse effects on fish habitat or fisheries productivity.

The noted gravel bar is upstream from the currently proposed bridge alignment by 10 m. The bridge designers have chosen the proposed pier location to be as close to the normal high water mark as possible, essentially creating a clear span of the main river channel. This reduces the likelihood of debris accumulation and scour around the pier and also improves constructability by allowing easy access for pile driving equipment working from the shore. The pier is designed to take loads and impacts from ice and debris and is complete with a steel diaphragm connecting the 4 piles together that will distribute horizontal loads and prevent debris from catching between the pier piles.

The geomorphological assessment conducted also provided insight into the creation and stability of the noted gravel bar. Based on this assessment, it was not recommended to place the bridge pier on the eroding gravel bar as the pier would likely be positioned in the thalweg in several years and be exposed to direct and regular impacts from rafted ice and large woody debris.

R410. A mitigation strategy for the cabin located at the southern edge of a proposed borrow pit and what if any measures will be in place to ensure continued access. In addition, identify whether the owner has been contacted or not. If so, please provide information regarding the outcome of this contact.

A description of the cabin and a photo is provided in the Heritage Baseline (Appendix 18B of the Proposal). The cabin is described as a “modern resource” and located on the Freegold Road Upgrade portion of the access road at what was previously known as "Mile 40". The cabin is located outside of the proposed Freegold Road Upgrade alignment and outside of the proposed borrow pit, though it is located on the south edge of a proposed borrow pit and access to the cabin may be affected during construction of the Freegold Road Upgrade.

Mitigation Measures

There are multiple cabins along the Freegold Road, with multiple users (placer mining, quartz claim owners, trappers, recreational, etc.). CMC has made a number of commitments to ensure continued access to these cabins. As the Project nears the construction phase, increased communication will be required with land owners to ensure they are aware of the proposed construction, the potential impacts, and the measures available to mitigate the potential impacts.

CMC’s commitments include:

- **Commitment 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.
- **Commitment 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.
- **Commitment 132**: To mitigate against changes to access to traditional land, mineral tenures, and recreational lands CMC commits to:
  - 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.

Efforts to Contact Owner

The cabin is located on overlapping placer and quartz claims, claims P 41778 owned by George S. Wilson and claim 39171 (DONALDA 3) owned by 0878950 B.C. Ltd., respectively. There is also a quartz lease (number OW00199) adjacent to the cabin location on the DONALDA 3 claim. George S. Wilson is also the owner of a current Class 1 notification in the area. The cabin may also cross onto Little Salmon/Carmacks A-Block settlement land LSC R-8A. As such, it is difficult to know who exactly owns the above cabin; however, letters to George S. Wilson and corporation 0878950 B.C. Ltd. were sent out June 9, 2015 to notify users of the proposed Casino Project, and inviting them to speak to CMC regarding the proposed project, in addition to consultation conducted in 2013 and 2014, as summarized in the response to R408. No return correspondence has been received from either user.

If the cabin is owned by a member of Little Salmon/Carmacks First Nation (LSCFN), there has been no contact with CMC on this matter during the extensive consultation CMC has been conducted with LSCFN. As the Project nears the construction phase, increased communication will be required with all land owners to ensure they are aware of the proposed construction, the potential impacts, and the measures available to mitigate the potential impacts.

Approach for Cabin Owners on the Freegold Road

Yukon Government has noted that typically, once a detailed design is completed, cabin owners/land owners that may be affected by proposed works are identified. Once a detailed plan for road upgrades is in place and prior to the start of road upgrades HPW determines which cabin owners or land owners could be affected, and determines how and if further engagement and discussions are required. From this point, a plan for engagement and potential mitigations could be developed. As part of developing a work and design plan for the upgrades and the by-pass, HPW would engage and consult with land owners, cabin owners, other road users, and First Nations.

B.4.5.1.2 R2-9

R2-9. Camp details including:
a. Information regarding surface water within the camp footprint and any diversions,
b. Supporting information on the appropriateness of a septic system,
c. Details for reclamation of camp site, and
d. Volumes of vegetation to be cleared and disposal methods.

Details of the current construction camp plan are discussed below. The proposed construction camp location at Big Creek is shown in more detail on Figure B.4.5-2. The details of the camp location, preparation activities and layout will be provided in the Road Construction Plan, required under the Quartz Mining Act as part of an application for a Quartz Mining Licence (Yukon Government, 2013).

The temporary camp used for the construction of the Freegold Road Extension will be much like other temporary camps frequently established by contractors as required for short term maintenance contracts in remote areas. The camps typically consist of a kitchen and wash-up trailer and possibly 8 - 12 ATCO type trailers to be used for living quarters, laundry and offices.

Potable water may be trucked in, or the contractor may choose to install a well. The contractor may choose to have a septic pump-out system or install a septic leach field. The camp will be kept clean and free of any domestic waste that may attract wildlife. Camp related waste will be disposed of at an approved dump site or incinerated. The camp will be entirely decommissioned after the project is complete.

All temporary construction camps will comply with, and acquire permits for, as necessary, all Yukon and Federal Acts and regulations as they apply to the construction and operation of camp facilities, including those summarized in Table B.4.5-1.

a. *Surface water:* Figure B.4.5-2 shows that there are no significant water courses within the camp footprint and therefore no water diversions are expected to be required for the proposed location.

b. *Septic system:* The final design may incorporate a septic pump-out system or install a septic leach field, subject to applicable regulatory approval as required by the Quartz Mining Act or the Yukon Water Act.

c. *Reclamation of camp site:* The area on the south side of Big Creek has multiple quartz and placer claims with extensive pre-existing disturbance (Figure B.4.5-3). The existing placer mine just east of the proposed construction camp location indicates that camp construction is viable in this location. As the area has already experienced extensive disturbance, reclamation activities for the camp site are not expected to be significant.

d. *Volume of vegetation to be cleared and method of disposal:* The area on the south side of Big Creek has multiple quartz and placer claims, with extensive pre-existing disturbance (Figure B.4.5-3). As a result of the existing disturbance, the volume of vegetation to be cleared is expected to be minimal. Any clearing will consist of clearing trees and brush from the area but little or no grubbing is expected to be necessary. Cleared material will be disposed of by burning.

CMC also commits to complying with the following guidelines when preparing its detailed design:

- Site preparation will be kept to a minimum as the facilities are temporary and designed to be easily transported, erected and dismantled;
- Camp preparation will consist of clearing trees and brush from the area but little or no grubbing is expected to be necessary. Cleared material will be disposed of by burning;
- Where utilities are required utilities will be run in utilidors wherever possible;
- The general area will be filled using native material and graded to promote the drainage of water and prevent inundation during periods of high runoff (e.g. during freshet). Drainage channels may be constructed to divert water;
- Imported granular fill will be used in areas of traffic to provide a suitable driving surface for construction vehicles and heavy equipment; and
- Wherever possible the fill material will be native unprocessed material from a local borrow pit.
- All temporary construction camps will comply with, and acquire permits for, as necessary, all Yukon and Federal Acts and regulations as they apply to the construction and operation of camp facilities.

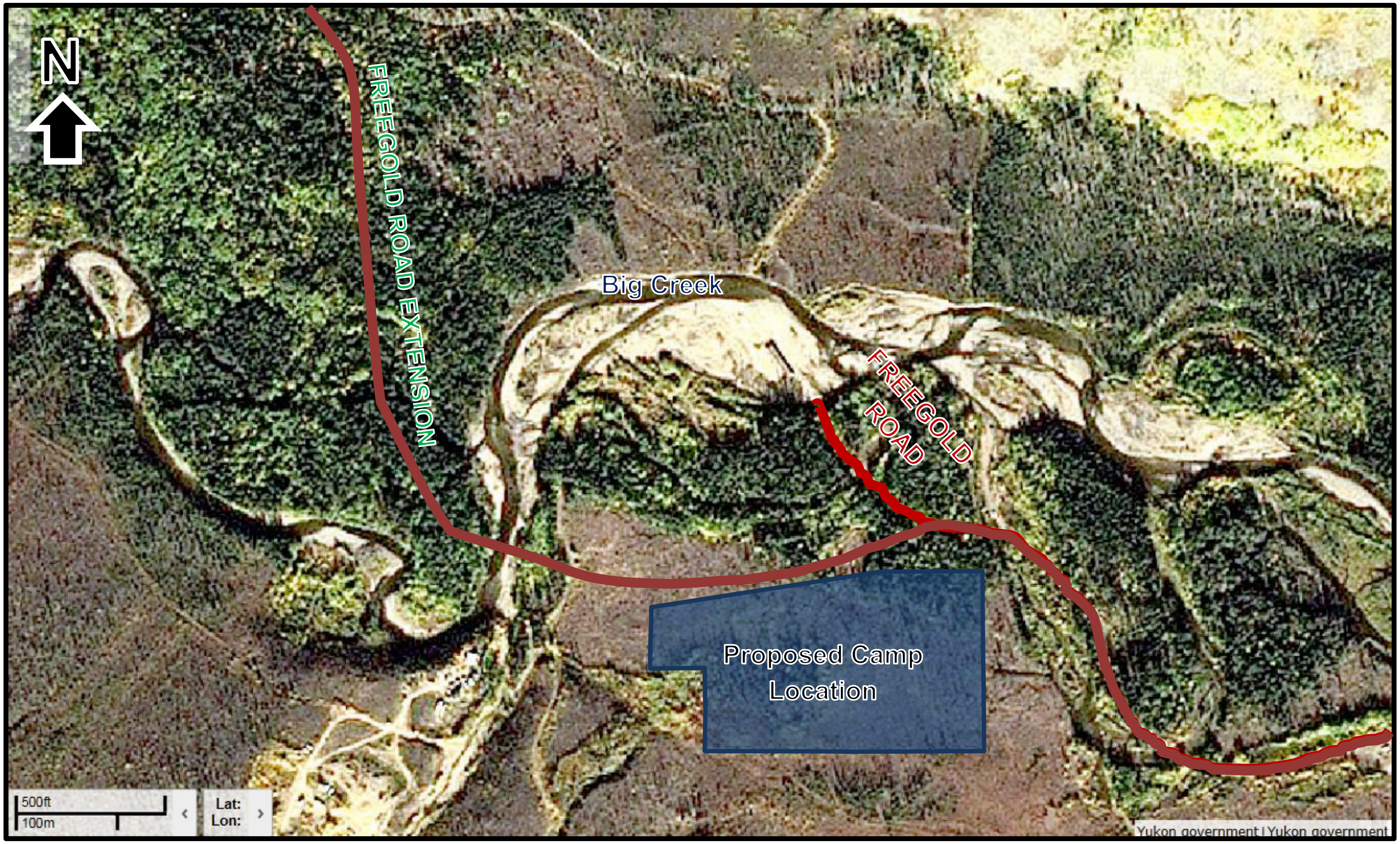


Figure B.4.5-2 Freegold Temporary Construction Camp Preliminary Location

Figure B.4.5-3 Big Creek Bridge Area

B.4.5.1.3 R2-10

R2-10. A description and assessment of the two possible scenarios for the Freegold Road extension:
a. Road closure and reclamation including methods, objectives, and timelines,
b. Continued road use including management, access, and effects.

The following narrative describes the two possible scenarios for the Freegold Road extension at the completion of the Project: road closure and reclamation, and continued road use.

a. *Road Closure and Reclamation:* As outlined in Section 4.5.4.1, 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, 2013). 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, 2013). 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.

Road construction, operation and closure will be in accordance with the new regulation pursuant to the *Territorial Lands (Yukon) Act*. The intent is to manage the construction, operation and maintenance and finally decommissioning and reclamation of access road over the life of the project. The new regulation is expected to address 6 key issues that are missing in the current regulations:

- Ability to tie the life of the permit to the life of the main project;
- Provide for appropriate security consistent with other policy direction (i.e. mine site reclamation policy);
- Ensure that resource roads do not become public;
- Ensure decommissioning plans are developed;
- Provide compliance and enforcement tools for road management; and
- Ability to manage and restrict access.

It is also expected to include an ability to authorize multiple permit holders and facilitate agreements for multi-use as may be allowed under a management plan.

To be clear, the Proposed Project includes decommissioning of the access road in accordance with Territorial regulations. Access to the site to conduct maintenance activities will be via air, with some heavy machinery left on-site for maintenance requirements.

b. *Continued Road Use:* CMC plans to decommission and reclaim all on-site roads, trails, and access corridors at the completion of the Project including the Freegold Road extension. Any change in road use of the scope described by YESAB in this request would likely be considered a significant modification to the Project and would require changes to existing permits and approval by YESAB and/or the Yukon Government.

B.4.5.1.4 R2-11

R2-11. Clarification if project traffic predictions and the project effects assessment include empty vehicles, and if not, updated predictions and corresponding effects assessments.

The updated projections now include all inbound and outbound vehicles. The updated projections do not significantly change the results of the effects assessment that the incremental effect of Project-related traffic remains within the range of historic traffic on the proposed routes. The detailed effects assessment is contained in the response to R2-12.

Updated Projections

An omission of 12 empty vehicles (8 copper concentrate and 4 molybdenum concentrate) resulted in an imbalance of vehicles leaving the facility compared to those returning to the facility in the response to R21 in SIR-A. These two values should always be equal. The response has been recalculated and an updated projection of Project-related highway traffic volumes is reproduced in Table B.4.5-2. The updates to the projections do not significantly change the effects assessment.

Table B.4.5-2 Projected Traffic Volumes during the Operations Phase

Vehicle Type	FHWA Classes	Inbound[1.] (loads per day)	Outbound (loads per day)
LNG Fuel	8-13	11	11
Diesel and Lubricants etc.	8-13	4	4
Lime (as backhaul)	8-13	6	0
Grinding Media (as backhaul)	8-13	3	0
Camp and Catering Supplies	3-7	2	2
Copper Concentrate	8-13	8	17
Molybdenum Concentrate	8-13	4	4
Other (QTY: FHWA Classes)	(5:3-7), (5:8-13)	10	10
Buses, vans, light vehicles	3-7	20	20
TOTAL		**68**	**68**

1. 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

B.4.5.1.5 R2-12

R2-12. An analysis of potential effects along the Klondike Highway, for all affected sections.

Generally, total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic throughout the proposed route. The potential effects analysis is detailed below.

There will be three major highway routes for Project-related traffic during operations:

1. LNG fuel trucks will travel northwest on the Alaska Highway from Fort Nelson, British Columba via Watson Lake to Whitehorse. These vehicles will turn north onto the North Klondike Highway to the Carmacks by-pass. Trucks transporting other supplies may also follow this route;
2. Copper/molybdenum concentrates will be trucked from the mine site to Skagway, Alaska, with grinding media and lime backhauled from Skagway to the mine site; and
3. Additional supplies are anticipated to be procured in Whitehorse and transported to the mine site.

Personnel will be flown into site via the Casino Airstrip.

Yukon Government, Department of Highways and Public Works (HPW), Transportation Engineering Branch has adapted the standard United States Federal Highways Administration (FHWA) classification scheme for Yukon. For planning purposes, FHWA classes are often grouped into light vehicles (classes 1-3), single-unit truck vehicles (classes 4-7) and heavy trailer truck vehicles (classes 8-13) (Yukon Government, 2014).

Single unit trucks (FHWA Classes 3-7) are not expected to have an effect on other highway users (Yukon Government, 2014). Trailer trucks are bigger and longer, accelerate and travel more slowly, and turn more widely than light vehicles (HPW, 2011).

Average daily Project-related one-way trips by route segment is summarized in Table B.4.5-3, and an assessment of the effects on the Alaska Highway – Whitehorse corridor, Alaska Highway – between Watson Lake and Carcross cutoff, the North Klondike and South Klondike is provided below.

The Yukon highway routes, and 2011 traffic volumes (HPW, 2011) are provided in Figure B.4.5-4.

Table B.4.5-3 Projected Traffic Volumes during the Operations Phase inbound and outbound by Vehicle Type

Vehicle Type	Alaska Hwy South of Carcross cutoff	South Klondike	Alaska Hwy Whitehorse Corridor	North Klondike to Carmacks By-pass
LNG Fuel	22	-	22	22
Diesel and Lubricants etc.	8	-	8	8
Concentrates, including backhauls	-	42	42	42
Camp and Catering Supplies	4	-	4	4
Other (QTY: FHWA Classes)	20	-	20	20
Buses, vans , light vehicles	-	-	40	40
TOTAL	**54**	**42**	**136**	**136**

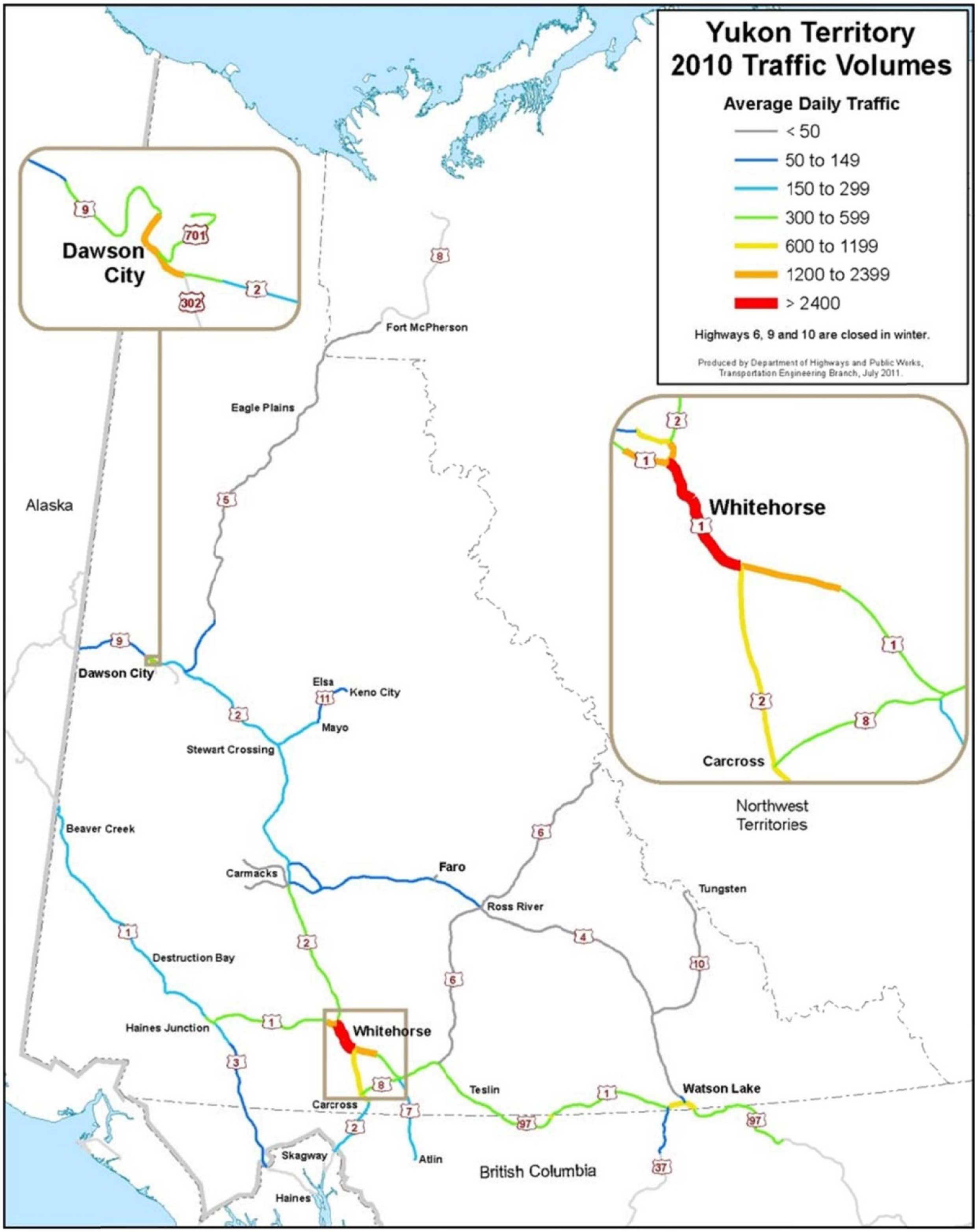


Figure B.4.5-4 Yukon Highway Schematic and 2011 Traffic Volumes (Yukon Government, 2011)

Alaska Highway – Whitehorse Corridor (connection between North Klondike and South Klondike)

Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic in the Whitehorse Corridor.

All Traffic

Traffic along the Alaska Highway between the North Klondike and South Klondike is measured at the Fox Farm Road (km 1411.6) and CEE & CEE Gravel pit (km 1435.2) (HPW, 2011). Traffic through this section is the highest of any in the Yukon and has been steadily increasing from 3,147 average annual daily traffic (ADT) in 1990 to 4,166 ADT in 2011 (HPW, 2011). This is the most used route by Project related traffic as all Project related traffic will travel this stretch (i.e., 136 vehicles per day - Figure B.4.5-5).

Truck Traffic

Truck traffic figures along the Alaska Highway between the North and South Klondike were collected over 1-2 weeks at various locations in the Whitehorse Corridor during the summer of 2011 (HPW, 2011), as shown in Table B.4.5-4. The percent of vehicles that were trucks ranged from 6.6% around Whitehorse (km 1426.3) to 8.5% North of the Carcross Cutoff (km 1404.5).

The average daily truck traffic on the Alaska Highway between the North and South Klondike is shown in Figure B.4.5-6. The annual average daily truck traffic along the Alaska Highway between North and South Klondike is ~313 trucks per day, which will increase, on average, to 409 trucks per day.

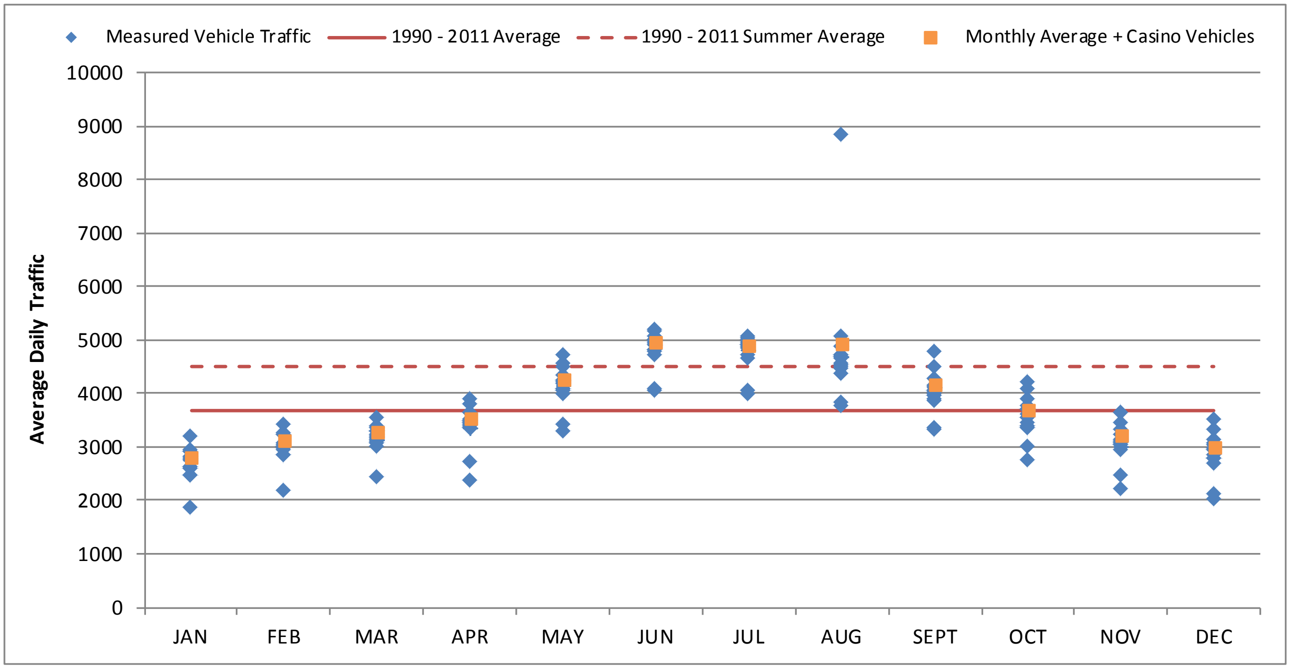
Table B.4.5-4 Traffic and Truck Count Statistics from the Whitehorse Corridor (Summer 2011) and Estimated Project-related Truck Traffic

Location on Alaska Highway	Average Daily Traffic (ADT)[1]	% Trucks[1]	Est. Number of Non-project Trucks/day	Est. Number of Project Trailer Trucks/day
South of Carcross Cutoff (km 1404.2)	2,720	6.9%	188	42
North of Carcross Cutoff (km 1404.5)	4,381	8.5%	372	54
Whitehorse, Two-mile Hill (km 1426.3)	13,480	6.6%	890	96
South of North Klondike (km 1432.2)	6,166	7.7%	475	96
North of North Klondike (km 1437.1)	1,716	12.1%	208	-

1. Yukon Government, 2014

Effects Assessment

The Whitehorse Corridor section of the Alaska Highway is already highly utilized. The increase in average daily traffic is expected to be seven vehicles per hour (1-3 trucks per hour) in an area that regularly experiences from 71 to 562 vehicle trips per hour. Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic in the Whitehorse Corridor.



*Data from Yukon Highways and Public Works, 2011

Figure B.4.5-5 Vehicle Traffic Measured at Alaska Highway km 1435.2 (North Klondike Junction) and added Casino Vehicles (Highway Data from 1990 – 2011)

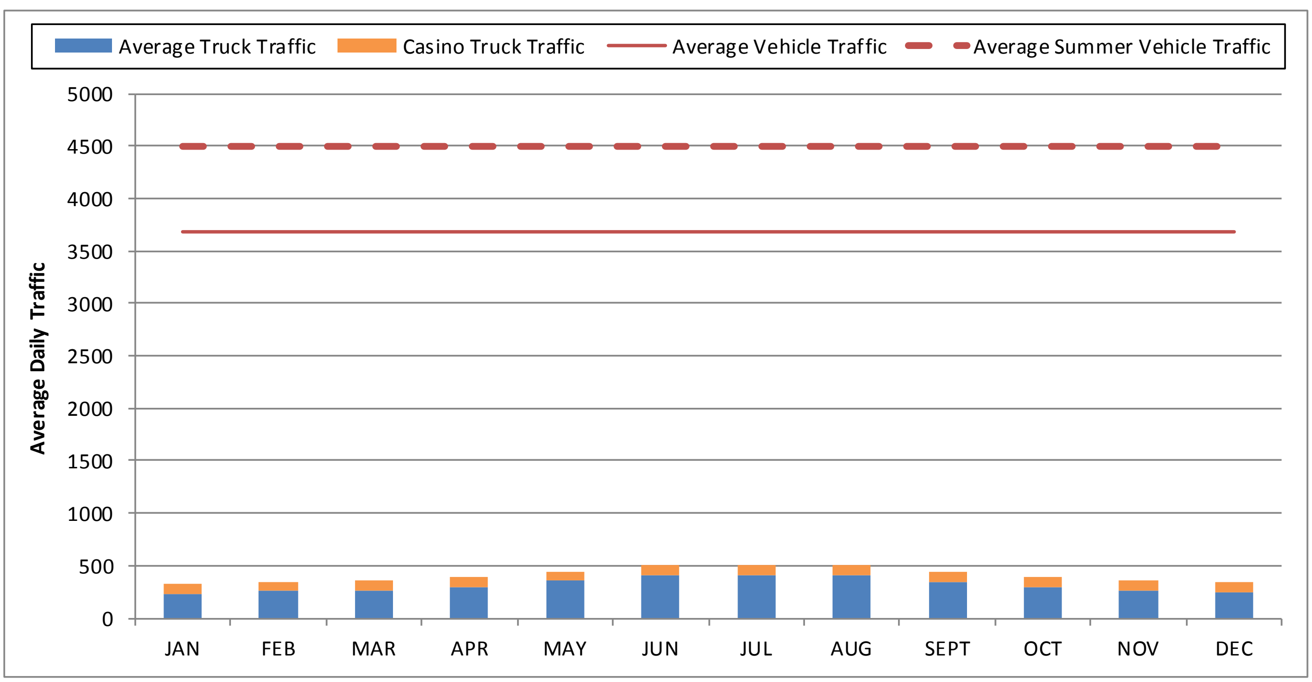


Figure B.4.5-6 Calculated Average and Casino Truck Traffic at Alaska Highway km 1435.2 (North Klondike Junction)

Alaska Highway – between Watson Lake and Carcross cut-off

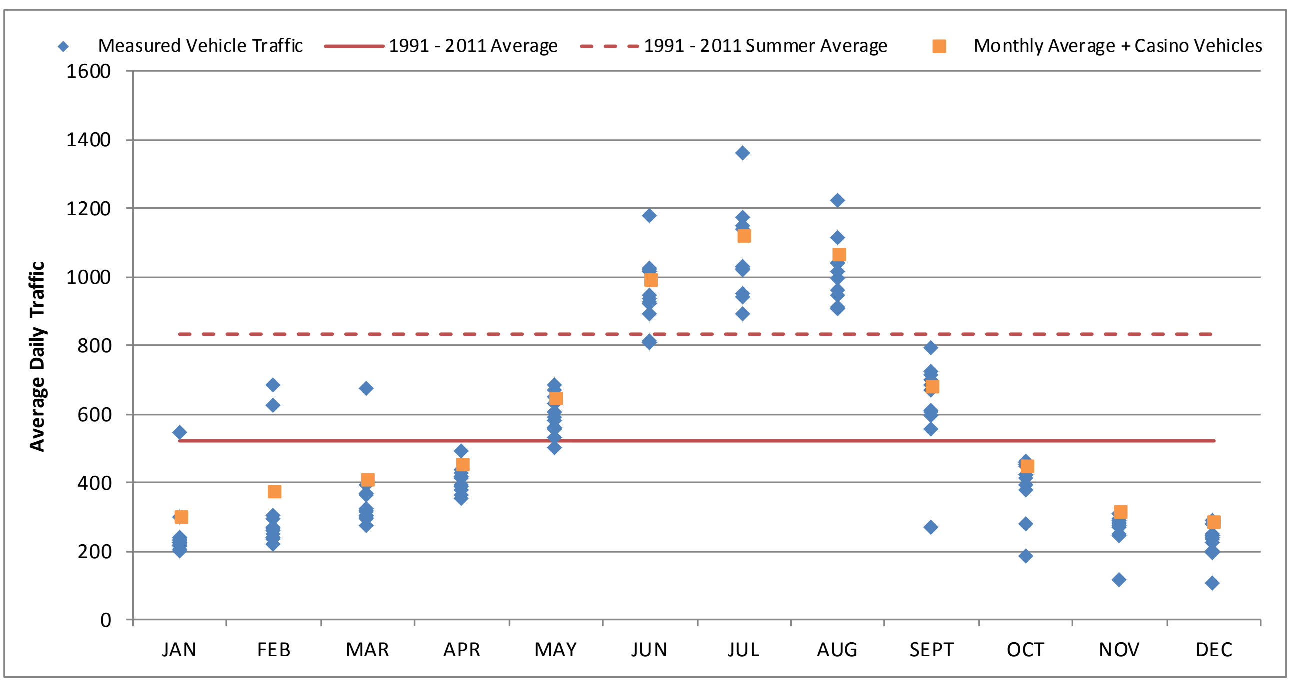
Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic on this section of the Alaska Highway.

All Traffic

Traffic that travels along the Alaska Highway between the Carcross cut-off and Watson Lake is measured at the Cassiar Junction South (km 1001.5) and the Swift River Grader Station (km 1136.7). Traffic at these stations has been relatively consistent from year to year, with average daily traffic of 568 vehicles per day at km 1136.7 and 523 vehicles per day at km 1001.5. Project related traffic likely to travel along this stretch is related to LNG (11), diesel and lubricants (4), camp and catering supplies (2) and other (10) for a total of 54 trucks both directions. Buses, vans and light vehicles will likely only travel between Whitehorse and the mine site and concentrate vehicles will turn off onto the South Klondike. Average daily traffic, by month, with the added Casino vehicles, for this stretch is shown in Figure B.4.5-7.

Truck Traffic

Truck traffic along the Alaska Highway between the Carcross cutoff and Watson Lake can be assumed to be equal to that South of the Carcross cutoff (6.9%). Assuming 6.9% of total traffic along the Alaska Highway towards Watson Lake are trucks, the average daily truck traffic is shown in Figure B.4.5-8 (blue columns). The cumulative effect of the 54 trucks from the Casino Project is also shown on Figure B.4.5-8 (orange column). The annual average daily truck traffic along the Alaska Highway between the Carcross cutoff and Watson Lake is ~36 trucks per day, which will increase, on average, to 90 trucks per day.



*Data from Yukon Highways and Public Works, 2011

Figure B.4.5-7 Vehicle Traffic Measured at Alaska Highway km 1001.5 (Cassiar Jct. South Side) and added Casino Vehicles (Highway Data from 1991 – 2011)

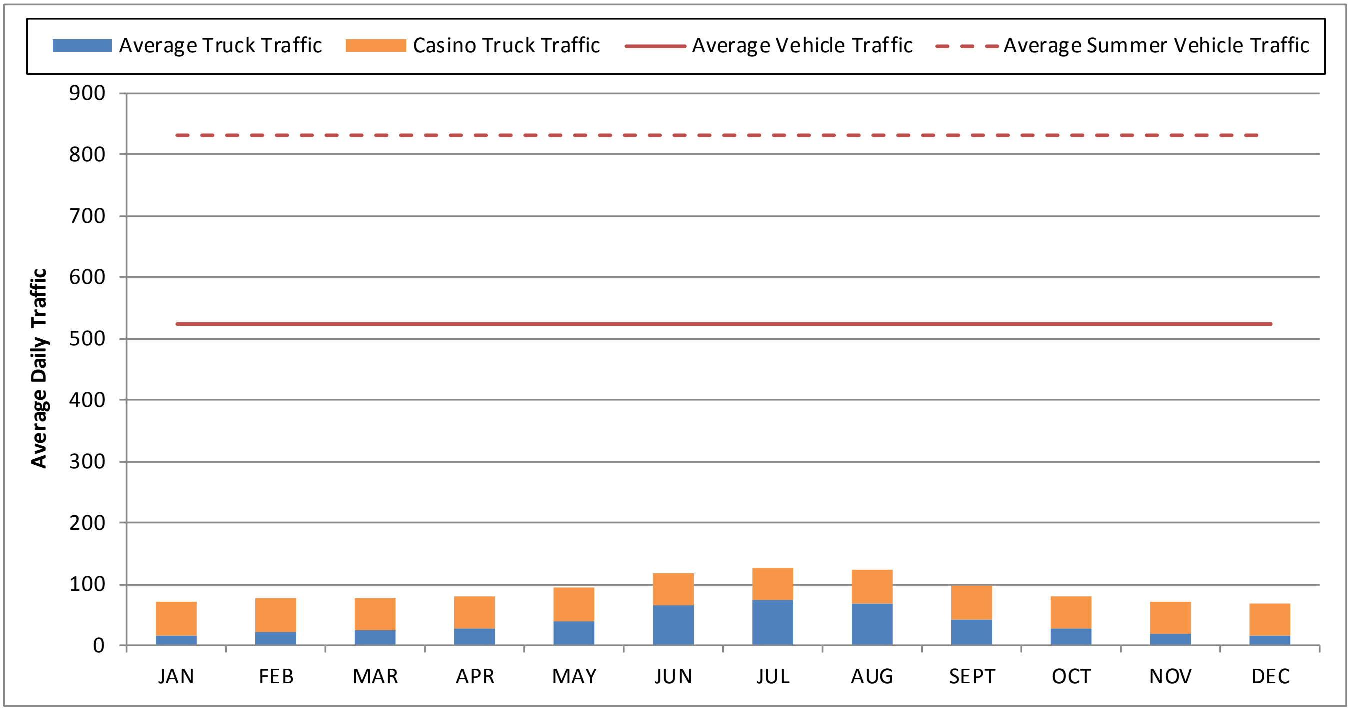


Figure B.4.5-8 Calculated Average and Casino Truck Traffic at Alaska Highway km 1001.5 (Cassiar Jct. South Side)

Effects Assessment

Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic on this section of the Alaska Highway, as shown as orange squares in Figure B.4.5-7, and as shown by the red lines in Figure B.4.5-8.

North Klondike

Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic on the North Klondike Highway.

All Traffic

Traffic along the North Klondike Highway is measured at Braeburn, using electronic traffic counters (HPW, 2011). Traffic through Braeburn has been relative consistent from 1996 through 2011, averaging ~436 vehicles per day, which increases to ~597 during the summer (HPW, 2011). All Project related traffic will travel on this section of the highway (i.e., 136 vehicles per day, on average). Average daily traffic, by month, is shown in Figure B.4.5-9, as is the increase in traffic with Casino vehicles.

Truck Traffic

To determine the effect of the Project on truck traffic, truck traffic volumes from the Alaska Highway, North and South of the Klondike, can be used. The volume of truck traffic ranges from 7.7% to 12.1%, therefore, assuming 12% of total traffic along the North Klondike are trucks, the average daily truck traffic on the North Klondike is shown in Figure B.4.5-10. The impact of the 96 trucks (all vehicles excluding the 40 buses, vans and light vehicles) from the Casino Project are also shown on Figure B.4.5-10 (orange columns). The annual average daily truck traffic through Braeburn is currently ~52 trucks per day, which will increase, on average, to 148 trucks per day.

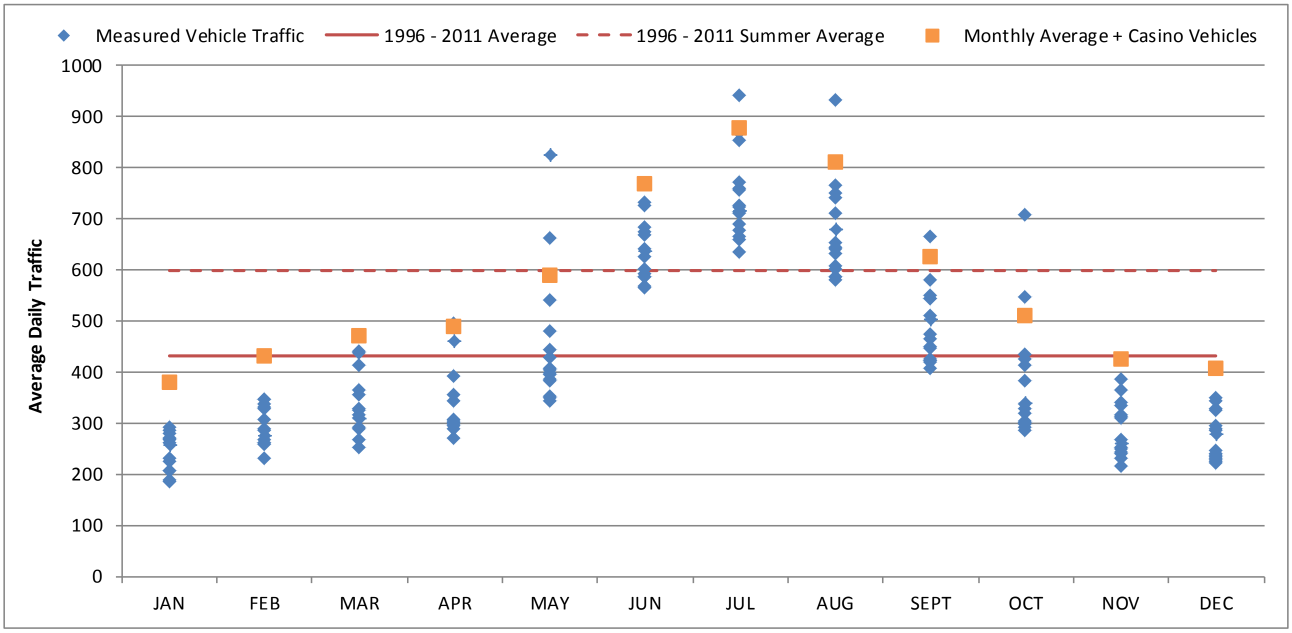


Figure B.4.5-9 Vehicle Traffic Measured at Klondike Highway km 280 (Braeburn) and added Casino Vehicles (Highway Data from 1991 – 2011)

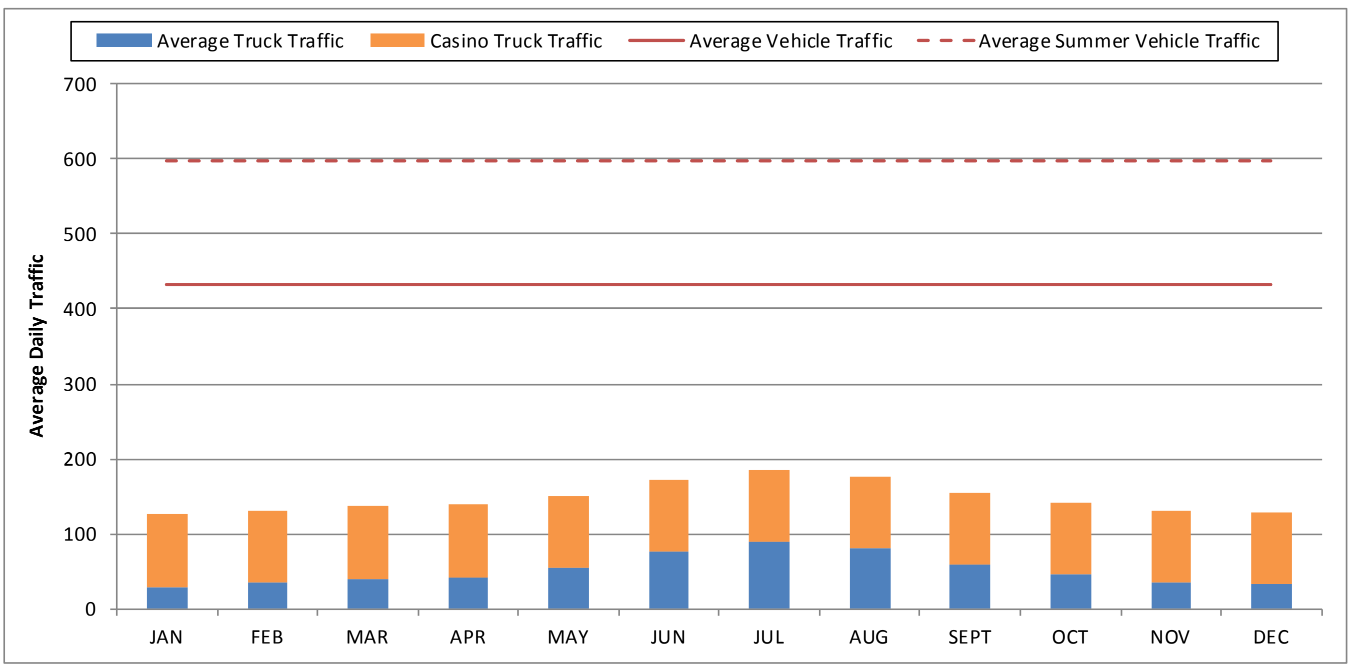


Figure B.4.5-10 Calculated and Casino Truck Traffic at Klondike Highway km 280 (Braeburn)

Effects Assessment

Total average daily traffic, including the incremental effect of Project-related traffic, is expected to be well within the range of historic traffic on the North Klondike Highway, as shown as orange squares in Figure B.4.5-9. Average daily truck traffic will increase, but will be below the overall average vehicle traffic (red lines on Figure B.4.5-10).

South Klondike

42 additional trucks will travel through Carcross (i.e., 21 trucks to Skagway and 21 trucks returning from Skagway) on a daily basis. The effect on average daily vehicle traffic through Carcross is well within the range of historic traffic for this section of road.

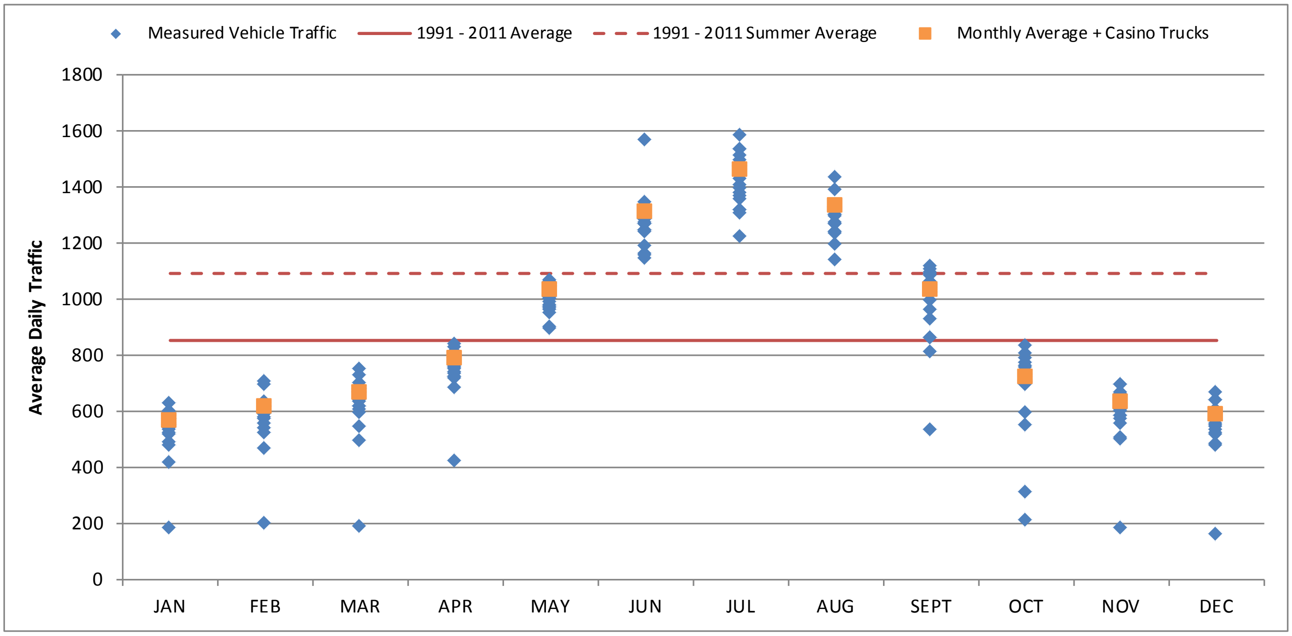
All Traffic

Traffic on the South Klondike Highway is measured on the North and South sides of Carcross, using electronic traffic counters (HPW, 2011). These results provide an estimate of overall traffic, and are not divided into truck, passenger vehicle and bus traffic. Project related traffic on the South Klondike will be concentrate trucks shipping concentrate to Skagway and returning with lime and grinding media, for an average of 21 trucks per day each way, or 42 trucks per day in total.

On average, from 1991 through 2011, 849 vehicles per day pass the traffic counter on the South side of Carcross, with the average increasing to 1,092 vehicles per day during summer months (May 1 through September 30) (HPW, 2011). The total monthly average daily traffic through Carcross, as measured by Yukon Highways and Public Works (HPW) traffic counter on the south side of Carcross on the Klondike Highway #2, is shown in Figure B.4.5-11.

Truck Traffic

To determine the effect of the Project on truck traffic, truck traffic volumes from the Alaska Highway at the Carcross cutoff can be used. The volume of truck traffic ranges from 6.9% to 8.5%, therefore, assuming 8.5% of total traffic along the South Klondike past Carcross are trucks, the average daily truck traffic on the South Klondike is approximately 72 trucks per day (Figure B.4.5-11). The impact of the 42 concentrate trucks (21 trucks in each direction) from the Casino Project are also shown on Figure B.4.5-12 (orange squares). The annual average daily truck traffic is expected to increase to 114 trucks per day.



*Data from Yukon Highways and Public Works, 2011

Figure B.4.5-11 Vehicle Traffic Measured at Klondike Highway km 106.3 (Carcross – South Side) (Highway Data from 1991 – 2011)

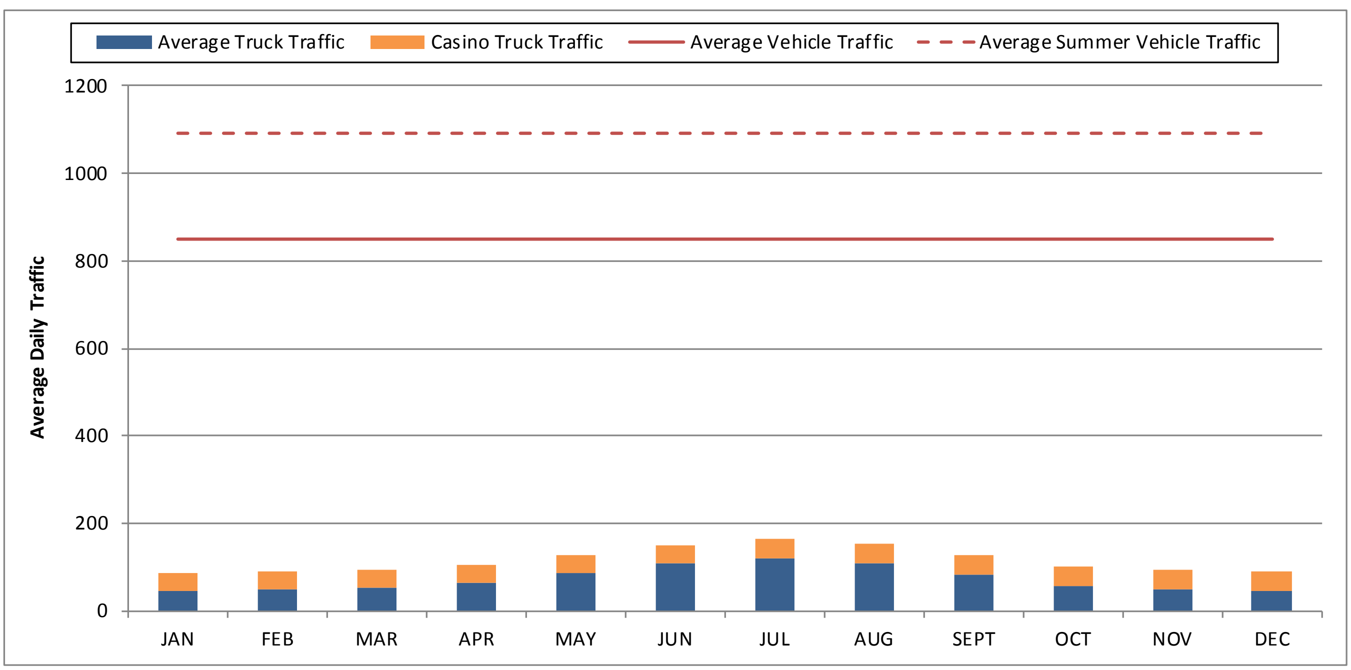


Figure B.4.5-12 Calculated and Casino Truck Traffic on Klondike Highway km 106.3 (Carcross – South Side)

Effects Assessment

The total of the additional 42 trucks through Carcross (i.e., 21 trucks to Skagway and 21 trucks returning from Skagway) on a daily basis and the baseline average daily vehicle traffic through Carcross is well within the range of historic traffic for this section of road (orange square in Figure B.4.5-11).

B.4.5.1.6 R2-13

R2-13. An assessment of and mitigations for potential effects due to traffic in Carmacks and Carcross.

Village of Carmacks

The following mitigation measures should minimize the potential effects that may be experienced by residents of the Village of Carmacks as a result of increased traffic from project-related activities.

Early Construction of Carmacks By-pass

The main mitigation measure proposed by CMC is the construction of the Carmacks by-pass road and bridge over the Nordenskiold River. This routing will minimize traffic through the Village of Carmacks and will minimize effects such as noise, safety, dust, etc.

The Carmacks by-pass will provide a route for construction and 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 (Figure B.4.5-1).

The by-pass construction will be one of the first construction activities completed, and as the right of way is already cleared, the construction is expected to be relatively quick, and as short as practical. Therefore, the effects of subsequent construction traffic through Camacks will be negligible, and will be limited to the construction period when the by-pass is not yet available for use.

Mitigation measures during by-pass construction

- *Routing:* During the construction of the by-pass, the proposed access route for vehicles requiring access to the Freegold Road is outlined in Figure B.4.5-1 and consists of a turn onto Freegold Road from Highway 2, then a left turn onto River Road, which turns into the Freegold Road. The route was chosen as it is the current route for traffic traveling through Carmacks to access the Freegold Road and it minimizes traffic near the school and recreation centre. As detailed in Table 4.3-5, annual average daily traffic is estimated to be 3 “heavy” vehicles and 1 “light” vehicle, for a total of 4 extra vehicles per day during this time.
- *Traffic management and safety procedures*: Vehicles will comply with all standards and guidelines established in the Traffic Management and Road Use Plans and with local speed limits.
- *Scheduling and communication:* CMC will communicate with the Village of Carmacks to indicate proposed construction windows, and as the route will be constructed by the Yukon Government Department of Highways and Public Works (HPW), communication will also be closely connected between HPW, the Village of Carmacks, CMC and the construction contractor. Notice will be given to residents in the surrounding area well in advance of the construction start date.
- *Noise levels:* Based on the existing model and predictions, noise levels in Carmacks during construction are anticipated to be consistent with the maximum daytime and nighttime noise levels predicted for the

Freegold Road Extension during construction (see Figures 9.4-1 and 9.4-2 in the Proposal). These predicted noise levels are below the maximum daytime and nighttime thresholds identified in the OGC guidelines (i.e., 55 dBA during the day, and 45 dBA at night).

Traffic Management Plan

Following construction of the Carmacks bypass, CMC will develop the Traffic Management Plan in support of the Road Use Plan. The final Road Use Plan for the Project will include a discussion of the potential impacts of mine site roads, haul roads and access roads (including the Carmacks by-pass road) and implement mitigation measures to avoid or minimize adverse effects on watercourses, wildlife, and the public, once finalized by the YESAB assessment process.

The Traffic Management Plan is expected to form a large component of the Road Use Plan. It will include a monitoring and reporting requirement that allows adjustments to be made to the plan to ensure the objectives are achieved and adverse effects are avoided or minimized. The Traffic Management Plan will be prepared by CMC and the implementation of it (and the larger Road Use Plan) will become a commitment of CMC and a license requirement for the Project under the Territorial Lands (Yukon) Act and the Quartz Mining License.

Carcross

Traffic passing by Carcross along the South Klondike Highway #2 will be limited to concentrate trucks travelling to and from Skagway for export, which at the maximum, is 24 trucks and 4 trucks per day, or on average, 17 trucks and 4 trucks per day, for copper and molybdenum concentrate, respectively. The highway route through Carcross travels north-south, on the east side of the town. To access the town, vehicles must turn west off of the highway. Traffic travelling along the highway towards Skagway or Whitehorse must comply with speed limits and other highway traffic conditions.

As detailed above, in the response to R2-12, the increase in traffic passing by Carcross on the South Klondike Highway #2 due to the Casino Project is consistent with traffic that residents are used to seeing in an average month, and in most months is below the average summer traffic values.

The traffic increase through Carcross is within the range of existing traffic. Mitigations proposed include compliance with all relevant traffic requirements in the Carcross area, including:

- Weight restrictions – weight restrictions are applied in the spring to protect highways from damage. On the Klondike highway, axle weights are historically reduced to 75% in late March or early April and increased back to 100% in May, with all restrictions rescinded by June (HPW, 2015).
- Speed limits – as posted.
- Air brake restrictions – as posted.
- Considerations for road conditions, including icy, slippery or snowy conditions.
- Applying safe following distances appropriate to the weight and speed of the vehicle.
- All other applicable regulations and safety considerations.

B.4.6 WATER MANAGEMENT PLAN

B.4.6.1 Conveyance of Water

B.4.6.1.1 R2-14

R2-14. Additional analysis regarding the appropriate PMP value for the design of the mine facilities. Specifically, utilize the full period of rainfall record as discussed by EcoMetrix (YOR 2014-0002-399-1), discuss the PMP contours presented in TP-47, and utilize other available methods of predicting PMP such as more recent publications regarding PMP estimates for eastern interior Alaska.

To clarify, the probable maximum precipitation (PMP) and 1:1,000 year return period rainfall event values were calculated to inform the selection of an appropriate Inflow Design Flood (IDF) for the Tailings Management Facility. The CDA Dam Safety Guidelines require that an appropriate IDF is an event equal to “one third between 1,000 years and the Probable Maximum Flood (PMF)” event (CDA, 2007). This value is used to calculate the storage required during operations. During closure, the IDF has been defined as the PMF. For the short-term Stage I TMF (preproduction and Year 1 of operations) the 72-hour 1:1,000 year event was adopted.

The IDF and PMF are derived from the PMP and potential snowmelt during occurrence of the PMP, to provide an estimate of flooding potential. The resulting total potential runoff depth from a combined return period rainfall event and snowmelt for the 24-hour and 72-hour events are:

- 72-hour 1:1,000 year total runoff depth = 201 mm;
- 24-hour PMP total runoff depth (24-hour PMF)= 175 mm; and
- 72-hour PMP total runoff depth (72-hour PMF) = 371 mm.

With an inflow catchment of 35 km^2, the resulting IDF flood volumes are:

- Starter Dam = 72-hour 1,000 year event = 7.0 million m^3;
- Operations Phase = 1/3 value between 1,000 year and 72-hour PMF event = 9.0 million m^3; and
- Closure Phase = 24-hour PMF = 6.1 million m^3.

Therefore, when storage requirements are most needed, during operations of the facility because an overflow spillway is not constructed, a PMP of 258 mm is actually used in the design.

Current estimates for PMP and PMF are initial values suitable for assessment purposes and will be reviewed for detailed design and construction purposes. As the project progresses into basic engineering and through the permitting process these values, including the data sources and methodologies used to establish these values, will undergo rigorous examination and review. The design of the TMF and HLF will be based upon the final determination of the PMP and PMF values developed by the EOR, as reviewed by the IERP, and reflected in the design documents submitted for regulatory review and license application processing. See Figure B.4.2-1 for a description of how initial values for key design features are incorporated into the design, construction and operation continuum.

CMC also notes that EcoMetrix states that *“… there is sufficient information available to assess implications during evaluation of the Project”* (YOR 2014-0002-399-1). CMC concurs with this statement and requests the

Executive Committee proceed with assessment recognizing CMC's commitment to examine the issue in greater detail in the basic engineering and permitting phases of the Project.

B.4.6.1.2 R2-15

R2-15. Typical cross-sections and design drawings of alignments for diversion ditching across the project site with particular focus around the HLF including:
a. confining embankment;
b. access road section; and
c. event ponds area.

Typical ditch design and alignment of the diversion ditching around the HLF is provided in Figure B.4.6-1. Diversion ditches around the heap leach facility will be constructed to intercept and divert surface runoff. The initial HLF development (Stage 1) will also include the complete development of the confining embankment, events pond and perimeter diversion ditches prior to commencing ore stacking and leaching. A series of diversion ditches will be constructed around the perimeter of the staged HLF to intercept overland surface runoff and convey flows to the TMF. Intermediate ditches within the HLF footprint will be constructed and decommissioned as necessary. Diversion ditches will be sized to convey the 100 year peak flow (Table B.4.6-1).

The alignments of the HLF diversion ditches are shown on Figure B.4.6-1. Diversion ditch requirements and dimensions are provided in Table B.4.6-1. At start-up, (Year -3), a temporary ditch (Ditch C) approximately six metres wide will be constructed that will divert surface runoff from the upper portion of the final HLF pad footprint. This temporary ditch will be decommissioned in Year 3 when the footprint of the HLF extends beyond El 1264 m.

Table B.4.6-1 HLF Diversion Ditch Requirements

Ditch Name	Length (m)	Water Depth 100 year event (m)	Total Ditch Width (m)	Velocity (m/s)	Flow Capacity (m^3/s)
Ditch A1	350	0.43	5.9	1.64	2.73
Ditch A2	930	0.27	4.3	4.04	2.77
Ditch A3	1110	0.37	4.7	5.29	5.36
Ditch A4	210	0.47	6.1	3.15	5.83
Ditch A5	110	0.32	4.5	6.77	5.72
Ditch B1	350	0.47	5.1	2.85	3.93
Ditch B2	1910	0.32	4.5	4.8	4.05
Ditch B3	120	0.48	5.1	2.9	4.13
Ditch B4	130	0.28	4.3	5.85	4.19
Ditch C	1250	0.49	6.2	1.51	2.95
Ditch A2	930	0.27	4.3	4.04	2.77

As described in the Water Management Plan (Appendix 4C), diversion ditches will typically be lined with vegetation, riprap, or other stable material, and are designed to divert non-contact surface runoff around mine facilities to downstream areas. Additionally, the topography of the HLF is such that should failure of the diversion ditches occur, surface runoff will simply be collected in the HLF and subsequently collected in the leachate collection sump. Should failure of the leachate collection system occur, any discharge will be collected in the events pond, and finally, should failure of the events pond occur, all material will be collected within the TMF.

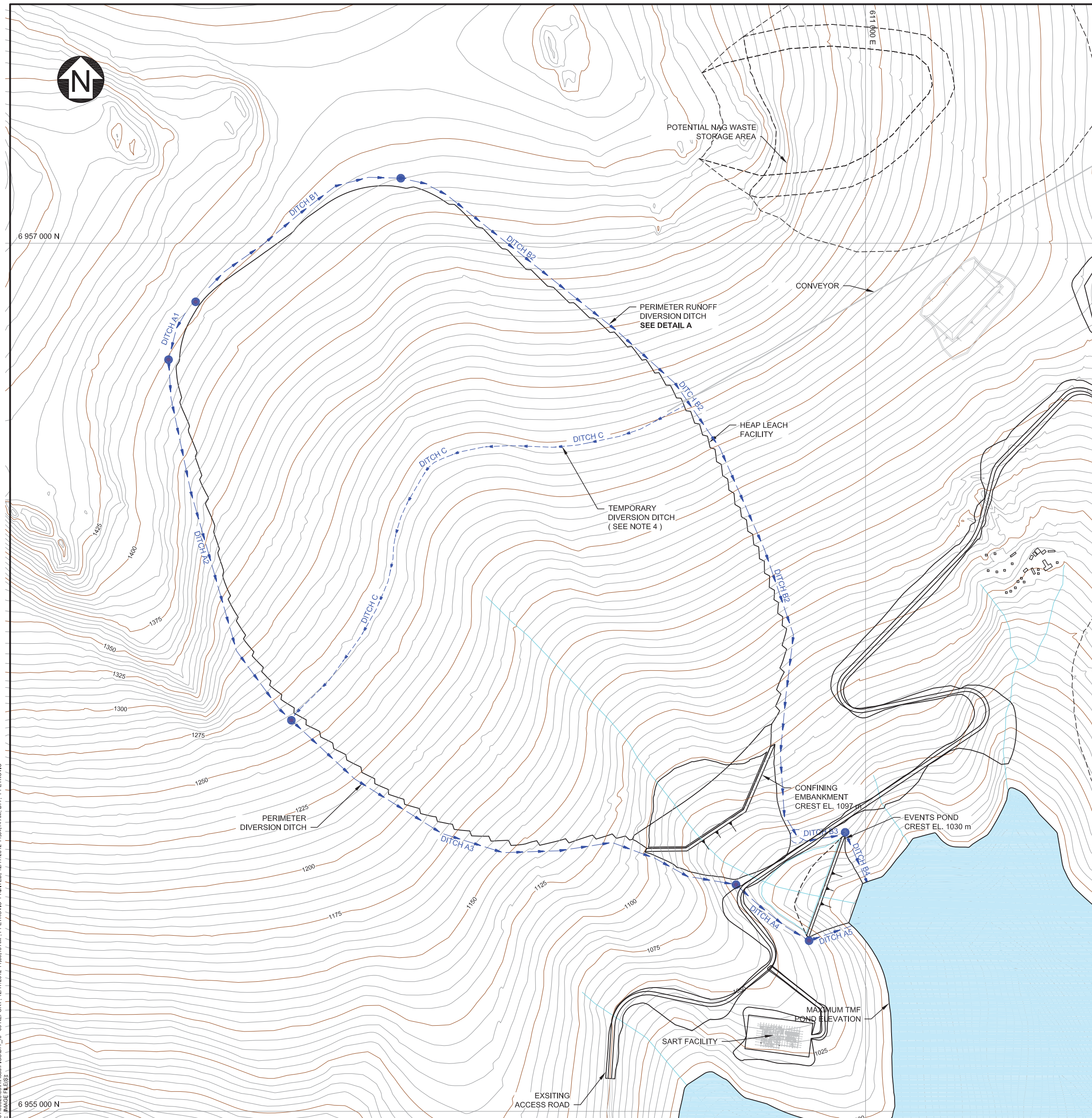
A series of diversion ditches will be installed upstream of the ore stockpiles to minimize the contact of runoff water with the ore stockpiles and divert surface flow to the TMF basin. Based on the topography at the Casino mine site, the total diversion ditch widths will range between 3-4 m for the protected ditch sections and 4-5 m for the shallow-grade earth lined sections. The diversion ditching system will meet the following design criteria:

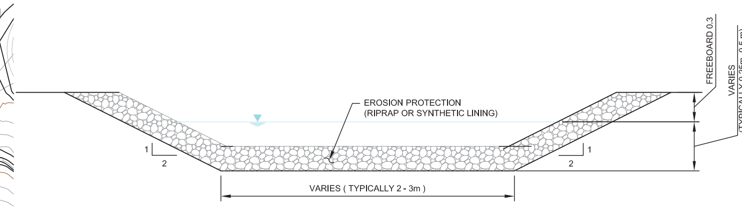
- Design storm conveyance: 1 in 100 year 24-hour duration storm event;
- Minimum freeboard = 0.3 m;
- Maximum design storm flow depth = 0.5 m;
- Minimum ditch grade = 0.01 m/m; and
- Minimum channel side slope = 2H:1V.

Sediment control fencing will be placed around the down-gradient perimeter sections of the ore stockpiles to prevent sediment discharge from the stockpiles.

At the Open Pit, a diversion ditch will be constructed to divert Canadian Creek around the Open Pit when the pit footprint intercepts the creek (approximately Year 10). Diversion ditches along the north and west pit crest are required to divert the surface runoff away from the pit during operations. These surface runoff ditches will capture and divert the majority of all runoff and snowmelt before the water flows into the pit and will reduce power requirements for pumping from the deeper levels of the pit. Ditches will need to be modified for different stages of pit development. It may be appropriate to include low permeability glacial till or synthetic liner materials along sections of these ditches in order to reduce ditch leakage.

Design drawings for the diversion and collection ditches will be prepared during the basic engineering phase (see Figure B.4.2-1), and designs will be provided in the Heap Leach Facilities Design and Construction Plan, the Storage Facility Design Plan, the Road Construction Plan and the Mine Development and Operations Plan, required for quartz mining under the Quartz Mine Act (Yukon Government, 2013).





DETAIL A
TYPICAL DITCH
SCALE B

LEGEND:

- TEMPORARY DIVERSION CHANNEL
- PERMANENT DIVERSION CHANNEL

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 5 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.
4. TEMPORARY DIVERSION DITCH TO CONTROL DRAINAGE, TO BE CONSTRUCTED AT START OF HEAP LEACH FACILITY CONSTRUCTION AND PRIOR TO ORE LOADING.
5. REFER TO TABLE IN REPORT FOR MINIMUM DITCH DIMENSIONS

SCALE A: 100 50 0 100 200 300 400 500 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	17DEC'12	ISSUED WITH REPORT	RSS	PP	LM	KJB

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

HEAP LEACH FACILITY
WATER MANAGEMENT PLAN

Knight Piésold CONSULTING

P/A NO. VA101-325/8 | REF NO. 9

Figure B.4.6-1 | REV 0

B.4.6.2 Probability of Failure Analysis of Infrastructure Components

B.4.6.2.1 R2-16

R2-16. Details and rationale on the selection of return period design criteria for all the WMP components during all phases of the Project, including long-term closure. Details should include calculation of the failure probabilities.

The data provided in Table A.4.7-1 includes the 'Probability of Design Exceedance' for the design return period. This is calculated by:

$$p_e = \left(1 - \frac{1}{T}\right)^n$$

Where p_e = probability of exceedance

T = return period (e.g., 10 year, 200 years, 1000 years)

n = design life (years)

Table A.4.7-1 is included in this response. Further explanation of the rationale for each design criterion is provided after the table. The comment numbers (1 through 14) correspond to the numbers identifying each rationale in Table A.4.7-1.

(1) Design guidelines by (BC MELP, 2001)

During the early years of construction the WMP will serve strictly as a sediment control pond, and as such the pond will constantly discharge through a low level outlet. The storage in the pond will be able to accommodate the flow volume of the 10 year 24 hr storm event, with the pond overflowing through the spillway during the occurrence of a more extreme storm event. During such an event, the discharge and sediment load in the receiving waters will be so great that any discharge from the pond would not materially affect the downstream water quality.

During the later years of construction and throughout operations, the WMP will serve to manage both sediment loading and other water quality constituents. The low level outlet will be decommissioned and water levels will be controlled by continuous pump-back of water to the TMF. The current design concept is that the pond storage capacity has been set at the flow volume of the 10 year 24 hour storm event, with the understanding that any flood volume exceeding this would overflow through the spillway to the receiving waters. As discussed in the sediment pond rationale, the discharge of the receiving waters would be so great during such extreme flow events that any potential water quality affects would be de minimis. Design criteria for this structure, as well as design capacity of the pump back systems, will be reviewed and adjusted, if required, in discussions with regulatory agencies during the next level of design for the permitting phase of the project.

Table A.4.7-1 Summary of Design Criteria and Probability of Exceedances for Water Management Components

Report	Components	Return Period Design Criteria	Design Life Phase	Design Life (years)	Probability of Design Exceedance	Rationale	Reference (Page)
Water Management Plan Report	Water Management Pond (WMP)	10 yr, 24-hr storm event	Construction and Operation	33	97%	Design guidelines by (BC MELP, 2001) **(1)**	12
	WMP Overflow Spillway	200 yr, 24-hr storm event	Operation	33	15%	Small structure and mid to low consequence of exceedance **(2)**	12
		200 yr, 24-hr storm event	Closure	100	39%	Structure must operate in perpetuity **(3)**	15
	Coffer Dams	10 yr, 24-hr storm event	Construction	1	10%	Temporary structures **(4)**	12
	Diversion Ditches	100 yr, 24-hr storm event	Construction and Operation	33	28%	Reasonably low consequence of exceedance **(5)**	14
	Sediment Settling Ponds	10 yr, 24-hr storm event	Construction	2	19%	Design guidelines by (BC MELP, 2001) **(6)**	
	Sediment Settling Pond Spillway	200 yr 24 hr storm event	Construction	2	1%	Design guidelines by (BC MELP, 2001) **(7)**	13
Tailings Management Facility Report	TMF Pond and Spillway	Pond: 1000 year 72-hour storm	Up to Year 1 of Operation	3	0.3%	Large structure. Based on CDA Guidelines. **(8)**	
		Pond: 1/3 between the 72-hr 1000 yr storm and 72 hr PMF	Operation	28	0.03%		
		Spillway: PMF, 24-hr PMP + 100 year snowpack	Closure	-	By definition, the PMF cannot be exceeded.		
Heap Leach Feasibility Design Update Memo	HLF Spillway	200 yr, 24-hr storm event	Operation	33	15%	Small structure and mid to low consequence of exceedance. **(9)**	10
	HLF In-Heap Storage	Total capacity of 172,600 m^3 (90,000 m^3 for normal operating capacity and 82,600 m^3 for storm capacity based on 25 yr, 24-hr storm event)	Construction and Operation	33	74%	Low consequences if storage is exceeded. Overflow will discharge into the TMF. **(10)**	
	HLF Embankment Spillway	200 yr 24 hr storm event	Construction and Operation	33	15%	Small structure and mid to low consequence of exceedance. **(11)**	
	HLF Events Pond	74,000 m^3 of storage capacity based on the 100 yr storm event (rainfall + snowmelt)	Construction and Operation	33	28%	Storage capacity to contain excess HLF leachate and surface runoff. Reasonably low consequence of exceedance. **(12)**	29
	Events Pond Spillway	200 yr, 24-hr storm event	Construction and Operation	33	15%	Small structure and mid to low consequence of exceedance. **(13)**	29
	Diversion Ditches	100 yr, 24-hr storm event	Construction and Operation	33	28%	Reasonably low consequence of exceedance. **(14)**	31

(2) Small structure and mid to low consequence of exceedance

According to the Canadian Dam Association (CDA), a small structure with a mid to low consequence of exceedance should be have an inflow design flood with a return period between 1/100 years and 1/1000 years. The spillway will be designed for a 1/200 year flood flow, which is within this range. For the 33 year mine life, this event has a calculated probability of exceedance of 15%. However, as with most overflow structures, the spillway will be sized with freeboard (0.5 m in this case), which will effectively increase the flow capacity by a substantial amount such that the actual probability of exceedance would be much less than 15%. (For example, the discharge capacity of a 5 m wide and 1 m deep trapezoidal spillway is doubled if one includes the flow capacity of 0.5 m of freeboard).

(3) Structure must operate in perpetuity

This statement is incorrect. The structure must operate until the water quality meets discharge requirements. The period of required operation is not known. The water management plan states that "In closure, the TMF water management pond will be replaced by a larger pond." When this larger pond is designed for construction prior to closure, an appropriately sized spillway for the structure will be included as part of the design, which will be based on information collected during the operational life of the Casino project. Furthermore, a wetland may be constructed downstream of the water management pond in closure, which will act as a dissipating filter to slow the release of water to the receiving environment.

(4) Temporary structures

The cofferdams are temporary structures and have a low consequence of failure. Furthermore, the spillways will be sized with 0.5 m of freeboard, which will effectively increase the flow capacity by a substantial amount such that the actual probability of exceedance over a 1 year period would be much less than 10%. As with the WMP, the design basis for these structures will be reviewed and adjusted, if need be, during the next level of design for the permitting phase of the project.

(5) Reasonably low consequence of exceedance

Exceedance of the design criteria of a diversion ditch will result in localized erosion with minimal consequences because the water and sediment will discharge into the TMF. The calculation for the Inflow Design Flood (IDF) for the TMF assumes that all ditches fail during the design storm event (the PMF).

(6) Design guidelines by (BC MELP, 2001)

The sediment ponds will be designed according to standard guidelines. The storage in the ponds will be able to accommodate the flow volume of the 10 year 24 hr storm event, with the ponds overflowing through spillways during the occurrence of more extreme storm events. During such events the discharge and sediment load in the receiving waters will be so great that any discharges from the ponds would not materially affect the downstream water quality.

(7) Design guidelines by (BC MELP, 2001)

The spillways for the sediment ponds will be designed according to standard guidelines. The spillways will be designed to pass the peak flow resulting from the 200 year 24 hr storm event, with 0.5 m of freeboard. This freeboard will effectively increase the flow capacity by a substantial amount such that the actual probability of exceedance in any 2 year period would be less than 1%.

(8) Large structure. Based on CDA Guidelines. The rationale for selection of the design events for the TMF pond and spillway is detailed in the TMF Feasibility Design Report (Appendix A.4D)

(9) Small structure and mid to low consequence of exceedance.

According to the CDA, a small structure with a mid to low consequence of exceedance should be have an inflow design flood with a return period between 1/100 years and 1/1000 years. The spillway will be designed for a 1/200 year flood flow, which is within this range. For the 33 year mine life, this event has a calculated probability of exceedance of 15%. However, the spillway will be sized with 0.5 m of freeboard, which will effectively increase the flow capacity by a substantial amount such that the actual probability of exceedance would be much less than 15%. Furthermore, the HLF will be located upstream of the TMF, so the consequences of failure are very low since the TMF will be able to contain any runoff. The TMF will be designed assuming that all upstream structures exceed their design criteria during the design storm event (the PMF).

(10) Low consequences if storage is exceeded. Overflow will discharge into the TMF.

(11) Small structure and mid to low consequence of exceedance.

The spillways for the HLF will be designed to pass the peak flow resulting from the 200 year 24 hr storm event, with 0.5 m of freeboard. This freeboard will effectively increase the flow capacity by a substantial amount, reducing the probability of exceedance.

Failure of a HLF spillway will result in localized erosion with minimal consequences because the water and sediment will discharge into the TMF. The TMF will be designed assuming that all upstream structures exceed their design criteria during the design storm event (the PMF).

(12) Storage capacity to contain excess HLF leachate and surface runoff. Reasonably low consequence of exceedance.

The storage in the events ponds will be able to accommodate the flow volume of the 10 year 24 hr storm event, with the ponds overflowing through spillways during the occurrence of more extreme storm events. All overflows will discharge into and be contained in the TMF.

(13) Small structure and mid to low consequence of exceedance.

The spillways for the HLF events pond will be designed to pass the peak flow resulting from the 200 year 24 hr storm event, with 0.5 m of freeboard. This freeboard will effectively increase the flow capacity by a substantial amount, reducing the actual probability of exceedance.

Failure of a HLF events pond spillway will result in localized erosion with minimal consequences because the water and sediment will discharge into the TMF. The TMF will be designed assuming that all upstream structures exceed their design criteria during the design storm event (the PMF).

(14) Reasonably low consequence of exceedance.

Failure of a diversion ditch will result in localized erosion with minimal consequences because the water and sediment will discharge into the TMF. The TMF will be designed assuming that all ditches exceed their design criteria during the design storm event (the PMF).

B.4.7 HEAP LEACH FACILITY

B.4.7.1 Liners

B.4.7.1.1 R2-17

R2-17. Additional supporting evidence to demonstrate the sufficiency of a 30 cm thick soil liner based on the actual conditions at the mine site (e.g. shear strength, slope stability, stack height, bedrock conditions).

See response to R2-18.

B.4.7.1.2 R2-18

R2-18. An outline of plausible mitigation strategies (e.g. intermediate liners; additional and/or higher standard liners) to ensure performance objectives of the HLF are achieved.

It is apparent that there is some confusion as to the design intent and function of elements of the liner system proposed for the Casino HLF. Please refer to the description of the liner system and function as described on pages 24 & 25 in Section 5.2 of the VA101-325/8-9 Rev 0. Please also refer to Figure 5.6, Liner and Embankment Detail. Two liner systems are described.

The first liner system is used up-slope of the area where ponding may occur and where the gradient of the lined area expedites the flow into the lower region (potential pond area) as depicted in Figure 5.6. What is referred to as a single liner system is used for this area. The single liner system consist of a single 80 mil LLDPE geomembrane under which there is a 300 mm layer of low permeability soil liner. Acting together they present two horizontal barriers to vertical flow. The 1 m thick over-liner is comprised of crush ore or natural soil with comparatively high permeability with two primary functions a) to conduct leachate flow to the leachate collection system described in Section 5.3, b) to provide physical protection of the 80 mil geomembrane from damage during ore placement.

The second liner system, referred to a double liner, is used in that portion of the leach pad where hydraulic loading from ponded leachate can occur. This liner system consists of an 80 mil geomembrane liner on top of a 300 mm low permeability soil liner over a second (60 mil in this instance) geomembrane liner. Together they present three horizontal barriers to vertical flow. The double liner is used in this area of the leach pad because this area is subject to a hydraulic head form ponded solution.

The geomembrane liners provided are high quality and of a thickness appropriate for the service and consistent with good design practice. In particular, the use of a 300 mm low permeability soil liner between the low-density polyethylene geomembrane and geotextile layer is typical of a valley-fill heap leach. In CMC's previous response, the Brewery Creek heap leach facility was brought forward as an example of a facility which had a 300 mm soil liner. Additionally the Eagle Gold Project also specifies a 300 mm soil liner, which is of a similar scale to the Casino project heap leach.

There are no intermediate liners included the design. Test work completed to-date and engineering evaluation of the expected material properties of the crushed ores does not indicate a need for the use of intermediate liners. As is the case for all heap leach operations, performance of the system will be monitored during operations to detect any loss of conductivity or other concerns. If such was to occur, design solutions or procedural changes will be implemented. The change control procedure outlined in R2-02 would be used to effect a design change including seeking the necessary regulatory approval to implement the change.

B.4.7.2 Leak Detection and Recovery

B.4.7.2.1 R2-19

R2-19. Clarification on how one portion of the pad versus another portion will be isolated if a leak is detected. In addition, please provide a full detail design diagram of the components used in the heap leach facility including placement of the LDRS components and how they interact.

The HLF is comprised of 16 independent cells and solution emitters are configured in a manifold in such manner that solution flow can be turned off for any specified cell if a leak is suspected within that cell. As the HLF has 16 independently monitored "cells" there will also be a correspondent 16 independently controlled barren solution manifolds.

In the event that a leak within the independent cell cannot be repaired CMC operations will abandon the effected cell, following measures outlined in closure (Section 4.5.2.2), CMC will rinse down the effected cell, decommission barren solution plumbing and delivery for the cell in such manner that contamination from other cells will not be possible. This decommissioned cell will still have in operation its LDRS components, and monitoring of the cell would continue.

The Leak Detection and Recovery System is described in the response to R2-20 below.

B.4.7.2.2 R2-20

R2-20. Details on the maintenance and repair of LDRS sumps.

The Leak Detection and Recovery System (LDRS) is designed to capture and convey any solution which leaks through the overlying geomembrane and low permeability soil layers. As presented in the detail in Appendix A.4C Feasibility Design of the Heap Leach Facility, there are two components to the LDRS, the LDRS under the double lined area and the LDRS under the single lined area.

The LDRS under the double lined area consists of a 0.3 metre thick sand layer which is embedded with 100 mm diameter perforated CPT collection pipes. A non-woven needle punched geotextile overlies the LDRS sand layer to prevent particles from the above low permeability soil layer from entering the LDRS, clogging the sand and impeding drainage flow.

The LDRS under the single lined area consists of a network of drainage 'trenches' which contain 100 mm diameter perforated CPT collection pipes surrounded by drainage sand. The trenches are aligned underneath the 'Collection Header' and 'Main Collection Header' pipes which are part of the Leachate Collection system embedded in the above overliner layer. These drainage trenches 'feed' into the LDRS layer underlying the double lined area in the lower heap leach portion.

Any leakage recovered by the LDRS will be conveyed into the LDRS sump at the toe of the confining embankment. A level-switch controlled submersible sump pump will transfer the recovered solution up the embankment slope via a pipe installed within the LDRS sand layer and connect into the main solution recovery line for processing. Monitoring of the leakage recovery will be undertaken through continuous monitoring of the pump hour records.

In order to facilitate advanced leak detection source identification, the entire heap leach pad leachate collection system is sub-divided into 16 independently monitored areas or "cells" separated by small cell division berms. Each of these cells has 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 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 are continuously monitored and measured prior to discharging into a sump. A float switch within the sump triggers a submersible pump which pumps the accumulated solution via a pipeline (located between the two liners on the confining embankment) back onto the heap pad.

LDRS sumps will be inspected for integrity on a regular basis. Maintenance personnel will visually check the condition of the sumps and will repair or replace the sump on an as-needed basis. Materials for repair of LDRS pumps will be inventoried by CMC maintenance. Any repairs or service will be recorded by CMC and monitored for performance.

Common monitoring for LDRS sumps includes:

- Vibrating wire piezometers installed in the sump to monitor fluid levels;
- Monitoring and return of any collected solution using submersible pumps covered with carbon steel pipes slotted to avoid migration of the LDRS drain aggregate into the pipes; and
- Visual inspections for flow and pumping as required.

B.4.7.3 Leachate Solution and Water Flows

B.4.7.3.1 R2-21

R2-21. Details on the pipelines, pumps, and related infrastructure connecting the components of the HLF including SART, cyanide, and gold extraction facilities. Include details on pipeline alignments and leak detection measures.

Pregnant Leachate solution (PLS) is transferred from sumps, located within the lined heap leach pad, via submersible pumps to the PLS distribution tank, located within the enclosed process facility, through an insulated and heat traced HDPE pipeline. Reclaimed solution from the lined events pond is transferred to the PLS distribution tank or to the Barren Leachate Solution (BLS) distribution tank as circumstances require via an insulated and heat traced HDPE pipeline. Note the events pond pump is not normally operating and is used infrequently in the event of solutions accumulating in the pond or to remove rainfall or snow melt. A submersible pump installed in a lined sump returns any leakage captured from the events pond by the leak detection system back to the events pond.

The BLS distribution tank is a partially in-ground & covered concrete tank located adjacent to the process facility building. BLS is pumped from this tank by vertical turbine style pumps installed on the tank. The approximate distance from the heap leach pad to the processing facility housing the distribution tanks is about 600 m. BLS pipelines from the BLS tank and pump to the heap leach pad are insulated and heated traced.

All PLS & BLS pipelines connecting the heap leach pad to the process facilities are located within a HDPE lined containment ditch protected by a 2m high chain-link fence. Where the lines must pass under a road the pipelines are installed inside larger diameter pipes that provide physical protection to the operating pipelines as well as double containment. See containment sketch. Details of the pipeline alignments, profiles and road crossings will be provided to the Regulator as part of the Quartz Mining License and Yukon Water Use License applications during the detailed engineering phase.

The lined containment ditch and insulated pipeline will be visually monitored for condition and performance by CMC operations personnel.

Please refer to drawings 050-FS-003 & 004 in Appendix A.4M for more details.

B.4.7.3.2 R2-22

R2-22. Clarify whether CMC intends to seek certification under the International Cyanide Management Code and conduct independent third-party auditing of its conformance with the cyanide management standards of practice. If so, clarify whether results of independent audits would be made available for review by interested stakeholders.

On July 08, 2015 Western Copper and Gold Corporation (and consequently wholly owned subsidiary CMC) became a signatory of the International Cyanide Management Code (ICMC). As a signatory, CMC will comply with the Principles and Standards of Practice that make up the ICMC. Once operational, CMC will seek certification in compliance with the ICMC, which will require meeting performance goals and objectives as detailed by the International Cyanide Management Institute (ICMI, 2015).

As a signatory, CMC will undergo a third-party Verification Audit for certification under the ICMC to confirm that the operations, including cyanide production, transportation or handling suppliers, meet the ICMCs Principles and Standards of Practice for these activities (ICMI, 2015). Summary Audit Reports and any Corrective Action Plans will be posted for public review by the ICMI (ICMI, 2015).

B.4.7.4 Ore Stacking Rate

B.4.7.4.1 R2-23

R2-23. Indication when results are expected from the additional test work and how these results will be provided in a timely manner iteratively throughout the screening process.

At this time, no additional testing of heap leach material is underway other than ongoing geochemical characterization of leached material, from which results will be submitted when complete. Additional reports received since the submission of SIR-A are included as part of this submission in Appendices B.4E and B4F. CMC has no immediate plans to initiate any further metallurgical or material characterization work on the heap leach material.

B.4.8 TAILINGS MANAGEMENT FACILITY

B.4.8.1 Design Methodology and Feasibility

B.4.8.1.1 R2-24

R2-24. An updated TMF dam hazard classification that is informed by the IGRP-overseen risk assessment and related dam breach/inundation study. Where relevant, also include details regarding the impacts to dam design and mitigation strategies as a result of this additional work.

The TMF risk assessment is provided in the response to R2-4. The dam breach inundation study, and corresponding environmental and socio-economic evaluations of impacts are provided in Appendix B.4C. There has been no change to the dam hazard classification and no change to the proposed design at this time; however, at each phase of the design process, the risk assessment will be re-visited to determine if reviews or updates to the design have changed the risk ratings.

As described in the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D), during the closure phase, the ultimate TMF dam is designed to pass the probable maximum flood (PMF) through the spillway and is capable of withstanding a maximum design earthquake (MDE). It therefore meets the most stringent design criteria suggested by the CDA Dam Safety Guidelines (CDA, 2007), equivalent to an “extreme” dam classification. Changing the design flood criteria for operations would not fundamentally change the TMF design. Larger storm events can be accommodated in the design by modifying the dam staging and by raising the intermediate crest elevations.

Concerns regarding the TMF dam classification appear to be based upon the following comments from EcoMetrix (2014-0002-399-1) and SNC-Lavalin Inc (2014-0002-403-1), which CMC has addressed below:

1. In the review of R65, EcoMetrix states that “the reviewer notes that major impact to fish population (threatened or other species) and habitat is not of relatively small concern” (page 25). CMC concurs with this statement but notes that there are no threatened species in the area likely to be impacted by a breach. The value of downstream fish and fish habitat has been incorporated into classification of the dam as “High” (per CDA, 2007). An assessment of effects of the dam breach inundation on fish and aquatic resources is provided in Appendix B.4C.
2. EcoMetrix also states several times in the review document that the proposed dam is “unprecedented” and uses this argument to support their contention that the dam should therefore be classified as Extreme. There are in fact several existing dams in operations, undergoing reclamation, and planned that are very comparable to the Casino dam (see Table B.4.8-1). These examples include cyclone sand dams that have:
   - Placement of sand at higher throughputs;
   - Greater dam heights (exceeding 300 m);
   - Dams in regions of higher seismicity; and
   - Placement of sand at temperatures far below freezing (up to -40 ºC).

   Re-classifying the dam to extreme is not justified based on the argument that there is no precedent.

Table B.4.8-1 Summary of Existing Cyclone Sand Tailings Dams

	Casino	Cerro Verde	Quillayes	El Mauro	KSM SE Dam	Highland Valley L-L Dam
Status	Design	Operating	Closure	Operating	Design (Approved)	Operating
Starter dam height[1] (m)	105	95	85	85	105	45
Maximum height of cyclone sand[1] (m)	200	195	220	235	155	115
Total height of dam[1] (m)	285	305	300	310	280	180
Owner	CMC	SMCV	Antofagasta PLC.	Antofagasta PLC.	Seabridge Gold Inc.	Teck
Engineer	Knight Piésold	MWH	Geotecnica	Geotecnica	KCB	Bechtel / KCB
Reference		Obermeyer and Alexieva, 2011	Barrera, Valenzuela and Campana, 2011		Klohn Crippen Berger, 2012	Klohn Crippen Berger, 2012

1. Note that dam height is measured from the lowest point in the general foundations to the crest of the dam (ICOLD, 1932)

3. In their review of Section A.4.9 of the SIR-A, SNC-Lavalin states “For example, a dam classified as High would be designed for exceedance probabilities of 2/3 between 1/1000 and PMF (not 1/3 between 1/1000 and PMF which is recommended for dams meant to last for decades)” (page 19). To clarify, the TMF is designed for exceedance probabilities of 1/3 between 1/1000 and PMF only during the 22 year operating phase. Post-closure the design for the spillway is for the PMF.

4. EcoMetrix and SNC_Lavalin also make multiple mention of re-evaluation of design criteria, such as the OBE, MDE, PMP, PMF and IDF. The verification of these values will be part of the design updates conducted as part of standard engineering refinement (see Figure B.4.2-1). Further, CMC proposes to have the IERP review the design basis for the TMF including, but not limited to: data sources, data quality, underlying assumptions and methodologies used to determine key design values throughout the design process. This includes values for OBE, MDE, PMP, PMF, IDF, and others. Other reviews to be conducted by the IERP are outlined in the response to R2-1.

B.4.8.1.2 R2-25

R2-25. Additional comparison information about natural analogies within similar environments. Include estimates of the hydraulic gradient(s) for the TMF dam, throughout its lifecycle (i.e. in perpetuity), and include a discussion that reflects on the findings of the Bjelkevik (2005) report (i.e. compare the estimated hydraulic gradient of the TMF with the hydraulic gradient of natural analogies that have demonstrated long-term stability).

Exceeding the hydraulic gradients observed in nature does not necessarily mean that a structure will not be stable in the long term. Hydraulic gradients in natural analogues are not applicable standards to the design of large engineered structures. However, CMC has provided information regarding existing facilities. As described above in the response to R2–24, the existing Los Quillayes, El Mauro and Cerro Verde mines, as well as the regulatory approved KSM mine have tailings impoundment facilities that are directly comparable to the proposed Casino TMF in terms of overall height and depth of cyclone tailings sand used in the downstream shell to provide strength to the structure. These operations establish ample precedent for the Casino design approach.

The Gibraltar (Klohn Crippen Berger, 2014), Highland Valley (Klohn Crippen Berger, 2012), and Kemess (Lysay, Davidson, and Martin, 2007) mines are Canadian operations with tailings impoundments where cycloned tailings sands are being placed and compacted in cells similar to that proposed for Casino at temperatures well below freezing. Gibraltar and Highland Valley are located in a continental climate region and Highland Valley has placed and compacted sands to -10°C. Kemess is located in a sub-arctic region and the placement and compaction of coarse sands down to -40°C has been documented by Lysay, Davidson, and Martin (2007). KSM and Casino projects will both be constructed and operated in sub-arctic regions with temperature regimes comparable to that of Kemess.

The *Dam Guide: Expectations and Required Information* (YESAB, 2012) clearly sets out the information requirements for Assessment and Regulatory review purposes. Information provided to-date demonstrates that the Casino TMF design is consistent with good engineering practice, within the bounds of current industry experience and best practice. It is fully recognized that additional information will be provided as the TMF design progresses through engineering design (Figure B.4.2-1) and further details may be provided through the licensing process as stated in the Dam Guide.

B.4.8.1.3 R2-26

R2-26. Additional information regarding the factor of safety including:

a. The factor of safety under pseudo-static condition, since the minimum factor of safety for slope stability under seismic loading is 1.0 and not less than 1.0 (refer to Table 6-3 of Canadian Dam Safety Guideline, 2007).

b. Was the excess pore pressure during the construction period and before the embankment rise considered?

c. Confirmation that the stability analysis during different stages of construction and impounding meets the minimum factor of safety proposed by CDA such that: the minimum factor of safety of 1.3 "Before the reservoir feeling" and FOS of 1.5 at the "normal reservoir level".

Design details and code or regulation compliance issues, such as factors of safety, will be further addressed during the basic engineering phase and reflected in the final design basis (Figure B.4.2-1). All key aspects of the final design basis will be established at that time, reviewed by the IERP and the final design basis will be provided in the Quartz Mining Licence and Water Use licence applications. Current CDA Dam Safety Guidelines will form the basis for all design for the construction and operation of the TMF.

CMC will design, construct and operate the Casino facilities in compliance with current codes and regulations; verifiable through the regulatory review and licensing process. For purposes of Assessment, YESAB should presume that all proposed CMC facilities, including the TMF and HLF, will be designed, constructed and operated in full compliance with code requirements, license terms and conditions and that the appropriate regulator will fully discharge its obligations to protect the public interest.

In response to request R2-26:

a. The factor of safety under pseudo-static condition will exceed 1. The pseudo-static analysis applies a horizontal force (seismic coefficient) to the model to simulate earthquake loading. In embankment stability analyses the seismic coefficient is commonly taken equal to one-half the peak ground acceleration at bedrock level, as suggested by Hynes-Griffin and Franklin (1984). This conservative method implies limited deformations (smaller than 1 m) are acceptable during an earthquake. The peak ground acceleration of the 1 in 10,000 year earthquake at Casino is 0.22g, which leads to a seismic coefficient of 0.11.

   The yield acceleration is the threshold acceleration acting upon a sliding mass above which permanent deformations occur. The yield acceleration for the main embankment is approximately 0.3 g, as described in Appendix C of the TMF design report (Appendix A.4D). Since the seismic coefficient for the 1 in 10,000 year earthquake is smaller than the yield acceleration, stability analyses result in a factor of safety exceeding 1.

   More detailed stability analyses will be conducted during detailed design.

b. Excess pore pressure was not considered during feasibility design, as the components that dominate the stability of the TMF Main Embankment are the shell zone and the foundation strength. The shell zone will be constructed from free draining cyclone sand material that will not result in excess pore pressures during construction. Additional drainage provisions will be included as required to satisfy the free draining nature of the embankment shell. The embankment foundation is not sensitive to excess pore pressures due to the removal of overburden materials.

   The potential for development of excess pore pressures will be further evaluated in detailed design.

c. The stability analysis during different stages of construction and impounding meets or exceeds a factor of safety of 1.5. Additional stability analyses to demonstrate the TMF meets or exceeds a factor of safety of 1.5 during operations will be provided during basic and detailed engineering.

B.4.8.1.4 R2-27

R2-27. A conceptual operations, maintenance and surveillance (OM&S) plan to demonstrate how the TMF will be managed in both the operational and closure periods. At a minimum, this plan will meet the current Mining Association of Canada's (MAC) guidance material for tailings management facilities. The OM&S plan must:
a. Comprehensively address how custodial transfer will occur for all liability associated with this project. This aspect of the plan will include criteria for custodial transfer (e.g. to whom; timing; security funding; other obligations) and consider scenarios such as abandonment and end-of-mine life transfer. Provide examples of successful custodial transfer of comparable projects.
b. Include supporting information that addresses monitoring and remediation activities that may be required during closure including the extent of remediation required in event of a maximum design earthquake. The plan must also consider response to multiple maximum design earthquakes that may occur considering the TMF is proposed to remain in perpetuity.
c. Evaluate the potential effects of climate change on the Project through all phases, in perpetuity.

Preliminary plans that will guide the design, construction, operation, and eventual closure and post-closure activities of the Casino TMF have been prepared and are provided in the following Appendices:

- Guide to the Management of the Casino Tailings Facility (Appendix B.4A);
- Casino Project, Operation, Maintenance and Surveillance Manual (OM&S) (Appendix B.4D).

Western Copper and Gold (and consequently wholly owned subsidiary CMC) is a member of the Mining Association of Canada (MAC) and these two plans are being developed based upon MAC guidelines. The CMC plans will be consistent with the intent and requirements of the MAC guidelines and will be implemented in the detailed engineering phase. CMC wishes to acknowledge and thank MAC for their support and assistance in the preparation of these important documents.

The preliminary plans clearly indicate the comprehensive scope and content of the plans. The plans provide a management and training guide as well as defining a comprehensive monitoring and reporting plan to ensure a safe and environmentally responsible development and operation of the Casino TMF. Further development of these plans will be conducted during the detailed engineering phase when the necessary supporting design documents become available. As per the Dam Guide (YESAB, 2012) the completed guides will be submitted in support of the Quartz Mining Licence and Yukon Water Use Licence applications.

In response to request R2-27:

a. Custodial transfer of the TMF, and indeed the entire Casino mine site, will be discussed during the Quartz Mining License application process. The criteria to be met to affect a custodial transfer as well as timing, security requirements and other considerations for such a transfer will be agreed upon through these discussions.

b. As stated previously, analysis of the TMF structure by the EOR indicates that minimal deformation of the dam is likely to occur under the design earthquake conditions. As an example, the Los Quiallyes dam in Chile (which is comparable to the Casino dam) has experienced large earthquakes with minimal deformation (Barrera, Valenzuela and Campana, 2011).

   As a practical precautionary approach, it would be prudent to set levels for seismic events and for flood events that would trigger the requirement for a site inspection to determine if any remedial work is required. The trigger levels will be included in the final OM&S manual and in the final dam design criteria established in the design stage.

c. As more fully discussed in the response to R2-2, the effects of climate change will be addressed in the periodic (5 year) assessments of the TMF facility during operations and in post-closure.

B.4.8.1.5 R2-28

R2-28. Detail on the care and maintenance costs in perpetuity. This estimate will be supported by the OM&S plan, which will document the ongoing care and maintenance requirements during the closure and post-closure period. This estimate must consider costs for all liability associated with the mine site infrastructure including accidents and malfunctions

As described in the Guide to the Management of the Casino Tailings Management Facility (Appendix B.4A), the TMF will be designed for closure, including protection of public health and safety, mitigation of negative environmental impacts and acceptable post-closure use within a feasible technical and economic framework. Decommissioning and closure of the TMF will be conducted in accordance with the criteria and procedures outlined in Section 9 of Appendix B.4A, and includes:

- Being in conformance with design;
- Providing continued protection of the environment and public health and safety;
- Mitigating negative environmental impacts;

- Meeting regulatory requirements, land use objectives, financial assurance commitments, company policies and standards, sound engineering and environmental practices, and commitments;
- Providing for long-term care and maintenance; and
- Ensuring long-term stability of tailings, dams, related facilities and structures.

The Operation, Maintenance and Surveillance (OM&S) Manual (preliminary version provided in Appendix B.4A) will be updated in advance of closure to:

- Identify and assess new environmental concerns that have become apparent since the plan was approved;
- Identify and assess potential environmental impacts that may be caused by the implementation of closure; and
- Assess alternative technology for closure.

A review of the progressive reclamation and reclamation and closure research conducted during operations will be conducted to update the closure plan with the most up-to-date information and techniques.

Risk management tools prepared for the closure period will include:

- Risk management plans to minimize the likelihood of adverse safety or environmental impacts, which will evaluate the risks associated with possible triggers and failure modes, identify possible impacts on the environment, public health and safety and determine the parameters that can have an impact on these triggers and failure modes;
- Contingency plans; and
- Emergency preparedness and response plans, which will identify possible accident or emergency situations, detail responses to emergency situations and prevent and mitigate on- and off-site environmental and safety impacts associated with emergency situations, as well as establishing procedures for periodic review, testing and distribution of the emergency preparedness and response plans within the organization and to potentially affected external parties.

A checking and corrective action procedure will be implemented, which will include periodic inspections to ensure compliance with regulatory requirements and conformance with design objectives, plans and commitments. The periodic review and subsequent audit and assessment of the TMF will be conducted to:

- Verify design assumptions against actual conditions and performance;
- Revisit or update the decommissioning and closing design and/or plans;
- Re-evaluate downstream risks;
- Update the risk assessment; and
- Evaluate the need for changes or updates to risk management plans, contingency plans and emergency preparedness and response plans.

And corrective action will be undertaken and documented as required.

Finally, an annual tailings management review for continual improvement will be conducted, to:

- Evaluate the performance of the tailings management system, considering inspection, audit and assessment reports, changing circumstances, monitoring results, spills and other incidents, recommendations and the commitment to continual improvement;
- Evaluate the continuing adequacy of, and need for changes to, policies and objectives and performance of the tailings management system;
- Address the need for changes to commitments to communities of interest; and
- Report the observations and conclusions of this annual review of tailings management to the accountable executive officer.

Preliminary post-closure monitoring and maintenance costs were provided in the response to R144 and included feasibility level values for monitoring and inspections and annual passive treatment of pit water. For a 200 year period of post-closure activity, at a 3.5% discount rate, the present value for post-closure monitoring and maintenance was ~$20M.

The executive committee has requested that the cost estimate for on-going care and maintenance during the post-closure period be extended to include accidents and malfunctions. As requested, the cost estimate has been updated to include event driven inspections and repairs of the tailings management and heap leach facilities. While these costs will only arise should a major environmental event occur (i.e., earthquake, extreme precipitation, forest fire), they have been incorporated into the annual cost to express the worst case scenario for post-closure monitoring. This update results in a present value of $32M over 200 years, equivalent to approximately $1M per year. These updated costs have been reflected in the overall security estimate provided in R2-85 as well.

For costs into perpetuity, after 200 years, the incremental cost at a discounted rate become negligible. For example, at 200 years, the cost is $31,963,313, after 400 years, the cost increases $32,854 to $31,996,166 and after 1000 years the cost increases only a further $34 to $31,996,200.

Table B.4.8-2 Post-Closure Care and Maintenance Cost Estimate

	Units	Quantity	Unit Cost	Cost
Water Quality Monitoring	bi-annually	2	$50,000	$100,000
Water quality sampling in TMF, HLF, Open Pit, Casino Creek and Dip Creek				
Site Water Management				
Compile data on flows, runoff, water quality for reporting and ongoing management of water control system	annually	1	$50,000	$50,000
Tailings Management Facility				
Dam and spillway geotechnical inspections: Annual Inspection	annually	1	$50,000	$50,000
External inspection and audit	every 3 years	0.3	$20,000	$6,667
Dam and spillway geotechnical inspections: Dam Safety Review	every 5 years	0.2	$100,000	$20,000
Event driven inspection	As required	n/a	$10,000	$10,000
Event driven repairs (e.g., repair rip rap in spillway, repair erosion on face of dam after major rain event, rair dam crest to correct settlement from an earthquake, repair berms in wetland due to settlement or high flow damage)	As required	n/a	$200,000	$200,000
Wetland maintenance and monitoring	annually	1	$50,000	$50,000
Open Pit				
Operation of water control system (remote control of valves)	annually	1	$2,000	$2,000
Inspection of energy system (solar cells, batteries, etc)	annually	1	$2,000	$2,000
Replacement of energy system components	every 10 years	0.1	$2,000	$200
Inspection of piping/valves, repair/replacement as needed	annually	1	$2,000	$2,000
Passive treatment of pit water	As required	1	$500,000	$500,000
Heap Leach Facility				
Inspect/repair erosion on face of dam after major rain event	As required	n/a	$50,000	$50,000
Provide nutrients for bio-reactor (not expected for long-term)	annually	1	$2,000	$2,000
Other Requirements				
Transportation	each	1	$40,000	$40,000
Power and heat (5 months per year)	monthly	5	$5,000	$25,000
General administrative expenses (5 months per year)	monthly	5	$2,000	$10,000
Annual post-closure costs				$ 1,119,867
Discount rate for calculation of net present value of post-closure cost				3.5%
Years of post-closure activity				200
Present Value of payment stream				**$ 31,963,303**

B.4.8.1.6 R2-29

R2-29. Demonstrate how the TMF dam will be able to achieve a steady state condition for passive care during the post-closure of this project (i.e. in perpetuity).

Design of the TMF dam was based on steady state conditions for the closure of the facility. In other words, the TMF was “designed for closure” and construction and operational components are designed to meet the ultimate closure objectives. For example, the minimum acceptable factor of safety for the tailings embankment under static conditions is 1.5 for long-term (steady-state and post-closure), which was incorporated into the embankment design. During closure, TMF components are designed to the highest possible standard (e.g., flood routing for the PMF) with redundant design components such as construction of the spillway in bedrock through the dam abutment. Other examples of TMF components designed to the highest possible standard include:

- Closure freeboard will meet CDA Dam Safety Guidelines at closure, and pond storage will increase in time due to settlement of tailings.
- The crest of the dam will be armored to protect against erosion, and to provide frost protection for the top of the core of the dam.
- The downstream face of dam will be vegetated and contoured to control erosion.
- Runoff will be directed into rip rap lined channels on the dam, and abutment slopes where feasible.
- No active care will be required to maintain any part of the TMF.

Passive care of the TMF during closure will consist of:

- Inspections (see the response to R2-28);
- Reading and maintenance of instrumentation;
- Periodically, as required:
  - Repair of any erosion due to extreme precipitation;
  - Repair of rip rap in non-bedrock segment of spillway;
  - Periodic removal of large trees; and
  - Restore vegetation after forest fire, and control erosion.

B.4.8.2 TMF Dam Failure

B.4.8.2.1 R2-30

R2-30. A dam breach analysis with water/tailings inundation modeling. Include information related to the IGRPs oversight and review of this work. The analysis must be consistent with the Canadian Dam Association's (2007) dam safety guidelines and include:

a. probable maximum flood inundation map showing the maximum extent of flooding relating to a sudden full storage embankment breach extending to when expected flooding is within the natural water channels;
b. an assessment of environmental and human impacts associated with a release of tailings;
c. an assessment of potential impacts to First Nation Settlement Lands;
d. an assessment of impacts to downstream infrastructure;
e. mitigation measures in the event of a tailings breach; and,
f. for each proposed breach scenario, a cross section of the critical TMF embankment, proposed loading factors, and each scenario's factor of safety.

The Dam Breach Inundation Study is provided in Appendix B.4C, and is accompanied by environmental and socio-economic impact assessments. As stated in the response to R2-24 the preliminary design basis including the key design values of PMP, PMF, and IDF will be reviewed in the process of establishing the final design basis for the Project. This review will be informed by the results of the inundation study and the final design basis will also reflect the critical review by the IERP. The resulting final design basis will be fully consistent with the CDA Dam Safety Guidelines and will be the basis of the project application for regulatory review and license application.

B.4.8.3 Quantity and Quality of Borrow Source Materials

B.4.8.3.1 R2-31

R2-31. Detailed information on the sources and quantities for all borrow materials that are required for all mine site infrastructure, the airstrip and airstrip access road, and the Freegold road upgrade and extension, throughout all phases. This information will be based on site investigations and will include: confirmation of the depth and areal extent of the proposed aggregate borrow sources; and, characterization of the physical and chemical variability of materials (i.e. quality and suitability for intended use) required for mine site infrastructure.

Mine Site and Yukon River Pipeline Access Road

The required quantities for borrow materials at the mine site are summarized in Table B.4.8-3 and the locations for borrow are provided in Figure B.4.8-1, Figure B.4.8-2 and Figure B.4.8-3. Further details of quantities are provided in Appendix A.4Q Mine Site Borrow Materials Assessment Report.

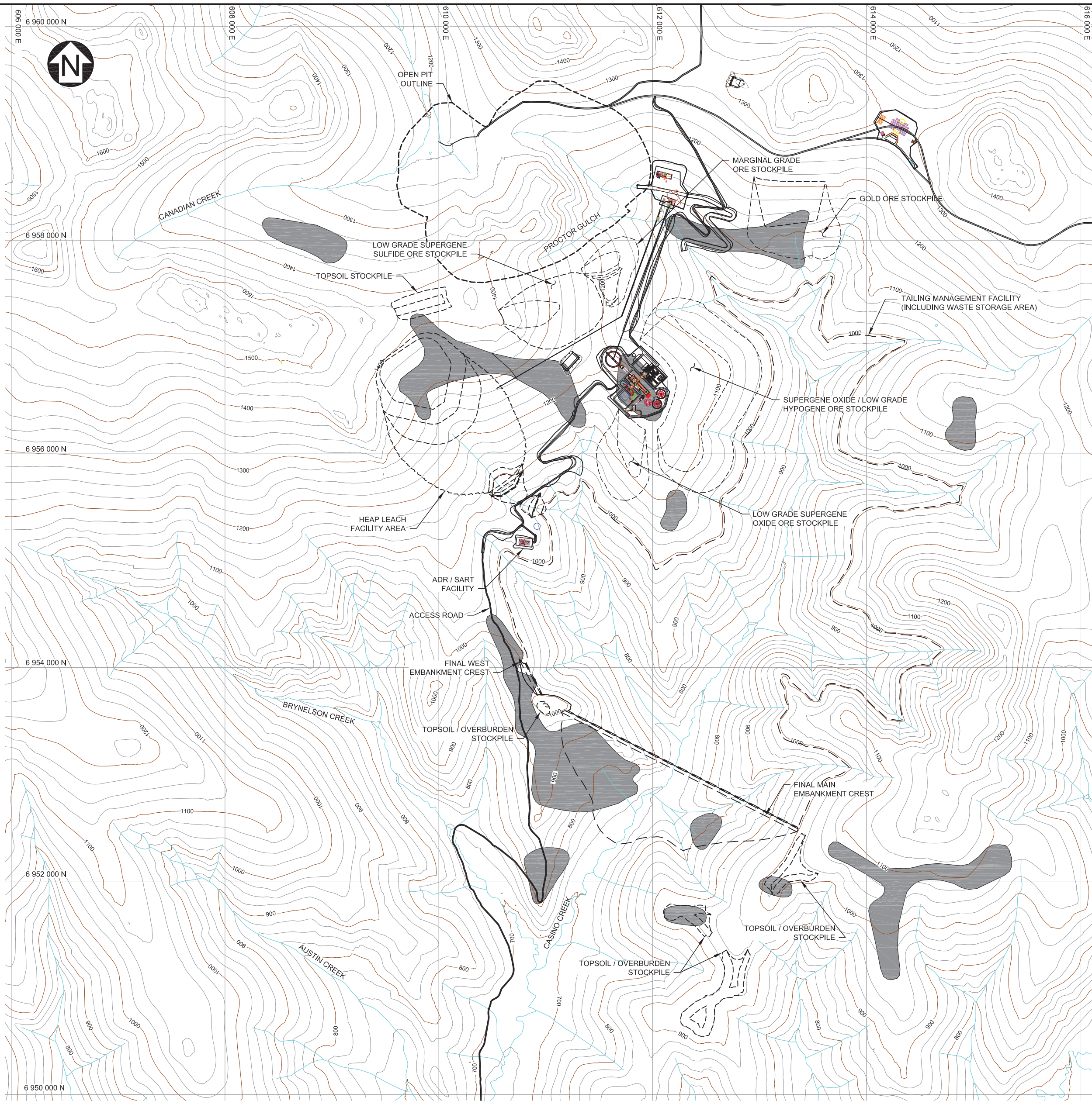
A geochemical assessment of these materials is provided in Appendix A.7K, and indicate that the borrow material from the majority of locations has a very low ML/ARD potential as the majority of samples have total sulphur values < 0.1% and little or no sulphide-sulphur mineralization. However, there is very little carbonate content and portions of the borrow material from the areas underlying the low grade stockpiles, the heap leach facility and the main power plant, may initially have mildly acidic paste pH values (paste pH < 5).

Organic acidity rather than sulphide acidity appears to be responsible for the depressed pH from these samples as demonstrated by the organic carbon content. These materials will not be a source of ARD.

ML/ARD management for the mine site is further described in the ML/ARD Management and Monitoring Plan (Appendix A.22H).

Table B.4.8-3 Mine Site Borrow Material Requirements

	Line Item	Required Volume (m^3)	Available Quantity (m3)
Low Permeability Material	Tailings Management Facility – Starter Dam	3,400,000	3,700,000
	Tailings Management Facility – Final Dam (excluding Starter Dam)	6,800,000	
	Heap Leach Facility	530,000	
	Miscellaneous (allowance for small ponds and other structures)	500,000	
Filter and Transition Zone Material	Tailings Management Facility – Starter Dam	250,000	6,500,000
	Tailings Management Facility – Final Dam (excluding Starter Dam)	1,350,000	
	Heap Leach Facility	1,840,000	
	Miscellaneous (allowance for small ponds and other structures)	200,000	
General Fill Material	Tailings Management Facility – Starter Dam	7,300,000	32,370,000
	Tailings Management Facility – Final Dam (excluding Starter Dam)	1,000,000	
	Heap Leach Facility	2,290,000	
	Miscellaneous (allowance for small ponds and other structures)	500,000	
Aggregate	Fine Concrete Aggregate	20,000	70,000
	Bedding Sand	45,000	
	Coarse Concrete Aggregate	40,000	300,000
	Structural Fill	220,000	



LEGEND:

LOW PERMEABILITY MATERIAL BORROW AREA

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 25 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.
4. OPEN PIT IS SHOWN AT ITS FINAL OUTLINE AS PROVIDED BY CASINO MINING CORPORATION (NOVEMBER 2012).
5. PLANT SITE AND CRUSHER LAYOUT PROVIDED BY M3 ENGINEERING AND TECHNOLOGY CORPORATION (OCTOBER 4, 2012).
6. HEAP LEACH PAD IS SHOWN AT ITS MAXIMUM SIZE.
7. ORE AND TOPSOIL STOCKPILES ARE SHOWN AT THEIR MAXIMUM SIZE DURING OPERATIONS.

SCALE A: 400 200 0 400 800 1200 1600 2000 m

CASINO MINING CORPORATION

CASINO PROJECT

LOW PERMEABILITY MATERIAL BORROW AREAS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/16	3

Figure B.4.8-1 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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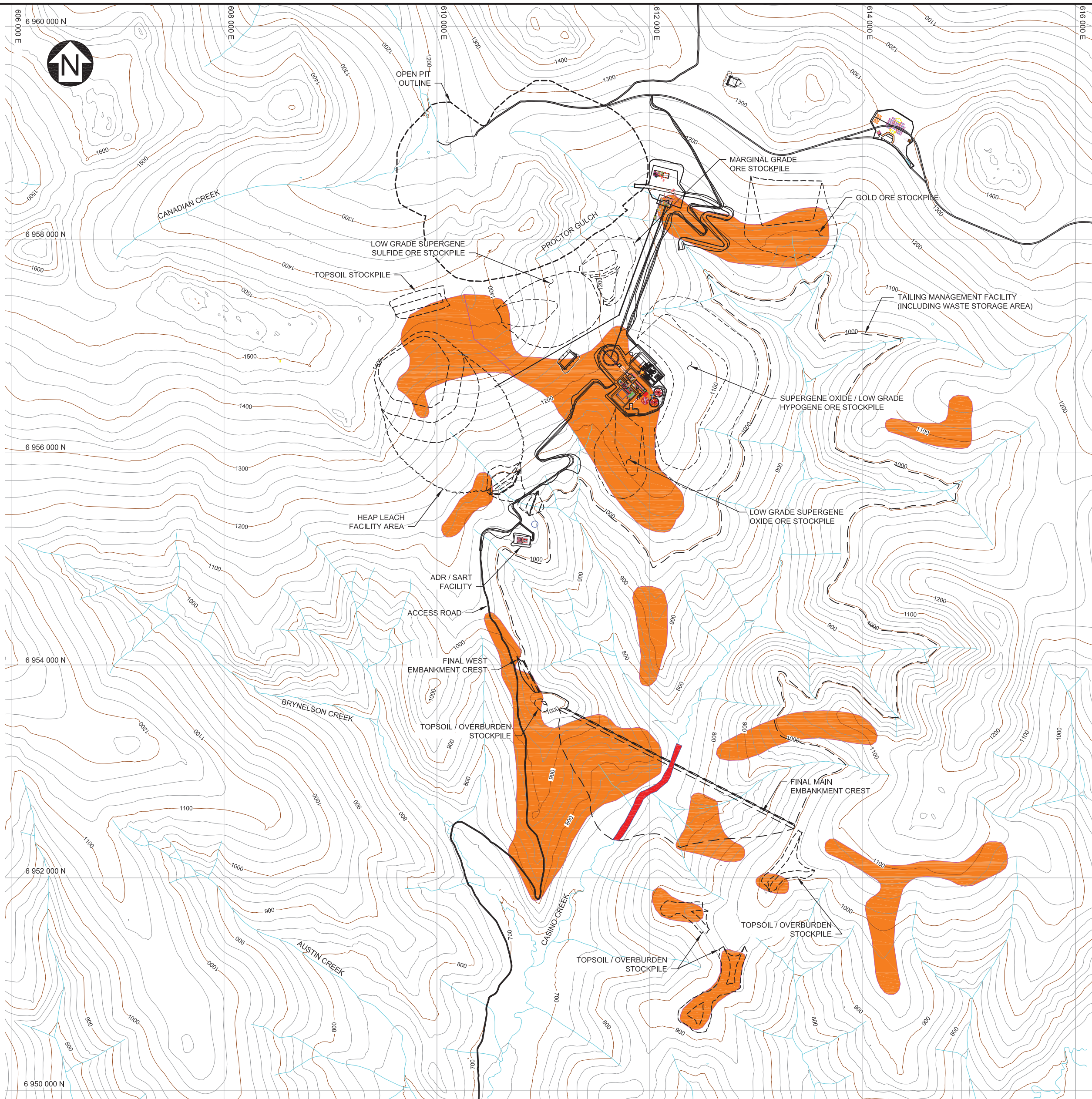

LEGEND:

FILTER AND TRANSITION ZONE MATERIAL AND GENERAL FILL BORROW AREA - RESIDUAL SOIL AND BEDROCK

FILTER AND TRANSITION ZONE MATERIAL AND GENERAL FILL BORROW AREA - ALLUVIAL CHANNEL DEPOSIT

NOTES:

1. COORDINATE GRID IS UTM (WGS84/NAD83) ZONE 7 (m).
2. CONTOUR INTERVAL IS 25 METRES.
3. DIMENSIONS ARE IN METRES UNLESS NOTED.
4. OPEN PIT IS SHOWN AT ITS FINAL OUTLINE AS PROVIDED BY CASINO MINING CORPORATION (NOVEMBER 2012).
5. PLANT SITE AND CRUSHER LAYOUT PROVIDED BY M3 ENGINEERING AND TECHNOLOGY CORPORATION (OCTOBER 4, 2012).
6. HEAP LEACH PAD IS SHOWN AT ITS MAXIMUM SIZE.
7. ORE AND TOPSOIL STOCKPILES ARE SHOWN AT THEIR MAXIMUM SIZE DURING OPERATIONS.

SCALE A 400 200 0 400 800 1200 1600 2000 m

CASINO MINING CORPORATION

CASINO PROJECT

FILTER AND TRANSITION ZONE MATERIAL AND GENERAL FILL BORROW AREAS

Knight Piésold CONSULTING

P/A NO. VA101-325/16 | REF NO. 3

Figure B.4.8-2 | REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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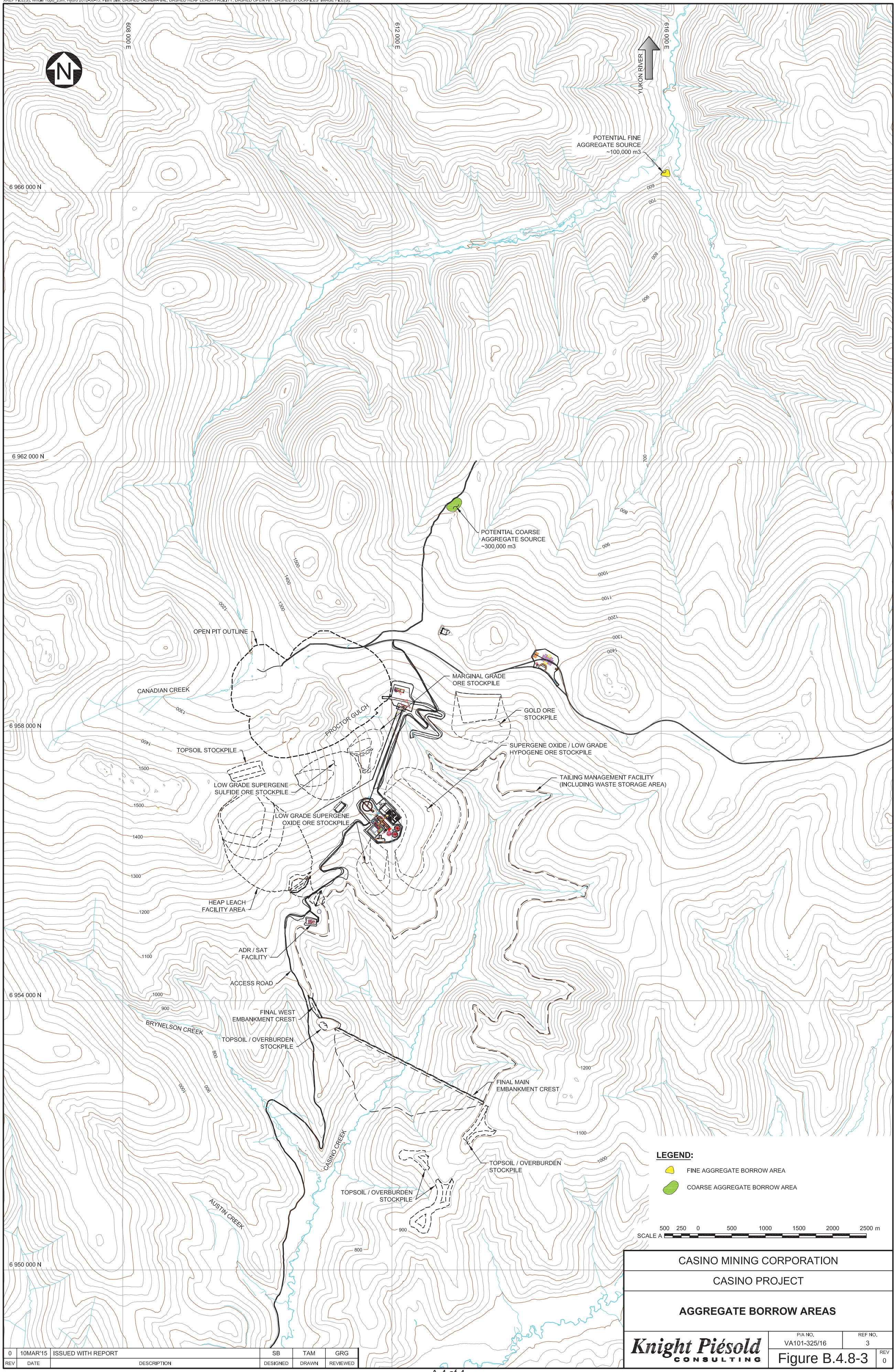
N
608 000 E
612 000 E
616 000 E
YUKON RIVER
POTENTIAL FINE AGGREGATE SOURCE ~100,000 m3
6 966 000 N
6 962 000 N
6 958 000 N
6 954 000 N
6 950 000 N
POTENTIAL COARSE AGGREGATE SOURCE ~300,000 m3
OPEN PIT OUTLINE
CANADIAN CREEK
PROCTOR GULCH
MARGINAL GRADE ORE STOCKPILE
GOLD ORE STOCKPILE
SUPERGENE OXIDE / LOW GRADE HYPOGENE ORE STOCKPILE
TAILING MANAGEMENT FACILITY (INCLUDING WASTE STORAGE AREA)
TOPSOIL STOCKPILE
LOW GRADE SUPERGENE SULFIDE ORE STOCKPILE
LOW GRADE SUPERGENE OXIDE ORE STOCKPILE
HEAP LEACH FACILITY AREA
ADR / SAT FACILITY
ACCESS ROAD
FINAL WEST EMBANKMENT CREST
BRYNELSON CREEK
TOPSOIL / OVERBURDEN STOCKPILE
FINAL MAIN EMBANKMENT CREST
CASINO CREEK
TOPSOIL / OVERBURDEN STOCKPILE
TOPSOIL / OVERBURDEN STOCKPILE
AUSTIN CREEK
LEGEND:
FINE AGGREGATE BORROW AREA
COARSE AGGREGATE BORROW AREA
SCALE A 500 250 0 500 1000 1500 2000 2500 m
CASINO MINING CORPORATION
CASINO PROJECT
AGGREGATE BORROW AREAS
Knight Piésold CONSULTING
P/A NO. VA101-325/16
REF NO. 3
Figure B.4.8-3
REV 0
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Access Road

Most of the fill required for road construction will be developed from borrow pits located along the road alignment and then hauled to where it is needed. The section of road from the Selwyn River to the mine is located in soil that is mainly suitable for road embankment construction and can be utilized for fill. Further soil testing may reveal other locations with borrow suitable for road construction which will result in shorter haul distances, reduced road construction costs, and reduced disturbance to areas outside of the road right of way.

Sources of bedrock and granular material are proposed along the Freegold Road extension at an average spacing of 3.8 km. The estimated volume of material available from these sources far exceeds the anticipated 1,300,000 m3 of borrow required for road construction. As a result, only a portion of some borrow pit areas will be required. On the Freegold Road upgrades, preliminary geotechnical investigations have been carried out, and material types identified. However further geotechnical field testing is required to determine the suitability and volume of material available.

The chosen borrow sites are located as close to the road alignment and fill areas as possible to reduce haul distances and impact on the environment. Any areas in close proximity to flood plains, watercourses, unstable terrain, and environmentally sensitive features have been avoided. Other areas have been avoided because they are known or suspected to be ice-rich or acid generating.

Proposed borrow sites are shown in Appendix C of the Freegold Road Report (Appendix 4B).

Geochemical analysis of these sites is provided in Appendix A.7J Casino Road: Preliminary Risk Assessment of Metal Leaching and Acid Rock Drainage. The risk assessment indicates that the majority of the road is low risk for ML / ARD; however, there are 16 sections of road over 38.25 km of the total 133 km long alignment that are deemed to have moderate-low risk or greater. These sections are generally in the final 50 km of the road alignment: from kilometer station 86+500 to 98+300 and 108+030 to 124+430. There are three exceptions to this, kilometer station 1+290 to 5+960, 13+420 to 18+400 and 78+420 to 79+010 also have an overall risk that is considered moderate-low or greater.

These sections were found to have a high enough ML / ARD risk potential that further work in these areas is recommended. This should include further sampling along these 16 sections of road, ideally by drilling in areas where bedrock will be disturbed. As fish sampling has not taken place in the westernmost sections, over a distance of roughly 50 km of the proposed road alignment, further characterization of the streams along this section of the road alignment will allow for an improved understanding of the risk to aquatic ecosystems in this area, and may reduce the potential risk of some of the road sections in this area. Additional rock and surficial material sampling will also be necessary once quarry locations are finalized in order to ensure that the material will not cause ML / ARD.

ML/ARD management for the access road is further described in the ML/ARD Management and Monitoring Plan (Appendix A.22H).

Airstrip and Airstrip Access Road

Three borrow sources are proposed near the Dip Creek Valley, and will be the source of fill material required for the airstrip and access road construction (Appendix 4B).

Four samples were collected from the airstrip borrow area, the samples indicate that the borrow material in these areas are non-acid generating as the paste pH values are high (> PpH 7) and the total sulphur values are low (0.01% or lower) (Appendix A.7K).

Additional exploration for suitable borrow material is required and will be done in the subsequent engineering and construction phases of the project. CMC does not propose to initiate further field investigation of borrow sources until the project is authorized to proceed.

CMC notes that EcoMetrix stated that CMCs response to R43 (detailed information on the sources and quantities of suitable borrow materials) “is considered to be adequate” (2014-0002-399-1).

The availability of suitable borrow material is really a commercial risk for the Project. In the event that more material be required than is available, CMC would need to bring in material from elsewhere, increasing costs but not disturbance.

B.4.8.4 Earthquakes

B.4.8.4.1 R2-32

R2-32. An explanation on the likelihood and implications of saturation of the TMF dam's foundation, drains, and lower portions.

TMF underdrains are installed to prevent saturation of the cyclone sand shell. The underdrain system is installed beneath the Main Embankment, and incorporates a 0.3 m thick gravel drainage blanket with perforated collection pipes to convey collected water away from under the embankment. The layout of the collection pipes has been designed with pipes installed at four phases during development, Year 1, Year 4, Year 10 and Year 22. The collection pipes will be spaced approximately every 230 metres as the footprint of the embankment increases with staged expansions. As the embankment height increases, it is expected that the perforated pipes will deform and likely collapse due to the embankment loading, however the majority of infiltration drainage from the cyclone sand operation is anticipated to be complete at this stage and any remaining drainage will still infiltrate through the gravel drainage blanket.

The drain design may be modified as construction of the foundations progresses if field observations and measurements of native ground inflows indicates inflows greater than assumed in the original design. Such design changes will be accomplished following the change management process described in the response to R2-2. For example, it may be necessary to use rock fill in the lower portions of the dam shell as an added contingency and to ensure saturations conditions do not occur.

The foundation and drain designs will be developed during the detail engineering design phase. The analysis of drains design requirements will take into account inflows from the native ground and excess water from the cyclone sand deposition.

B.4.8.4.2 R2-33

R2-33. The references used to guide the factor of 1.5 and a discussion about the applicability of the reviewed cases to this project.

Stability analyses were carried out to investigate the stability of the Main Embankment under both static and seismic loading conditions (Appendix C in the Report on Feasibility Design of the Tailings Management Facility – Appendix A.4D). These comprised checking the stability of the embankment arrangement for each of the following cases:

- Static conditions during operations and post-closure

- Earthquake loading from the Operating Basis Earthquake (OBE) and the Maximum Design Earthquake (MDE); and
- Post-earthquake conditions using residual (post-liquefaction) tailings strengths.

The stability analyses were based on a typical cross-section through the Main Embankment for the final TMF with a supernatant pond elevation of 995 m and an embankment crest elevation of 998 m.

The stability analyses were carried out using the limit equilibrium computer program SLOPE/W. In this program a systematic search is performed to obtain the minimum factor of safety from a number of potential slip surfaces. Factors of safety have been computed using the Morgenstern-Price method.

In accordance with international recommendations (ICOLD, 1995) and standard industry practice, the minimum acceptable factor of safety for the tailings embankment under static conditions is 1.3 for short-term operating conditions and 1.5 for long-term (post-closure) of the TMF. A factor of safety of less than 1.0 is acceptable under earthquake loading conditions provided that calculated embankment deformations resulting from seismic loading are not significant and that the post earthquake stability of the embankment maintains a factor of safety greater than 1.2, implying there is no flow slide potential. For the post earthquake case the tailings deposit was conservatively assumed to be fully liquefied, and an appropriate low residual strength was applied.

The results of the stability analyses satisfy the minimum requirements for factors of safety and indicate that the proposed design is adequate to maintain both short term (operational) and long term (post-closure) stability. The seismic analyses indicate that any embankment deformations during earthquake loading from the OBE or MDE would be minor, and would not have any significant impact on embankment freeboard or result in any loss of embankment integrity. The results also indicate that the embankment is not dependent on tailings strength to maintain overall stability and integrity. Details of the embankment stability analyses, including the adopted material strength parameters are presented in Appendix C of Appendix A.4D.

Please refer to the Report on the Feasibility Design of the TMF (Appendix A.4D) and Appendix B of that report for a discussion on the seismicity assessment that has been carried out for the Casino Project, including a review of the regional seismicity and a seismic hazard analysis.

As previously stated in response to R2-14 and elsewhere, the final design basis for the TMF & HLF will be in full compliance with current codes and regulations. The factors of safety pertaining to the construction, operating and closure & post-closure phases of these facilities will be demonstrated to be in full compliance with the current codes and regulations. The final design will reflect the review and input from the IERP. The designs with supporting data and documentation will be provided with the license application to enable the Regulator to verify code compliance. The Regulator will not grant a license to construct until CMC can demonstrate compliance with applicable codes and regulations.

B.4.8.4.3 R2-34

R2-34. The measured shear wave velocity for the foundation material.

Please refer to the Report on the Feasibility Design of the TMF (Appendix A.4D) and Appendix B of that report for a discussion on the seismicity assessment that has been carried out for the Project, including a review of the regional seismicity and a seismic hazard analysis.

Section B.3.1 Ground Motion Attenuation of that report provides the basis for the ground motion assumption used for preliminary engineering purposes. The peak ground accelerations and spectral accelerations predicted using the attenuation relationships are for soft rock/very dense soil site conditions, assuming an average shear wave velocity in the upper 30 meters (defined as the Vs30 value) of 560 m/sec (range of 360 to 760 m/sec). This corresponds to Site Class C, as defined by the National Building Code of Canada (NRC, 2010). Any colluvial apron material and other ice-rich soils will be removed from the dam foundation. The resulting dam foundation will primarily be constituted of Granodiorite bedrock. The selected Site Class C is conservative for these site conditions, resulting in conservatively high peak ground accelerations. This is a provisional value that may change when the balance of the planned geotechnical field investigations are completed during the basic and detail engineering phases. CMC will conduct geophysical data interpretation along the thawed zones to confirm the shear wave velocity and establish the value for ground acceleration to be used for design.

As previously stated in response to R2-14 and elsewhere, the final design basis for the TMF & HLF will be in full compliance with current codes and regulations. The factors of safety pertaining to the construction, operating and closure, and post-closure phases of these facilities will be demonstrated to be in full compliance with the current codes and regulations. The final design will reflect the review and input from the IERP. The designs with supporting data and documentation will be provided with the license application to enable the Regulator to verify code compliance. The Regulator will not grant a license to construct until CMC can demonstrate compliance with applicable codes and regulations.

B.4.8.4.4 R2-35

R2-35. Mean PGA as derived from EZ-FRISK.

Refer to the response to R2-34.

B.4.8.5 Flood Modeling

B.4.8.5.1 R2-36

R2-36. Information regarding PMP and the IDF including:

a. An updated PMP estimate using more robust storm expansion techniques. This modelling must be done by a trained meteorologist with a background in PMP derivation;

b. Justification for using the 100 year snowpack combined with the PMP for computing the PMF instead of a more conservative return period; and

c. Evidence demonstrating that the IDF represents the worst case in terms of volume of inflow.

a. As detailed in the response to R2-14, the probable maximum precipitation (PMP) and 1:1,000 year return period rainfall event values were calculated to inform the selection of an appropriate Inflow Design Flood (IDF) for the Tailings Management Facility using current techniques by trained professionals in the field.

   Current estimates for PMP and PMF are provisional values suitable for assessment purposes and will be reviewed for detailed design and construction purposes. As the project progresses into basic engineering and through the permitting process these provisional values, including the data sources and methodologies used to establish these values, will undergo rigorous examination and review. The design of the TMF and HLF will be based upon the final determination of the PMP and PMF values developed by the EOR, as reviewed by the IERP, and reflected in the design documents submitted for regulatory review and approval. See Figure B.4.2-1 for a description of how provisional values for key design features are incorporated into the design, construction and operation continuum.

b. The use of the 100 year snowpack in combination with the PMP is as per the CDA Dam Safety Guidelines (2007), which state that the PMF is to be computed "with spring PMP and snow accumulation with frequency of 1/100 year".

c. The inflow design flood (IDF) used during operations is one third between 1,000 years and the Probable Maximum Flood (PMF) event for 72 hour storm duration and the IDF for closure is the PMF. The IDF during operations is not derived from a "worst case" scenario, but from guidance from the CDA (2007 & 2014). The IDF during closure is the PMF, which, by definition is the theoretically largest flood resulting from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur in a given area.

B.4.8.6 Spillways

B.4.8.6.1 R2-37

R2-37. Following an updated dam hazard classification as requested in section 2.7.1 include a description of how the IDF design will protect the TMF dam from overtopping.

As stated in the response to R2-14, the IDF and PMF are derived from the PMP and potential snowmelt during occurrence of the PMP, to provide an estimate of flooding potential. For a dam classification of "High" the IDF is one third between 1,000 years and the PMF; for a dam classification of "Very High" the IDF is two thirds between 1,000 years and the PMF; and for a dam classification of "Extreme" the IDF is the PMF (CDA, 2014). However, the CDA Dam Safety Guidelines do not specify which storm duration to extend the event over (e.g., 24-hour or 72-hour). To calculate the IDF, CMC has conservatively used the 72-hour 1,000 year return period event for the starter dam, the 72-hour 1,000 year return period and 72-hour PMF for the operations phase, and the 24-hour PMF for the closure phase, which is equivalent to a risk classification of "Extreme".

The design of the TMF embankments includes storm storage volume requirements for the IDF above the operating supernatant pond elevation, plus an additional two metres for wave run-up protection.

Continuous climate and hydrological monitoring throughout the mine life will provide a more appropriate estimate of the climate at closure and final closure, and 5 year reviews will take into account any changes in meteorological conditions observed during the life of the mine.

Current estimates for PMP and PMF are provisional values and will be reviewed during detailed design and construction. As the project progresses into basic engineering and through the permitting process these provisional values, including the data sources and methodologies used to establish these values, will undergo rigorous examination and review. The design of the TMF and HLF will be based upon the final determination of the PMP and PMF values developed by the EOR, as reviewed by the IERP, and reflected in the design documents submitted for regulatory review and license application processing. See Figure B.4.2-1 for a description of how provisional values for key design features are incorporated into the design, construction and operation continuum.

B.4.8.6.2 R2-38

R2-38. Further discussion on the implications of ice build-up in the spillway and how this will be monitored and managed. In addition to ice build-up, describe how the spillway will be monitored and maintained in perpetuity post-closure – this must consider any changing circumstances

and/or conditions that may compromise the function of the spillway.

It is common to install barriers (pillars) upstream of a spillway to limit the size of ice blocks in the vicinity of the spillway. The spacing of the barriers limits the size of ice blocks so that they cannot form an ice jam at the spillway. This feature may be provided for the Casino TMF.

Site maintenance and management will also be conducted to prevent any blockages, which will be detailed in the OM&S plan prepared by CMC (preliminary plan provided in Appendix B.4D).

Continuous climate and hydrological monitoring throughout the mine life will provide a more appropriate estimate of the climate at closure and final closure, and planning will be updated to account for these records.

Refer to the response to R2-2 as to how changing circumstances and changed conditions are addressed during the design and construction stage and in perpetuity.

B.4.8.6.3 R2-39

R2-39. Mitigations, with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, both in the spillway channel and downstream water bodies.

The upper and middle portions of the spillway will be cut into bedrock that is erosion resistant. The design also includes a plunge pool to dissipate the energy of cascading water and to minimize potential erosion effects below the plunge pool and in the downstream watercourses. Erosion protection requirements and design features for the lower section of the spillway and watercourses will be determined in the detailed design stage. The objective of the design will be to minimize or eliminate downstream erosion effects, thereby reducing or eliminating on-going maintenance of this section.

A preliminary OM&S which discusses the mitigation measures with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, in both the spillway channel and the downstream water bodies, is provided in Appendix B.4D.

B.4.8.7 HLF Failure

B.4.8.7.1 R2-40

R2-40. Ensure that the risk assessment requested in section 2.2.2 considers the likelihood and consequence of an HLF failure that results in displacement of water in the TMF.

Failure of the HLF embankment and the resulting release of leach solution and embankment material into the TMF is considered in the Risk Assessment provided in the response to R2-4. The maximum volume reporting to the TMF in the event of a failure is approximately 246,000 m^3, which is insignificant (~3%) compared to the storage capacity available over maximum operational level (freeboard) of 9,000,000 m^3.

B.4.8.8 TMF Dam Core and Downstream Filter

B.4.8.8.1 R2-41

R2-41. An expansion of CMC's response related to core and filter thickness by providing a review of comparable designs. Also, provide a detailed analysis that describes the deformation response of the core and the downstream filter during different stages of construction.

Examples of existing cyclone sand tailings dams are shown in Table B.4.8-1. The following discusses core and filter thickness off comparable TMF designs:

- *KSM:* The TMF for the proposed KSM project in BC includes a tailings dam of similar total height to the proposed Casino TMF dam (Table B.4.8-1). Both projects propose rockfill starter dams with ongoing centerline raises using cyclone sand. The thickness of the core for the Casino main embankment is 20 m for that portion of the dam above the starter dam crest. The thickness of the core for the KSM Southeast dam is also 20 m above the starter dam crest.
- *Highland Valley Copper:* The L-L Dam at the operating Highland Valley Copper mine is a centreline cyclone sand dam that has a core thickness of 15 m (Singh et. al., 2009).
- *Cerro Verde:* The dam at the Cerro Verde mine in Peru is one of several successful cyclone sand dams in South America that do not include a core zone (Obermeyer and Alexieva, 2011). The Cerro Verde mine employs a geomembrane on the upstream face of the starter dam and relies on the impounded tailings to provide hydraulic resistance to seepage through the dam for ongoing raises above the crest of the starter dam.

CMC will undertake an analysis of potential deformation of the dam components to inform the design of the core, filter and transition zones during the detail design phase of the project. The results will be reflected in the final design submitted with the applications for Quartz Mining and Water Use licences.

B.4.8.8.2 R2-42

R2-42. A comprehensive description of the tailings beach design including but not limited to: beach length, width, slope, deposition strategies, construction QA/QC and monitoring/maintenance requirements in perpetuity.

The general description of the design and operation of this system, design criteria, process flow diagrams (PFD), process and instrumentation diagrams (P&ID), and considerable detail of this system is provided in the Casino Project Tailings Cyclone and Transport Study, provided in Appendix E of the Feasibility Design of the Tailings Management Facility (Appendix A.4D). In particular refer to drawings 5277-3-001, Rev.0 and 5277-3-103, Rev.0 and also the section entitled "Casino Jacking Header Summary".

The tailings beach as described and depicted in the TMF Feasibility Design (Appendix A.4D) varies over the course of operations generally as follows:

- *Beach length:* The length of the beach is essentially that of the main dam crest until the tailings approach the elevation of the West Saddle dam. At this point the spigotting system will be modified to develop a beach along the West Embankment, resulting in a beach length that includes the main dam crest length and that of the West Saddle dam.

- *Beach Width:* A minimum beach width of 250 m for normal operating pond levels was adopted for the design (page 15 of Appendix A.4D). The primary objectives of this beach above water are to facilitate future embankment raises and to reduce the hydraulic gradient through the dam, resulting in lower seepage rates and improved stability. The beach width will be re-evaluated as part of detailed design.
- *Beach Slopes:* The beach slopes are a function of the discharge velocity and tailings slurry characteristics including density, gradation and solids content. The coarser fraction of the discharged tailings will settle rapidly and accumulate near the discharge points, forming a beach above water. Experience at similar operations suggests the beach slope above water should average about 0.3%. As the tailings flow into the supernatant pond it forms a submerged beach with a steeper slope, typically in the order of several percent. Finer tailings particles will travel further out into the supernatant pond before settling at flat slopes. Further study may be required as part of detailed design. However, the tailings deposition system at Casino is adaptable to manage a range of tailings characteristics and will be operated such that the requirements for the minimum beach above water geometry are met.
- *Deposition strategy:* The formation of the tailings upstream beach is managed by opening or closings the branch lines off the cyclone overflow jacking header. Normally one off-take will be open to directly discharge cyclone overflow material or whole tailings as operating conditions require (page 70 of Appendix A.4D). The branch lines off the jacking header are spaced at 100 m interval for this purpose. This system provides a high degree of flexibility and control over the beach development and allows adaptation to changing operating conditions.
- *QA/QC:* During operation the facility operators manage the deposition to achieve the design requirements, maintaining the design beach width. A QA/QC requirement during operations by site management is to ensure the minimum beach width and freeboard is maintained by controlling beach development and through water management. Annual internal audits & scheduled external audits verify that beach widths and water levels are consistently maintained in accordance with the design and operating criteria.
- *Maintenance:* Post-operations the beach width is controlled by the invert elevation of the spillway. A vegetation cover is provided for the beach above water after closure to control erosion and to prevent fugitive dust. On-going maintenance consists of annual inspection and repairs to the cover if needed.

B.4.8.8.3 R2-43

R2-43. Quantification of the reduction of seepage and hydraulic gradient throughout the various phases of the TMF dam based on the chosen design. Provide an estimate of how the seepage and hydraulic gradient may change in perpetuity.

The quantification of the seepage from the TMF is discussed in detail in the Revised TMF Seepage Assessment provided in Appendix A.4L. This report details the following information related to seepage:

- The estimated seepage rate at each phase in the life cycle of the TMF facility, including pre-production, various years of operation and at closure and post closure (long-term).
- Figures 3.1 to 3.6 in Appendix A.4L indicate the predicted phreatic surface at each stage of the project and illustrate that the phreatic surface drops to downstream shell foundation drain elevation at all stages. The cyclone sands forming the downstream shell are drained (unsaturated) at all times.

- The report details the analysis of the seepage flows throughout the operating life of the structure and in post-closure. The peak seepage occurs at operating year 22 at 40 l/s and similar seepage flow is anticipated for post-closure (i.e., long-term seepage value).
- The analysis indicates approximately two thirds of the seepage is into original ground and only about one third passes through the dam. Further, the analysis indicates that flow through the dam is not particularly sensitive to the core permeability, as per the sensitivity analysis conducted in Appendix A.4L, which indicates that reducing the permeability of the embankment core zone from 1 $x10^{-5}$ cm/s to 1 x 10^{-6} cm/s reduces the predicted seepage rates by only approximately 10%.

B.4.8.9 Use of Cyclone Sand in Embankments

B.4.8.9.1 R2-44

R2-44. The results of laboratory tests conducted to assess whether 12 percent fines sand would be free-draining including under the very high stresses in the proposed dam and frost susceptible of this material. Additionally, if applicable, provide the implications of the 12 percent fines sand not being free-draining or being frost susceptible.

The results of laboratory testing performed on Casino tailings can be found in the Report on Laboratory Geotechnical Testing of Tailings Materials provided in Appendix A.4R. The test results indicate that even at extreme pressure, the permeability of the cyclone underflow product (coarse sands fraction used for dam construction) will remain greater than 1 x 10^{-4} cm/sec and hence will be free draining. This is consistent with other operations processing copper ore and with similar primary grind. It is also consistent with direct observations by others of how rapidly and effectively cyclone sands, in this grind regime, drain and can be efficiently compacted to the design density.

The test work referenced above also indicates that the design target of 15% fines in the cyclone underflow is achievable, consistent with the experience at other operations, and that the percent by weight of <0.02 mm fines present in the underflow is about 6%. Frost susceptibility of this material may range from very low to high. A maximum fines content of 12% has been adopted for the Feasibility design.

Construction of the cyclone sand tailings at the Kemess mine was successfully conducted at temperatures as low as -40°C (Lysay, Davidson and Martin, 2007). The gradation of the Casino cyclone sand is very similar to Kemess. Lysay et al. mention fines contents of up to 15% are permissible in the downstream shell of the Kemess dam. Gradation testing indicates fines contents are consistently below this target and generally average about 12%. Ice lenses in the cyclone sand shell are generally absent as verified using test pits.

CMC intends to conduct test work to confirm a number of parameters with respect to the use of cyclone tailings for dam construction including permeability testing, frost susceptibility testing, and other during the basic engineering phase and prior to construction. In the event that either permeability or frost susceptibility are identified as problematic, the engineer of record will develop solutions to address these issues, incorporate the necessary design changes in the appropriate design documents, which will be provided for review and approval throughout the QML licencing process. See response to R2-2 for more details on change management procedures and the role of the engineer of record.

B.4.8.9.2 R2-45

R2-45. Information regarding sand properties including:
a. Explanation why the more conservative 30° angle of internal friction for angular sands was not selected for the Casino dam design;
b. Explanation why the same value can be assumed to apply to the tailings generated from processing of all of the three ore types; and,
c. Implications if the more conservative value of 30° is applied to the tailings generated from processing of all of the three ore types.
d. Confirmation whether the maximum anticipated stress for placed cyclone sand is supported by completed testing.

a. To clarify, the friction angle of 36° quoted by EcoMetrix (2014-0002-399-1) was not used for stability analysis. A strength envelope was assigned which is a function of stress, not just a friction angle, as explained in Appendix C of the Report on the Feasibility Design of the Tailings Management Facility (Appendix A.4D). Conservatively, the relationship based on angular sand was used, not the lower bound rockfill. All strength test results indicate strengths higher than the angular sand envelope. Also, the effects of height on sands specifically for copper porphyry, as is the case for Casino, are detailed by Barrera et al. (2011). The design values used in the CMC study are consistent with the demonstrated, successful application of cyclone sands for high dams in Chile and elsewhere.

b. There is a reasonable expectation that similar values will be obtained from all ore types. CMC plans to conduct additional confirmatory test work after a decision to proceed with the project is made and the results of this investigation will be reflected in the final design basis.

c. Please refer to (a) above.

d. The strength envelope discussed in (a) above does assign a lower friction angle for higher stresses. Specialized test work will be performed to confirm the values to be used in detailed design.

B.4.8.9.3 R2-46

R2-46. Identification the actual source of the discrepancy present in the specific gravity values for the tailings sand products through repeat testing. If repeat testing is not possible, describe the implications of this discrepancy using conservative assumptions.

The specific gravity of copper porphyry ore typically ranges between 2.70 and 2.80, as is the case for Casino. The specific gravity for bulk tailings and cyclone overflow for Casino were determined by testing. The specific gravity for cyclone underflow was back-calculated from a hydrometer test. Back-calculation is a less reliable method of calculation than testing. The range of values is not significant (~4%) at this level of design and therefore there is no significant implication to the design arising from this minor discrepancy. As previously stated, this discrepancy will be resolved in the basic and detail engineering phase after a decision to proceed with the project has been made.

B.4.8.9.4 R2-47

R2-47. A response to the concerns articulated by EcoMetrix regarding 2 m lifts.

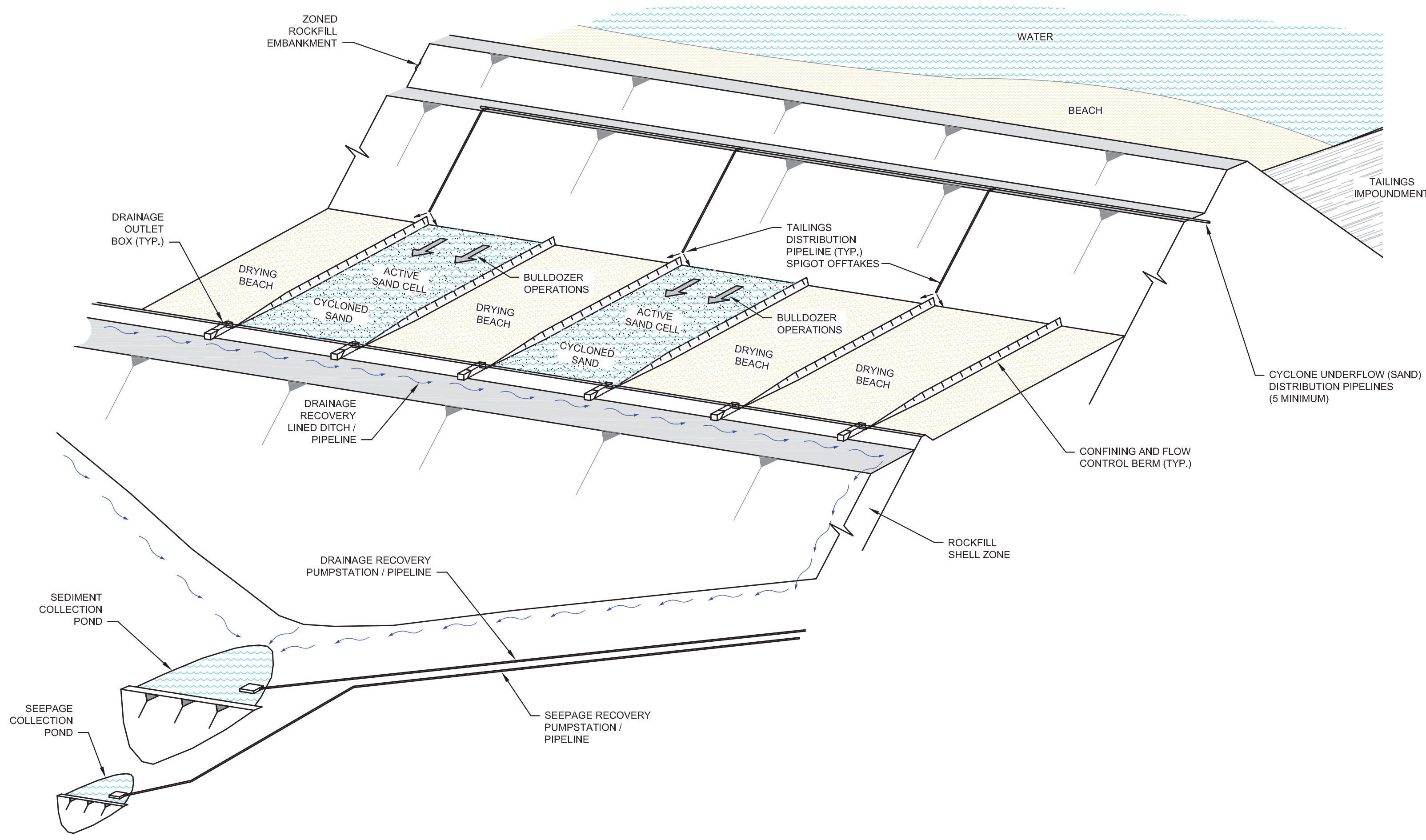
The following is a more detailed description of how the coarse sands are placed and compacted on the tailings dam downstream shell to achieve consistent design density/compaction requirements, as per .

- A bull dozer is used to construct a temporary confinement berm (1-2 meters high) by pushing up previously placed, drained and compacted sand to form a cell to contain fresh slurry and allow the solids to drop-out and to decant the water from the cell (Figure B.4.8-4). Tailings slurry is directly discharged into the cell (or paddock) that has been constructed by the bull dozer.
- The coarse sands in the slurry drop-out quickly and the sand drains readily such that the bull dozer can spread and compact the sands concurrently with the inflow of slurry or shortly thereafter.
- Water is removed from the cell by a portable/moveable decant box.
- The action of the dozer in spreading and leveling the deposited coarse sand results in the compaction of the sands in effectively thin layers and consistently achieves the design degree of compaction and density (Figure B.4.8-5). This method has proven very successful at various operations, including:
    1. Kemess: This methodology has demonstrated consistent placement and compaction to design density even in very cold weather.
    2. Highland Valley Copper: “cyclone sand slurry floods each construction cell to depths of 0.5 m to 2.0 m, and is heavily track packed by sand cat dozers” (Sing et al., 2009).
- The process continues until the total depth of the coarse sand deposited and compacted within the cell reaches the limit of the temporary confinement berm. The slurry is then re-directed to the next pre-prepared cell and the process is repeated.

QA/QC will be conducted to ensure specified densities are achieved. Adjustments to the construction process will be implemented as required, although changes are expected to be minor based on the above mentioned experiences with successful operations.

Figure B.4.8-4 Confinement Berm Construction

Figure B.4.8-5 Sand Cell Compaction



NOTES:

1. SAND CELL PLACEMENT OPERATIONS OCCUR SIMULATANEOUSLY IN TWO OR THREE CELLS.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	19MAY'10	ISSUED WITH REPORT	AG	RP	GRG	KJB

WESTERN COPPER CORPORATION

CASINO COPPER -GOLD PROJECT

CYCLONE SAND DEPOSITION SCHEMATIC

Knight Piésold CONSULTING

P/A NO. VA101-325/3

REF NO. 2

Figure B.4.8-6

REV 0

B.4.8.9.5 R2-48 through R2-56

R2-48. Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity. Specifically:

a. Confirm whether lidar data has been collected to determine the presence or absence of young faults near the tailings dam;

b. Provide the detailed joint surveying along the dam foundation and the abutments and update the seepage analysis report; and,

c. Provide a geostatistical model that represents the permeability characteristics of the bedrock below the dam foundation.

R2-49. Additional drill results and associated foundation characterization (e.g. packer testing, trenching), with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification of fault/shear zones within the embankment foundation.

R2-50. A description of how grouting can be successfully performed given the challenges presented by permafrost. Also, update the responses for R89 a – e of the ARR in accordance with the response to R2-49.

R2-51. The rationale behind “the material is assumed to be isotropic” knowing the horizontal permeability is greater than vertical permeability in embankment dams that is constructed in several stages. Also assuming an isotropic permeability for the rock, will not be a valid assumption due to preferential seepage in the rock mass.

R2-52. The justification on why no seepage barrier is proposed for the dam foundation despite the calculated seepage rate.

R2-53. The anticipated seepage problems surrounding the storage area.

R2-54. Details regarding permafrost and permafrost conditions in relation to the TMF, including:

a. confirmation that an assessment of the hydraulic properties of the permafrost under the embankment structures studies will be conducted during the detailed design;

b. a winter construction execution plan that details measures and procedures for embankment placement of fill that ensures the fill soils are not frozen at the time of placement and compaction;

c. QA/QC plan for construction during the cold season;

d. details on permafrost conditions of the foundation materials before the construction and during the embankment raise;

e. a discussion regarding the potential segregation of solids and water fractions, with the formation of discrete ice lenses within the tailings mass and its implication for tailings management; and,

f. a discussion regarding the integrity implications of the potential frozen and unfrozen fill co-existing within the structure.

R2-55. A detailed schedule for the works required to construct the TMF before and during operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays and freezing conditions.

R2-56. QA/QC measures during the lifetime of the embankment to ensure the effectiveness of insulation and the core structure will not be affected by the action of freezing. Please also provide confirmation regarding if permafrost aggradation potential has been considered into the TMF containment structure? If permafrost aggradation has not been considered, provide a discussion regarding the potential of permafrost aggradation into the TMF.

Requests R2-48 through R2-56 relate to foundation design and detailed geotechnical matters. CMC has provided all information available on these matters in the Project Proposal and the SIR-A. This level of information is consistent with the Project's current stage of development. The matters described in requests R2-48 through R2-56 need to be, and will be, addressed during regulatory review to demonstrate that the project is in compliance with CDA and other applicable codes or regulations.

Further field investigations are planned to support detail engineering and this work will progress once the project proceeds past the assessment phase. This work will be performed to provide a firm design basis and will be submitted in support of CMC's application for a Quartz Mining License and Water License consistent with the regulatory review and permitting process. New information or different interpretation of the conditions in the field discovered by the extended field geotechnical investigations or revealed upon excavation of the foundations of the TMF will be dealt with appropriately as described under Change Management Framework described in the response to R2-2.

It is also important to note that during their review of CMC's SIR-A, both of YESAB's consultants, EcoMetrix and SNC Lavalin, either deemed CMC's previous responses to be *"Adequate"* or had no further comments. In some instances, the above-noted consultants offered comments or suggestions for actions during the detail engineering phase. These comments demonstrate their understanding of the evolutionary process to progress a project from preliminary design through to final design and that there are expected limitations on the availability data, extent of design, understanding of risks, etc. during the preliminary design phase.

B.4.8.9.6 R2-57

R2-57. Additional detail to understand the implication of shorter than expected construction windows for the TMF dam and specifically:
a. Describe the implications of suspensions in fill placement operations if CMC is unable to operate in November and/or March. Also consider the implications of not being able to operate for additional months should they prove too cold. Describe how CMC will manage these implications.
b. Clarification if the likelihood of one or more very cold years for the construction window has been evaluated. If so, describe the implications. Describe how CMC will manage these implications.

Implications of shorter than expected construction windows that are not significantly different from normal temperature ranges are accounted for in normal project planning and contingency allowance. In the event that extreme weather impacts the construction schedule to the extent that cannot be mitigated by reasonable measures, it may be necessary to delay aspects of the work in order to meet necessary quality standards. This may or may not result in an overall project schedule delay but in any event represents a business risk, not a threat to the integrity of the constructed facilities. A more detailed discussion follows:

a. To clarify, the "suspension in fill placement operations" refers only to the placement and compaction of coarse sands on the downstream shell of the TMF dam. It should be noted that CMC expects that placement can be achieved 75% of the time (i.e. equivalent of 9 out of 12 months per year). As discussed in R2-7, experience at other operations has demonstrated that coarse tailing can be placed and compacted to specification at temperatures down to -40°C. CMC has applied a conservative threshold to not place tailings during the seasons where the daily minimum temperature falls below -30°C. In the 2008 through 2014 site meteorological record, there were 51 days (of 793, or 6%) where the minimum daily temperature fell to below -30°C. Over the 2008-2014 site record only two days were, on average, less than -25°C (bold values Table B.4.8-4). However, a 75% placement assumption due to inclement weather has been conservatively assumed.

Table B.4.8-4 Average Minimum Temperatures at Casino Mine Site 2008 - 2014

Day of the Month	Average Minimum Temperature (2008 - 2014)				
	November	December	January	February	March
1	-12	-21	-20	-16	-13
2	-13	-21	-21	-15	-12
3	-14	-19	-21	-16	-14
4	-13	-18	-20	-17	-14
5	-10	-15	-20	-18	-16
6	-12	-14	-19	-16	-15
7	-13	-14	-15	-14	-14
8	-16	-15	-16	-15	-16
9	-16	-14	-21	-16	-16
10	-16	-15	-24	-16	-15
11	-13	-13	-24	-15	-15
12	-15	-17	-21	-15	-14
13	-15	-18	-24	-17	-17
14	-16	-19	-21	-14	-16
15	-16	-19	-13	-12	-15
16	-19	-18	-14	-12	-16
17	-21	-22	-15	-12	-16
18	**-25**	-21	-13	-10	-16
19	**-25**	-20	-14	-14	-14
20	-24	-19	-14	-11	-15
21	-23	-19	-15	-14	-18
22	-22	-16	-19	-15	-19
23	-18	-18	-17	-15	-17
24	-17	-19	-17	-15	-15
25	-14	-21	-15	-12	-12
26	-14	-19	-17	-14	-11
27	-15	-20	-20	-14	-13
28	-15	-20	-22	-13	-11
29	-17	-19	-22	-17	-9
30	-19	-19	-21		-8
31		-18	-17		-6
Days <-30°C	0	0	0	0	0

In the event that CMC cannot meet its conservative 75% assumption due to inclement weather, there may be an impact on the construction schedule and cost for elements of the Project that cannot be mitigated by reasonable measures. In such a circumstance, it will be necessary to delay aspects of the work in order to meet necessary quality standards. This may or may not result in an overall project schedule delay but in any event represents a business risk, not a threat to the integrity of the constructed facilities.

b. The current project planning is based upon an assumption that the winter weather experienced during the construction duration will be typical for the region. That is to say that the winter weather may range from colder than average to warmer than average but does not take into account extreme winters. This range is accounted for in normal project planning and contingency allowance.

In the event extreme weather is experienced there may be an impact on the initial construction schedule and cost for elements of the Project that cannot be mitigated by reasonable measures. In such a circumstance, it will be necessary to delay aspects of the work in order to meet necessary quality standards. This may or may not result in an overall project schedule delay but in any event represents a business risk, not a threat to the integrity of the constructed facilities.

Project specifications and procedures, developed during detail engineering, will define limits on work performed during inclement weather and the appropriate measures and controls necessary to maintain QA/QC requirements as is the norm in industry.

In the event that one or more very cold years are experienced during the project construction this development will be handled through the project “Change Control “process as is typical of all major projects and as discussed under R2-2.

B.4.8.9.7 R2-58

R2-58. Further detail on the referenced examples provided in response to R94. Demonstrate how these examples are applicable to this project and how they support the proposed construction schedule and methodology. Include details regarding the equipment and infrastructure required to facilitate winter construction.

Examples of existing cyclone sand tailings dams are shown in Table B.4.8-1. The Gibraltar (Kolhn Cripen Berger, 2014), Highland Valley (Klohn Crippen Berger, 2012), and Kemess (Lysay, Davidson, and Martin, 2007) mines are Canadian operations with tailings impoundments where cycloned tailings sands are being placed and compacted in cells similar to that proposed for Casino at temperatures well below freezing. Gibraltar and Highland Valley are located in a continental climate region and Highland Valley has placed and compacted sands to -10°C. Kemess is located in a sub-arctic region and the placement and compaction of coarse sands down to -40°C has been documented by Lysay, Davidson, and Martin (2007). KSM and Casino projects will both be constructed and operated in Sub-arctic regions with temperature regimes comparable to that of Kemess.

Placement of coarse sands is expected to occur 75% during of the calendar year (i.e. equivalent of 9 out of 12 months per year). The estimated number of days that the Casino site might be expected to see the daily minimum temperature fall below -30°C is approximately 40-50 days per season. This illustrates that the 75% placement assumption due to inclement weather is conservative.

The design, construction, operation, and ultimately, the closure and reclamation of key facilities at the Casino Project (e.g., TMF and HLF) is complex. It may be necessary to modify the design and operating practices at each stage because of new information or advances in technology, changes in regulation, climate change, or a variety of other reasons.

In the event that CMC cannot meet its conservative 75% assumption due to inclement weather, there may be an impact on the construction schedule and cost for elements of the Project that cannot be mitigated by reasonable measures. In such a circumstance, it will be necessary to delay aspects of the work in order to meet necessary quality standards. This may or may not result in an overall project schedule delay but in any event represents a business risk, not a threat to the integrity of the constructed facilities.

The general framework that governs changes to engineering design is outlined in Figure B.4.2-1, providing an overview of the inputs and possible change management outcomes during the conceptual design, engineering design, construction, operations and closure phases of the Project.

Additional and/or complementary information is contained in responses to R2-2, R2-7, R2-25, R2-47 & R2-57.

B.4.8.9.8 R2-59

R2-59. Discuss the implications of potentially incorporating frozen layers within the embankment (e.g. discrete ice lenses within the tailings mass; layers of frozen and unfrozen fill) to the stability and integrity of this infrastructure.

Appropriate QA/QC measures and controls will be developed during the detail engineering phase of the Project that will be applicable to the initial construction and to the on-going construction during operations. Implementation of these QA/QC measures and controls is designed to preclude inclusion of frozen layers within the embankment. In the unlikely event that frozen material is discovered through the QA/QC process or otherwise, CMC will take appropriate action to resolve the matter to ensure the stability and integrity of the structure.

The QA/QC measures and controls will be provided for regulatory review as part of the application for the Quartz Mining License and the Water License.

See also the response to R2-2 with regards to change management and on-going QA/QC, and the draft Guide to the Management of the Casino Tailings Facility in Appendix B.4A.

B.4.8.10 Surface Preparation

B.4.8.10.1 R2-60

R2-60. Provide comprehensive characterization of the depth, extent and nature of permafrost where the TMF is to be constructed. Based on this characterization, confirm that excavation of all permafrost soils will be practical and how this excavation will successfully be achieved.

Permafrost is discontinuous over the TMF embankment area, and is primarily present at the valley bottom, north-facing slopes and shaded areas. The ridges at higher elevations and upper slopes on the west abutment are southeast-facing, and are generally free of permafrost except for some local shaded areas. Permafrost is common in the northwest-facing east abutment area, where test pits were terminated at shallow depths in frozen colluvium and residual soils.

Permafrost has been identified in the organic, silty colluvial apron of the Casino Creek and tributary valley bottoms. The overburden is generally saturated and frozen in these areas, with high ice contents. The site investigation data also indicated ground ice close to tributaries leading to Casino Creek. The average thickness of the colluvial apron is expected to be approximately 10 metres based on the findings of the site investigations.

To ensure the stability and integrity of the TMF dam foundation, CMC plans to perform the following activities:

- Unsuitable soils and all vegetation underlying the TMF dam foundation will be removed. The topsoil will be stockpiled for reclamation purposes.
- Overburden (including topsoil) will be left in place in the impoundment area upstream of the dam. Disturbance of the vegetative mat will be avoided to the maximum extent possible.

CMC has stated that overburden underlying the Main Embankment will be excavated down to bedrock or suitable overburden foundation conditions. SNC-Lavalin has speculated that this may not be practical. While there is the some possibility that it may not be entirely practical, it is important to keep in mind the length and breadth of the excavation is such that large, suitable construction equipment will be able access and excavate to a considerable depth. The EOR working with the construction contractors will develop solutions in the unlikely event that normal excavation and construction methods are unable to completely meet the objective. These kinds of eventualities and challenges are routinely addressed and overcome in major construction projects. For information on change management, please refer to the response to R2-2.

Further information on permafrost conditions and removal, informed by additional investigations, will be provided during the licensing process. The Regulator will not grant a license to construct until CMC can demonstrate compliance with applicable codes and regulations. Furthermore, any deviation from the design basis will be reviewed and approved by the Regulator.

The equipment spread and excavation plan details will be provided in support of the applications for the Quartz Mining License and Water Use License, as appropriate.

B.4.8.10.2 R2-61

R2-61. Details regarding:

a. A clear definition of ice-rich soils and rock;

b. Characterization of the ice content of the near surface soils and rock to assess the potential volume of ice-rich materials to be excavated and disposed;

c. A well-defined and rational methodology and decision making process to identify and characterize permafrost soils and rock that can be used to guide all excavation and stripping work;

d. A detailed permafrost hazard map (predictive) and associated methodology that identifies type, nature, and magnitude of permafrost related hazards in the study area;

e. If the TMF is situated on permafrost soils that are too deep to excavate, consideration of creep deformation of those permafrost soils resulting from placement of the TMF; and,

f. Based on the map above, identification of specific risks to the Project (i.e. minesite infrastructure and the Northern Freegold Road) from identified permafrost hazards. The map should include consideration of climate change, as well, over the life of the Project.

a. *Definition of ice-rich soils and rock:* Permafrost is discontinuous over the TMF embankment area, and is primarily present at the valley bottom, north-facing slopes and shaded areas. The ridges at higher elevations and upper slopes on the west abutment are southeast-facing, and are generally free of permafrost except for some local shaded areas. Permafrost is common in the northwest-facing east abutment area, where test pits were terminated at shallow depths in frozen colluvium and residual soils.

   Permafrost has been identified in the organic, silty colluvial apron of the Casino Creek and tributary valley bottoms. The overburden is generally saturated and frozen in these areas, with high ice contents. The site investigation data also indicated ground ice close to tributaries leading to Casino Creek. The average thickness of the colluvial apron is expected to be approximately 10 metres based on the findings of the site investigations.

b. *On-going characterization of ice-rich soils:* To ensure the stability and integrity of the TMF dam foundation, CMC plans to perform the following activities:

- Unsuitable soils and all vegetation underlying the TMF dam foundation will be removed. The topsoil will be stockpiled for reclamation purposes.
- Overburden (including topsoil) will be left in place in the impoundment area upstream of the dam. Disturbance of the vegetation mat will be avoided to the maximum extent possible.

Overburden underlying the Main Embankment will be excavated down to bedrock or suitable overburden foundation conditions. SNC-Lavalin has speculated that this may not be practical. While there is the some possibility that it may not be entirely practical, it is important to keep in mind the length and breadth of the excavation is such that large, suitable construction equipment will be able access and excavate to a considerable depth. The EOR working with the construction contractors will develop solutions in the unlikely event that normal excavation and construction methods are unable to completely meet the objective. These kinds of eventualities and challenges are routinely addressed and overcome in major construction projects. For information on change management, please refer to the response to R2-2.

c. *Process to identify permafrost conditions:* When the balance of the planned geotechnical investigations (described in the project proposal and referred to in various responses) has been proposed to be completed during the detail engineering phase, a detailed construction work plan will be developed by the EOR and EPCM contractors with input from the construction contractor(s) to guide the work. Informed by the results of the geotechnical investigation, the EOR will characterize and define acceptable parameters and criteria for the excavation of frozen soils and rock. Any deviation from the defined criteria will be dispositioned by the EOR as described in the response to R2-2, in regards to change management.

The geotechnical engineer representing the EOR will make the determination that the as excavated conditions meet the foundation design requirements. No work will proceed until such time as the EOR declares the foundation preparation to be satisfactory.

d. *Permafrost hazard map:* Terrain mapping and terrain stability mapping was conducted to predict the potential for landslides, snow avalanches and permafrost disturbances, and the results are provided in Appendices 6B, 6D and 6E and summarized in Section 20.3.2. The overall potential effects of terrain instability, in particular permafrost degradation, on the Project is considered not 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. However, 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, which include:

- 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.
- 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.
- 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.

The geotechnical engineer representing the EOR will make the determination that the as excavated conditions meet the foundation design requirements. No work will proceed until such time as the EOR declares the foundation preparation to be satisfactory.

e. *Consideration of creep deformation:* CMC has stated that overburden underlying the Main Embankment will be excavated down to bedrock or suitable overburden foundation conditions. While there is the some possibility that it may not be entirely practical, it is important to keep in mind the length and breadth of the excavation is such that large, suitable construction equipment will be able access and excavate to a considerable depth. The EOR working with the construction contractors will develop solutions in the unlikely event that normal excavation and construction methods are unable to completely meet the objective. These kinds of eventualities and challenges are routinely addressed and overcome in major construction projects. For information on change management, please refer to the response to R2-2.

The geotechnical engineer representing the EOR will make the determination that the as excavated conditions meet the foundation design requirements. No work will proceed until such time as the EOR declares the foundation preparation to be satisfactory and in compliance with applicable codes and regulations, and the terms of licenses.

f. *Risks specific to the Project from permafrost:* For information on permafrost hazards, please refer to the response to R2-94.

The geotechnical engineer representing the EOR will make the determination that the as excavated conditions meet the foundation design requirements. No work will proceed until such time as the EOR declares the foundation preparation to be satisfactory and in compliance with applicable codes and regulations, and the terms of licenses.

B.4.8.10.3 R2-62

R2-62. Based on the risk identified in response to the questions above, please provide general options and considerations for engineering design to mitigate the identified risks.

Terrain mapping and terrain stability mapping was conducted to predict the potential for landslides, snow avalanches and permafrost disturbances, and the results are provided in Appendices 6B, 6D and 6E and summarized in Section 20.3.2. The overall potential effects of terrain instability, in particular permafrost degradation, on the Project is considered not 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. However, 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, which include:

- 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.

- 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.
- 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.

The geotechnical engineer representing the EOR will make the determination that the as excavated conditions meet the foundation design requirements. No work will proceed until such time as the EOR declares the foundation preparation to be satisfactory and in compliance with applicable codes and regulations, and the terms of licenses.

For information on change management, please refer to the response to R2-2.

B.4.8.10.4 R2-63

R2-63. Provide a comprehensive assessment of how groundwater flow may be affected due to changing thermal conditions (i.e. melting permafrost). Consideration should be given to all stages of the Project, including in perpetuity for post-closure.

As stated in the response to R2-111 and to R2-112, the numerical groundwater model was conducted at a regional scale, and groundwater flow is assumed to be homogeneous and isotropic at the regional scale for the purpose of regional and project-site scale assessment of groundwater flow. At the regional-scale, the net volume of groundwater discharge to the creek valleys is expected to be independent of permafrost distribution, particularly considering the relatively steep valley slopes that drive groundwater flow at the Project site. It is considered sufficient for the purpose of the regional hydrogeology assessment to consider the subsurface as a homogeneous unit that is permafrost-free.

Additionally, while representation of permafrost in the numerical groundwater model as a barrier to groundwater flow was considered during initial development of the numerical model, permafrost zones with a lower hydraulic conductivity were not represented within the subsurface of the baseline numerical model since the distribution of permafrost is not expected to have a significant effects on the regional-scale seepage pathways from facilities to downstream receptors or impact seepage rates. The relatively steep topography at the site is expected to drive groundwater flow and define groundwater recharge and discharge zones at topographic highs and lows, respectively.

The purpose of the groundwater model is to assess the effects of the Project on the environment, not the effects of permafrost degradation on groundwater flow. The Mine Life Modflow models assumed that permafrost below all facilities degrades or is removed during mine operations. This allows groundwater to flow unobstructed to the downgradient discharge location.

B.4.8.10.5 R2-64

R2-64. Provide further justification of the validity of the baseline model calibration and its potential impact on groundwater flows in the Mine Effects models ensuring permafrost is considered in the calibrations.

Please refer to the response to R2-63.

B.4.8.11 TMF Dam Core Construction

B.4.8.11.1 R2-65

R2-65. Confirm how the dam core will be insulated during construction and include comprehensive details (e.g. properties and characteristics of insulation; methodology for installing insulation; objectives and adaptive management). Provide relevant examples to support the proposed methodology.

*C*MC plans to manage dam core construction to avoid freezing within the dam core, as follows:

Management methodology

- Construction of the core zone for Casino will not take place during winter months (i.e., December – February) when soil freezing is likely to occur.
- Adequate insulation of the core material will be required for the final dam and for intermediate stages. Insulating layers are to be placed over the core after each lift and removed immediately prior to construction of the consecutive lift. Insulating blankets and tarps will be used to keep lifts from freezing during placement and compaction of the dam.
- Engineers will be in close contact with contractors during the construction phase to verify adequate material quality and compaction, and revise construction procedures as necessary.

Methodology for installation of insulation

Construction of the dam core will not occur during winter months. During the construction period freezing temperatures will be experienced, particularly during the shoulder seasons (spring & fall) and overnight. When freezing conditions are anticipated or present, depending on how cold it is at the time, it may be necessary to protect that area of the core under active construction from the effects of freezing. This is accomplished by using insulated tarps and/or other measures as is commonly done in construction in colder climates. This temporary protection is routine in the construction industry and familiar to any competent civil contractor. The EOR will specify the conditions under which temporary protection is required and what materials and methods are acceptable in the project specification developed in the detail engineering phase of the project.

It should be noted that a completed core lift goes through one winter then the next lift is placed and compacted. Individual lifts do not go through numerous repeated freeze thaw cycles. A protective insulation layer will be provided on top of the final embankment crest to prevent repeated seasonal frost penetration into the upper few meters of the core zone. This cover will likely comprise several meters of coarse, non-frost susceptible fill, similar to the designs at the White Lake Dam and Charlot River Dam in Saskatchewan (Solymar and Nunn, 1983).

Insulation properties and characteristics

Insulated concrete curing blankets that are frequently required to protect curing concrete can be used for this purpose as well as other similar product available to industry (e.g., TarpsNow, 2015). Typically these tarps are made of flexible hydrophobic foam that provides the highest possible R values, up to 7.7.

Adaptive management

The EOR working with the construction contractors will develop solutions in the unlikely event that normal construction methods are unable to completely meet the objective. These kinds of eventualities and challenges are routinely addressed and overcome in major construction projects. For information on change management, please refer to the response to R2-2.

B.4.8.12 Starter Dam and Tailings Interface

B.4.8.12.1 R2-66

R2-66. An explanation on how the additional transition zones can affect the current analysis.

The purpose of the filter and transitional zones is to prevent the migration of finer graded material into coarser graded material, to limit differential settlement between materials with different properties, and to safely convey any seepage to the downstream area. The filter and transition zones will be sized to meet these criteria, and have been modelled accordingly in the seepage analyses. The strength properties of additional transition zones are similar to the conservative strength properties assigned to the shell zone. Additionally, the effect on the stability is limited due to small size of any additional transition zones relative to the total dam section. Including additional transition zones to the stability model will not result in significant changes to the predicted factors of safety.

It is important to note that both YESAB consultants (EcoMetrix & SNC-Lavalin) found CMC's response to R102 contained in the SIR-A to be adequate.

B.4.9 LIQUIFIED NATURAL GAS AND DIESEL

B.4.9.1 Description of LNG Facilities

B.4.9.1.1 R2-67

R2-67. Identification of potential hazards of wildfire to LNG facilities at the Casino Mine site and a quantitative assessment of the related risk to those facilities. Ensure that risks and procedures associated with forest fires are discussed.

The design and location of the LNG facility are such that a wildfire will have little to no effect on the LNG storage. The concentrator and associated power plant infrastructure is located at ~1,200 masl, beyond the tree line (Figure B.4.9-1 and Figure B.4.9-2). Further, the LNG storage is centralized within the concentrator and infrastructure site, with a minimum distance to forested areas of about 2 Kilometres. (Figure B.4.9-3). With a separation distance of this magnitude a forest fire will have no appreciable impact on the LNG storage tank.

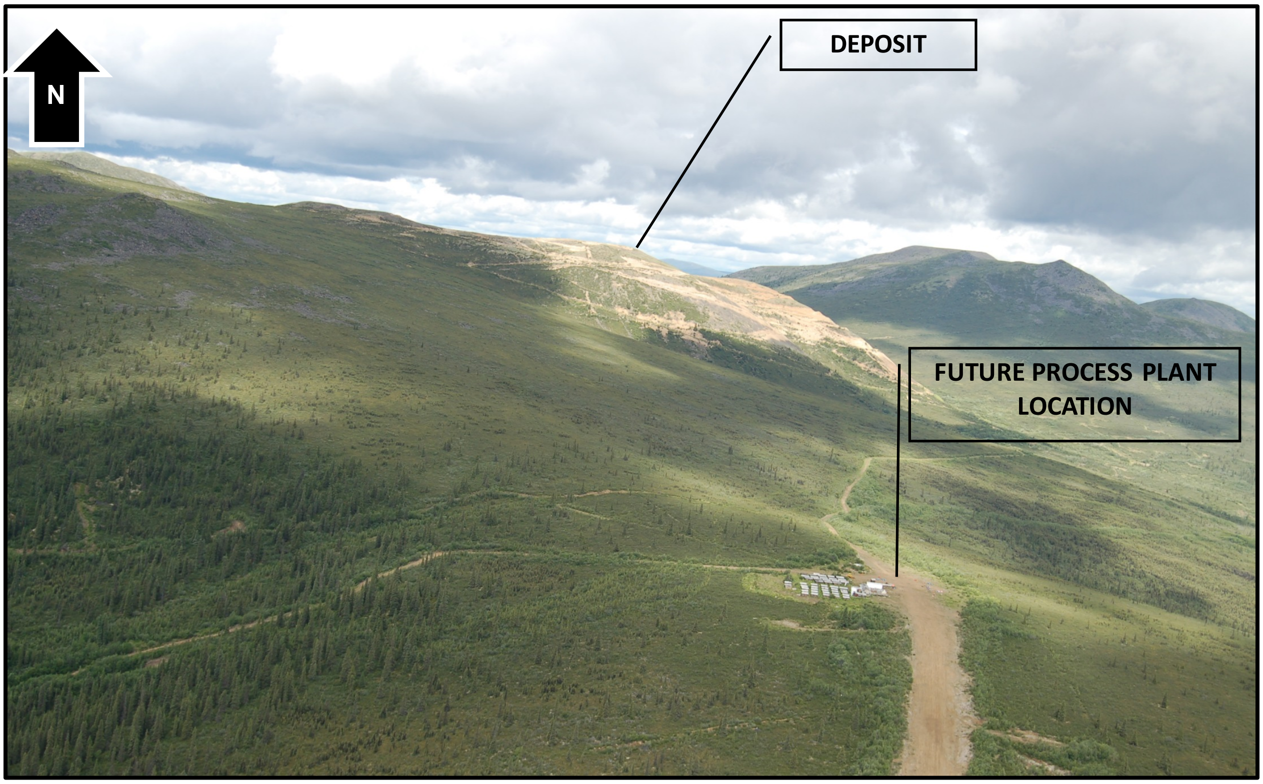


Figure B.4.9-1 Future Process Plant (and LNG facility) location

Figure B.4.9-2 Rendering of Proposed Process Plant overlain on Actual Topography

Procedures and measures associated to forest fires

The LNG storage tank will be constructed and managed in accordance with the National Fire Code, conforming with the Environmental Code of Practice for Above-ground Storage Tank Systems Containing Petroleum Products and Canadian Standards CSA Z-276-11 for LNG facilities.

The LNG tank is insulated by approximately 1,500 mm of perlite insulation as per 7.1.7.3 of CSA Z-276-11. LNG piping is insulated and protected as per 9.2.1.3 of CSA Z-276-11. The tank insulation effectively limits the boil off generated during a hot summer day conditions to less than 0.3% per day. There is no possibility that a forest fire will heat the tank contents to a level that would overwhelm the boil-off control system and tank relief system resulting in conditions that even begin to approach a BLEVE risk.

In the event of a forest fire during the construction, operation, or decommissioning phases, ongoing activities would be suspended in potentially affected areas if conditions were considered to be unsafe by CMC. In the event of a forest fire that is deemed to be of concern, the Emergency Response Management Team will implement appropriate actions as established in the Emergency Response Plan (ERP).

It should be noted that during 2015, the Casino site was threatened by a fire of approximately 400 hectares. This fire burned to the edge of the airstrip of the exploration camp with no physical damage to the camp. During the fire, zero release of the 1,750 litres of pressurized propane occurred. During this fire, the Yukon Wildland Fire Management erected a simple sprinkler system to protect structures.

CASINO

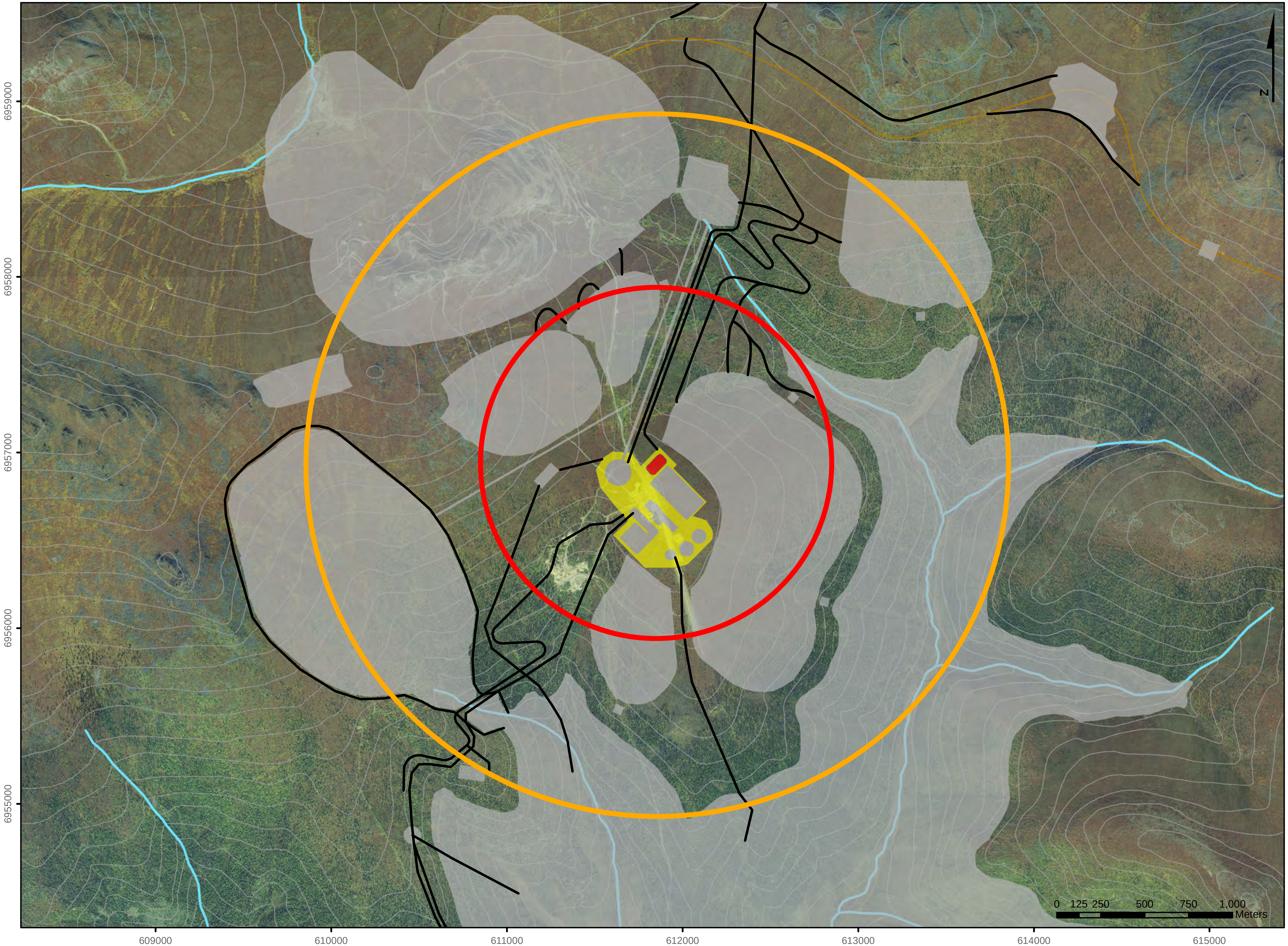


Figure B.4.9-3: LNG Storage Separation Distance to Forested Areas

Legend

- proposed line facilities
- proposed polygon facilites
- LNG Facility
- Plant Site
- River
- Radius of Influence (1 km)
- Radius of Influence (2 km)

Date: 14/12/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

B.4.9.2 Description of Diesel Facilities

B.4.9.2.1 R2-68

R2-68. For the diesel facilities and fueling stations, provide:
a. a detailed description for all facilities related to diesel including location, design, construction, operation and closure;
b. measures for the safety of project personnel including separation distances from office and living areas; and
c. design measures and operating procedures to prevent a cascading accident.

The design, construction and operation of diesel facilities and fueling stations will be in accordance with the Fuel Storage and Handling Guidebook (INAC, 2002) and National and Territory regulations. Per Yukon regulations, all such installations will require a license to construct and operate and details of each fuel site will be provided to the regulator with the permit applications.

a. *Description of facilities:* Diesel fuel storage and fueling stations will be located near the truck shop, which is at the center of the principle demand, namely the mining fleet and support equipment. However, during the construction phase of the project it will be necessary to provide temporary diesel fuel storage at a number of locations to service the needs of construction equipment and for electrical power generation purposes. The location of these fuel depots is liable to change as the work progresses and operations change. The location of the depots during construction will be determined as part of the temporary infrastructure planning effort during the detailed engineering phase and early construction phase with input from the construction contractors at that time.

b. *Safety measures:* The design, construction, and operation, including consideration of separation distances, will be consistent with the Fuel Storage and Handling Guidebook and applicable regulations (i.e., *Environment Act: Storage Tank Regulations*). CMC will obtain the necessary license and permits to construct and operate the facility from the Yukon Regulatory Agency in compliance with the National and Territory regulations (e.g., storage tank systems permit).

   More specifically, during the construction phase, the preferred diesel fuel storage solution is Double-Walled tanks, as per Section 3.1.2.1 of the Fuel Storage and Handling Guidebook (INAC, 2002). In some instances single walled tanks located within dyked containment areas may be used per Section 3.1.2.2 of the the Fuel Storage and Handling Guidebook.

   Given the volume and extended duration of the diesel fuel storage requirements during operations it is likely that single-wall tanks located within a dyked containment area will likely be used.

c. *Design measures and procedures to prevent cascading events:* The design, construction, and operation, including consideration of separation distances, will be consistent with the Yukon Guidebook (INAC, 2002) and applicable regulations. CMC will obtain the necessary license and permits to construct and operate the facility from the relevant Yukon Government departments (e.g., Department of Energy, Mines and Resources Lands Branch and Department of Environment: Environmental Programs) in compliance with the National and Territory regulations.

B.4.10 CONCEPTUAL CLOSURE AND RECLAMATION PLAN

B.4.10.1 Long-Term Closure and Ongoing Monitoring and Maintenance

B.4.10.1.1 R2-69

R2-69. Further analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks. The options analysis should include:

a. open pit;
b. tailings management facility;
c. heap leach facility;
d. stockpile areas; and
e. water management and treatment.

All components of the Project were designed for closure. Key in this regard was the alternatives assessment for selection of the best location for the TMF. Selection of practical and feasible closure options were based on: design for closure, placing uneconomic PAG material in the TMF for permanent underwater disposal, and ensuring no enduring post-closure active care of the site. Primary consideration was selecting the best closure technology. Costs were then considered in the evaluation of technically viable solutions. Costs will be further evaluated during the finalization of the closure plan for Quartz Mining Licencing. Options that did not meet these objectives were rejected early in the development of the conceptual closure plan, limiting the remaining options.

To further illustrate this point, the various options have been provided in Table B.4.10-1, with ranking for qualitative long and short-term costs, environmental risks, feasibility, and effectiveness. The comments in the table explain why the selected option was chosen, and what the limitations to the other options are.

The analysis provided in Table B.4.10-1 is in keeping with the requirements of the *Reclamation and Closure Guidance* (EMR, 2013), which state:

"While early initiation of reclamation and closure planning is critical, an RCP will be refined throughout the mine life as specific information is gathered and lessons are learned through reclamation research programs and monitoring programs. Early versions of an RCP, like those prepared during pre-feasibility stages of project planning, may be conceptual in nature and be based upon closure options and assumptions for these options provided that these are based upon the best available information and have sufficient reasoning."

Table B.4.10-1 Closure Options Analysis

Component Closure Option*	Long-term costs	Short-term costs	Ranking: Environmental risks	Ranking: Feasibility	Ranking: Effectiveness	Overall Rank	Comments
Open Pit							
1.a. Divert Canadian Creek	Maintain ditch	Upgrade ditch to PMF	Low	High	High	4	Expedited flooding of the pit is desired to minimize pit wall exposure
1.b. Remove Canadian Creek Diversion	None	Remove diversion	Low	High	High	**5**	
2.a. Passive discharge to TMF	Maintain ditch	Construct ditch to TMF	Low	High	High	**5**	• Active pumping and maintenance is undesirable. • Treatment wetland is designed to accommodate peak flows. • Discharge to Canadian Creek would impact Britannia Creek and potentially the Yukon River.
2.b. Active discharge to TMF	• Provide power and personnel for annual operation. • Maintain pond below invert. • Operate pumps for spring/summer discharge to TMF wetland.	Install barge and pump/piping system.	Low	Low	High	2	
2.c. Discharge to Canadian Creek	• Provide power and personnel for annual operation. • Maintain pond below invert. • Operate pumps for spring/summer discharge to Canadian Creek.	Install barge and pump/piping system.	High	Low	High	1	
3.a. Pit water in-situ treatment: Lime treatment	None	Lime addition during waste rock (marginal grade ore) disposal.	Low	High	Moderate	3	May improve water quality in the long term. May not be necessary if pit pond stratifies.
3.b. Pit water treatment: Biological treatment	Intermittent biological treatment of pit water to stimulate microbial activity, if necessary.	Intermittent biological treatment of pit water to stimulate microbial activity, if necessary.	Low	Moderate	Moderate	3	• May be used for complementary water treatment should pit water quality warrant it. • North Wetland will be primary treatment system.
3.c No pit water treatment	None	None	Low	High	Low	2	The North treatment wetland is designed to intercept untreated pit overflow.
4.a. No active pit overflow treatment	None	None	Moderate	High	High	3	• Untreated water from the Open Pit would flow into the TMF and be incorporated into the TMF pond. • Modeling indicates high concentrations of Cd, Cu, Se and U.
4.b. Pit overflow passive treatment	• Wetland monitoring • Wetland maintenance	Wetland construction	Moderate	High	High	**5**	• Treatment wetland design assumes no regulation of flow from the open pit, and is therefore designed to treat for spikes in concentrations and flows. • Environmental risks are only in the case of failure of the treatment wetland. • Failure of the treatment wetland will be muted by the large volume of water in the TMF.

Component Closure Option*			Ranking			Overall Rank	Comments
	Long-term costs	Short-term costs	Environmental risks	Feasibility	Effectiveness		
Heap Leach Facility							
1.a. Rinse HLF	None	Detoxification of cyanide via heap rinsing	Low	High	High	**5**	• Rinsing will be continued as long as necessary to flush leaching compounds from the HLF. • If rinsing is not conducted, contaminants will flush from the heap as precipitation percolates through the heap and discharge to the TMF pond. • Contingency: all heap drainages goes to TMF (dilution and wetland treatment)
1.b. Do not rinse HLF	None	None	Moderate	High	Low	1	
2.a. Install downstream passive treatment: Biopass	Following draindown, bioreactor would be shut down and the matrix permanently sealed in place	Installation of bioreactor	Low	High	Moderate	4	• Modeling indicates that post-rinsing, water from the HLF may be elevated in SO_4, F, Cd, Cu, Fe, Mo, Se and U. • A treatment wetland has been designed to intercept runoff from the HLF and will minimize contaminants entering the TMF pond. • The wetland option ensures long-term treatment, instead of short-term treatment via bioreactor. • Environmental risks are only in the case of failure of the treatment wetland. • Failure of the treatment wetland will be muted by the large volume of water in the TMF.
2.a. Install downstream passive treatment: Wetland	• Wetland monitoring • Wetland maintenance	Wetland construction	Low	High	High	5	
2.c. No downstream treatment	None	None	Moderate	High	Low	2	
2.d Low permeability cover to reduce flushing	Minor for maintenance of cover	High	Low	Low	High	2	No local source of good cover material. Slopes are too steep for geomembrane, and would need to be re-countoured.
Stockpile Areas							
1.a. Leave in place and cover	Collect and pump seepage to the TMF	Re-contour and cover stockpiles	Moderate	Moderate	Low	2	• Leaving stockpiles in-place may result in long-term contaminated seepage. • There is insufficient low infiltration cover material. • Stable geomembrane covers require relatively flat slopes in alpine setting. • Depending on market conditions, the marginal grade ore may be milled near the end of operations, therefore, disposing of the material in the TMF during operations would preclude further recovery of the ore. • Disposal in the TMF would increase the storage volume in the TMF, which would necessitate a higher dam. • Disposal in the TMF may impact the pond water quality.
1.b Dispose directly in TMF throughout operations	None – all activities conducted throughout operations	Trucking during operations	Low	Moderate	High	2	
1.c Store on surface and dispose of in pit at closure	Potential treatment of pit water (see Open Pit section above)	Disposal of material in the open pit	Low	High	High	5	
1.d. Store on surface and relocate to TMF at closure	Potential impact to the TMF pond water quality	Disposal of material in TMF	Moderate	Moderate	High	3	
Tailings Management Facility (for operational and design considerations see the full alternatives assessment in Appendix B.4B.)							
1.a Disposal in-place with no cover	• Long-term acid generation issues with flushing of oxidation products. • Long-term water treatment would likely be required.	None	High	High	Low	1	No water cover does not prevent oxidation of PAG materials.

Component Closure Option*	Long-term costs	Short-term costs	Ranking			Overall Rank	Comments
			Environmental risks	Feasibility	Effectiveness		
1.b. De-pyritized tailings and water cover	• Maintenance of the overflow spillway • Polishing of pond water for key parameters required.	Spiggoting and distribution of de-pyritized cover over entire waste rock and PAG tailings surface area	Low	High	High	5	De-pyritized tailings and water cover is best management practice for PAG materials, as determined by site-specific evaluation conducted by Lorax Environmental.
1.c. De-pyritized tailings and dry cover	• Maintenance of the dry cover. • Long-term water treatment would likely be required.	• Spiggoting and distribution of de-pyritized cover over entire waste rock and PAG tailings surface area. • De-watering of remaining water. • Cover of entire surface area with effective low-permeability cover.	Moderate	Moderate	Moderate	3	• Dry cover does not prevent oxidation of PAG materials. • Insufficient low infiltration cover material on-site for the entire area.
2.a Locate TMF further downstream	Comparable to the costs of the current design.	Comparable to the costs of the current design.	Moderate	Moderate	Moderate	3	• Downstream location increases available dilution • Downstream location results in greater flood risk to TMF
3.a Seepage collection and pump back to TMF	Long-term pumping	Installation of seepage collection pond and pump-back system.	High	Low	Low	1	Long-term power requirements for pump back is not a valid closure option, according to the Yukon Government guidelines.
3.b. Reduce seepage through foundation treatment	None	Additional grouting during foundation preparation of the dam.	Moderate	Moderate	Moderate	3	• Grouting may lower the permeability of the subsurface rock. • Grouting will be considered as a complementary method of seepage reduction.
3.c. Seepage treatment	• Wetland monitoring • Wetland maintenance	Wetland construction	Low	High	High	5	• Modeling indicates that seepage may be elevated in SO_4, F, Cd, Cu, Mo, Se and U. • A treatment wetland has been designed to intercept seepage and treat it to acceptable discharge concentrations. • The wetland option ensures long-term treatment, with minimal maintenance. • Environmental risks are only in the case of failure of the treatment wetland. • Ongoing monitoring will ensure the treatment wetland is functioning as required.
4.a Dam embankment topsoil and vegetation cover	Maintenance of vegetated cover	Topsoil and vegetation placement	Low	High	Moderate	4	• Dam embankment is constructed of de-pyritized non-acid generating material. Therefore, the geochemical risk is low. • Vegetation can be an important aspect of erosion control.
4.b Dam embankment low infiltration cover	Maintenance of cover	• Placement of low-infiltration cover • Cover with topsoil and vegetation	Low	Moderate	Moderate	3	Low-infiltration cover not required for non-acid generating material.
Water Management and Treatment							
1.a No treatment	None	None	High	High	Low	1	• Modeling indicates that TMF pond water and seepage will be elevated in SO4, F, Cd, Cu, Fe, Mo, Se and U. • Direct discharge without treatment will result in exceedances of water quality objectives in Casino and Dip Creeks.
1.b. Active water treatment plant	High long-term operating costs	• Installation of a water treatment plant • Treatment plant on-site for cyanide treatment may be re-purposed to treat	Low	Low	High	1	• Active long-term treatment is in contradiction of the stated objectives of the Yukon Government for non-active closure. • Costs for long-term treatment are prohibitive and un-economical.

Component Closure Option*	Long-term costs	Short-term costs	Ranking: Environmental risks	Ranking: Feasibility	Ranking: Effectiveness	Overall Rank	Comments
		parameters of concern in the TMF pond.					• May be available as a contingency measure during the early years of wetland construction and development. However, the many "design for closure" aspects of the Casino project suggest that this is very low probability (worst ML/ARD risks are eliminated during operations).
1.c. Passive water treatment systems (treatment wetlands)	• Wetland monitoring • Wetland maintenance	Wetland construction	Low	High	High	5	• Installation of wetland treatment systems at various sources (HLF, Open Pit, TMF and downstream of TMF embankment) introduces redundancies in the treatment and creates a treatment train to improve overall water quality. • Environmental risks are only in the case of failure of the treatment wetland. • Ongoing monitoring will ensure the treatment wetland is functioning as required.
1.d. Storage and discharge of seepage in conjunction with treatment wetlands	• Wetland monitoring • Wetland maintenance • Maintenance of seepage discharge system	• Wetland construction • Seepage pond construction • Installation of linked discharge system	Low	Moderate	High	3	• Due to excavation of overburden at the foundation of the TMF, a storage pond at the toe of the embankment would have to be very large, and would need to be pumped to be discharged, which is in in contradiction of the stated objectives of the Yukon Government for non-active closure.
1.e. Discharge seepage and TMF overflow directly to Dip Creek via pipeline	Pipeline and pump maintenance	Construction of pipeline Installation of pumping system	Moderate	Moderate	Moderate	2	To avoid discharge to Casino Creek, discharge could be pumped directly to Dip Creek and meet water quality objectives through higher dilution availability. Pumping would be required, which is in in contradiction of the stated objectives of the Yukon Government for non-active closure.

*Option in **bold** is the chosen option

B.4.10.1.2 R2-70

R2-70. Discussion and, if necessary, an update to the conceptual closure plan to take into account the most recent Government of Yukon Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013). Details should include:
a. additional closure methodology that demonstrates that the open pit water can passively flow to the TMF without continued intervention; and
b. identification of closure methodologies that have been demonstrated effective in northern environments, and that clearly meet the objectives described in Section 5 of the guidance document.

a. The North TMF Wetland, which receives discharge from the Open Pit, has been designed to accept uncontrolled flows from the Open Pit to the TMF. A review of the North TMF Wetland design has been conducted (Appendix B.4G), and includes a 12 ha wetland (previously a 7 ha wetland) which is sized to achieve CCME guidelines for all parameters at the 95^{th} percentile concentration and 50^{th} percentile flows, with added contingency. These calculations are based on no control of flow from the Open Pit.

   Therefore, while CMC believes that controlling discharge from the open pit is feasible, the design for closure has been evaluated to have that control as only a contingency measure, with a robust treatment wetland design to intercept that discharge at variable flow rates.

b. As detailed in the Conceptual Closure and Reclamation Plan (Appendix 4A), although “conceptual”, the plan is based on numerous site characterization and engineering studies in support of the mine plan and closure. This plan will be expanded during the Quartz Mining License application to meet additional reporting requirements, such as costing, as detailed in the Yukon Mine Reclamation and Closure Policy.

   Consistent with the objectives described in Section 5 of the *Reclamation and Closure Planning for Quartz Mining Projects* (Government of Yukon, 2013), CMC outlined general closure objectives in Section 1.4 of Appendix 4A as well as the comprehensive and conservative approach to closure planning undertaken by CMC to ensure the objectives are met in Section 2 of that same plan. These were further detailed in the response to R110, and include:

   - Protect public health and safety;
   - Minimize, mitigate or prevent adverse environmental impacts;
   - Reclaim the site to a land use state consistent with surrounding conditions;
   - Ensure long-term stability of the spent ore and waste rock storage area and site water quality;
   - Restoration of the mine area, considering terrestrial restoration (vegetation) compatible with surrounding area;
   - Physical stability of residual structures (i.e. tailings dam, heap leach facility, etc.);
   - Protection of downstream receiving environment; and
   - Minimize requirements for post-closure activity (i.e. site presence).

   For comparison, Table B.4.10-2 outlines the objectives outlined in the Government of Yukon report (2013) and the components of the Casino Project closure plan that meet these objectives.

CMC considers all closure methodologies presented in the Conceptual Closure and Reclamation Plan to be applicable in northern environments. For reference, CMC has provided a list of "Northern" mines where comparable methodologies have been applied in Table B.4.10-3. This list is not exhaustive, but is meant to identify comparable locations, with the intent of demonstrating the applicability of those methodologies to the Project. Mines with the methodologies detailed in government approved closure plans, but not yet implemented, are identified with italics in Table B.4.10-3.

Table B.4.10-2 Closure Components to meet Government of Yukon Closure Objectives

Objective (Government of Yukon, 2013)	Conceptual Closure and Reclamation Plan Components (Appendix 4A)
Physical Stability • All mine-related structures and facilities are physically stable and performing in accordance with designs. • All mine-related structures, facilities and processes can withstand severe climatic and seismic events.	• Design and construction of the TMF dam for the 1 in 10,000 year earthquake and probable maximum flood (the highest standards recommended by the Canadian Dam Association). • Processing of all ore stockpiles or disposal in open pit (no material left on surface). • Filling of open pit with groundwater and surface water to minimize geochemical exposure. • Construct berm at access points around perimeter of open pit. • Detoxification of Heap Leach Facility and capture of infiltration discharge in the TMF. • Re-contouring of surface slopes to meet long-term stability objectives. • An active closure period of 3 years to remove mine infrastructure from the site and construct covers on the TMF embankment, HLF after detoxification, and stockpile footprints. • Decommissioning of the Freegold Access Road.
Chemical Stability • Release of contaminants from mine related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.	• Mitigation "by design" of major infrastructure to: • Minimize project footprint; • Ensure all sources of uncontrolled discharge are captured by the TMF or open pit; • Dispose of geochemically reactive waste using best management practices; and • Maximize source control (e.g., segregation of non-PAG waste). • All sources of discharge post-closure may be intercepted by passive treatment systems to form a "treatment train" of redundant treatment systems to ensure ultimate protection of the receiving environment (e.g., North TMF wetland, HLF wetland, South TMF wetland, seepage wetland). See Appendix B.4G.
Health and Safety • Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features. • Reclamation and closure implementation avoids or minimizes adverse health and safety effects on	• Dismantle buildings and infrastructure and salvage any material with value. Inert material without salvage value disposed of in on-site landfill. • Remove and properly dispose of any hazardous materials off-site. • Decommission power plant. • Reclaim roads not required for post-closure activities. • Clean up and dispose of any debris and garbage. • Decommission access road to prevent public access.

Objective (Government of Yukon, 2013)	Conceptual Closure and Reclamation Plan Components (Appendix 4A)
the public, workers and area wildlife.	• Remove and remediate any hydrocarbon contaminated soils. • Re-vegetate disturbed areas. • Construct berm at access points around perimeter of Open Pit. • Maintain site access roads for on-going monitoring access only. • Monitoring of the TMF and open pit lake will include determination of any wildlife attraction, an assessment of the risks if wildlife are using it, and the need for deterrence measures, if required (see SIR-A Section A.12).
Ecological Conditions and Sustainability • Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. • The mine site supports a self-sustaining biological community that achieves land use objectives.	• Open pit will become a pit lake, with acceptable water chemistry for wildlife use. • Tailings Management Facility will become a shallow lake with treatment wetlands at key locations. Water chemistry will be acceptable for wildlife use. No accumulation of metals predicted in wetland plants. • Treatment wetland at toe of tailings embankment will maintain water quality objectives in the Casino Creek receiving environment (see Section B.4.10).
Land Use • Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations. • Site access is consistent with community land use expectations.	• Dismantle buildings and infrastructure and salvage any material with value. Inert material without salvage value disposed of in on-site landfill. • Remove and properly dispose of any hazardous materials off-site. • Decommission power plant. • Reclaim roads not required for post-closure activities. • Clean up and dispose of any debris and garbage. • Decommission access road to prevent public access. • Remove and remediate any hydrocarbon contaminated soils. • Re-vegetate disturbed areas (including stockpile areas and heap leach facility). • Construct berm at access points around perimeter of Open Pit. • Maintain site access roads for on-going monitoring access only.
Aesthetics • Restoration outcomes are visually acceptable.	• Final landscape will consist of lakes, wetlands and hill-slopes vegetated with native plants. • Final landscape will appear similar to other comparable high alpine Yukon landforms.

Objective (Government of Yukon, 2013)	Conceptual Closure and Reclamation Plan Components (Appendix 4A)
Socio-economic expectations • Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. • Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.	• Closure activities would be carried out concurrently with mine operations wherever possible. • Most of the mine site area will be available for a variety of land uses following reclamation. However, the area occupied by several reclaimed site facilities (i.e. TMF and open pit) will be unavailable for future land use activities. • Closure activities will comply with regulatory requirements. • Monitoring will continue to ensure continued compliance.
Long-term certainty • Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.	• Mitigation "by design" of major infrastructure to: • Minimize project footprint; • Ensure all sources of uncontrolled discharge are captured by the TMF or open pit (i.e., only one source of discharge); • Dispose of geochemically reactive waste using best management practices; and • Maximize source control (e.g., segregation of non-PAG waste). • Design and construction of the TMF dam for the 1 in 10,000 year earthquake and probable maximum flood (the highest standards recommended by the Canadian Dam Association). • Re-contouring of the heap leach facility to stable slope. • All sources of discharge post-closure may be intercepted by passive treatment systems to form a "treatment train" of redundant treatment systems to ensure ultimate protection of the receiving environment (e.g., North TMF wetland, HLF wetland, South TMF wetland, seepage wetland). See Appendix B.4G. • A long-term monitoring program consisting of active and passive phases will begin after the primary reclamation activities have been completed.
Financial considerations • Minimize outstanding liability and risks after reclamation activities are complete.	• Mitigation "by design" minimizes liability and risk in the design phase. • Passive treatment systems require minimal maintenance, and are self-sustaining in the long term. • Quality control and quality assurance during the construction phase ensures facilities will meet design standards post-closure.

Table B.4.10-3 Proposed Closure Methodologies and Demonstrated Use in Northern Environments

Proposed Closure Methodology	Demonstrated Use *(italics indicate Projects not yet in closure)*	Location	Average Annual Temperature (average range)	Reference
Disposal of remaining stockpiles in open pit	Owl Creek pit	Timmins, Ontario	2°C (-17°C to 17°C)	MEND, 1995
	Collins Bay B-Zone Pit, Rabbit Lake Operation	350 km north of La Ronge, Saskatchewan	-5°C (-17°C to 20°C)	MEND, 1995
	Udden pit	Northern Sweden	8°C (-2°C to 19°C)	MEND, 1995
	Kemess South	300 km northwest of Mackenzie, BC	2°C (-11°C to 15°C)	Lysay, et.al., 2011
	Minto Mine	Minto, YT	-2°C (-43°C to 30°C)	Capstone, 2014
	• Over 10 more sites in Canada			MEND, 1995
Filling of open pit with water	Owl Creek pit	Timmins, Ontario	2°C (-17°C to 17°C)	MEND, 1995
	Collins Bay B-Zone Pit, Rabbit Lake Operation	350 km north of La Ronge, Saskatchewan	-5°C (-17°C to 20°C)	MEND, 1995
	Sture pit	Northern Sweden	8°C (-2°C to 19°C)	Lu, 2002
	Udden pit	Northern Sweden	8°C (-2°C to 19°C)	Lu, 2002
	Cluff Lake	75 km south of Lake Athabasca, Saskatchewan	-4°C (-27°C to 16°C)	CNSC, 2003
	Fort Knox Mine	Fairbanks, Alaska	-2.9°C (-23°C to 17°C)	Schlumberger, 2013
	Mt.Milligan	155 km northwest of Prince George	3.5°C (-10°C to 15°C)	Terrane, 2008
	• Over 20 more sites in Canada, many with multiple open pits • All open pit mines result in pit lakes at closure			MEND, 1995 Gammons et al., 2009
Pit lake treatment (lime or biological treatment)	Collins Bay B-Zone Pit, Rabbit Lake Operation	350 km north of La Ronge, Saskatchewan	-5°C (-17°C to 20°C)	Cameco, 1999
	Highland Valley Copper	80 km southwest of Kamloops, BC	9°C (-5°C to 21°C)	Larratt et al., 2007
	Faro Mine	Faro, Yukon	-2.2°C	Laberge, 2010

Proposed Closure Methodology	Demonstrated Use *(italics indicate Projects not yet in closure)*	Location	Average Annual Temperature (average range)	Reference
			(-22°C to 15°C)	
	Colomac Mine	220 km northwest of Yellowknife, NWT	-5°C (-27°C to 17°C)	Laberge, 2010
	Island Copper	Port Hardy, BC	8°C (3°C to 14°C)	Laberge, 2010
	Equity Silver	Houston, BC	11°C (-5°C to 22°C)	Laberge, 2010
Rinsing of HLF	Brewery Creek	55 km east of Dawson City, YT	-4°C (-27°C to 16°C)	EBA, 2011
	Gilt Edge Mine	Lead, South Dakota	7°C (-7°C to 19°C)	US. EPA, 1994
	Fort Knox Mine	Fairbanks, Alaska	-2.9°C (-23°C to 17°C)	Fairbanks Gold Mining, 2013
	Eagle Gold Project	Mayo, YT	-3.6°C (-27°C to 16°C)	Victoria Gold Corp., 2012
Vegetated cover of HLF	Brewery Creek	55 km east of Dawson City, YT	-4°C (-27°C to 16°C)	EBA, 2011
	Key Lake Mine	570 km north of Saskatoon	-5°C (-17°C to 20°C)	MEND, 2009
	Fort Knox Mine	Fairbanks, Alaska	-2.9°C (-23°C to 17°C)	Fairbanks Gold Mining, 2013
	Eagle Gold Project	Mayo, YT	-3.6°C (-27°C to 16°C)	Victoria Gold Corp., 2012
	• Earthen or dry cover systems are the best available technology for spent heap leach piles			Ayres and O'Kane, 2013 MEND, 2009 MEND, 2010 MEND, 2013
INCO/SO_2 Cyanide destruction water treatment plant	Equity Silver	Houston, BC	4°C (-10°C to 15°C)	Price and Aziz, 2012
	Premier Gold Project	20 km north of Stewart, BC	6°C (-4°C to 15°C)	Zurkirchen and Mchaina, 1999
Co-disposal of tailings and waste rock in TMF	Eskay Creek Mine	50 km northwest of Stewart, BC	6°C (-4°C to 15°C)	Barrick, 2014
	Huckleberry	86 km southwest of Houston, BC	4°C (-10°C to 15°C)	Lighthall et al., 2007
	Mt.Milligan	155 km northwest of Prince George	3.5°C (-10°C to 15°C)	Borntraeger and Hamilton, 2011
NAG tailings and/or water cover of tailings and waste rock	Equity Silver	Houston, BC	4°C (-10°C to 15°C)	Price and Aziz, 2012
	Kemess South	300 km northwest of Mackenzie, BC	2°C	Lysay, et.al., 2011

Proposed Closure Methodology	Demonstrated Use *(italics indicate Projects not yet in closure)*	Location	Average Annual Temperature (average range)	Reference
			(-11°C to 15°C)	
	Eskay Creek Mine	50 km northwest of Stewart, BC	6°C (-4°C to 15°C)	Barrick, 2014
	Wolverine Mine	Frances Lake, YT	-3°C (-20°C to 13°C)	Yukon Zinc, 2015
	Mt.Milligan	155 km northwest of Prince George	3.5°C (-10°C to 15°C)	Borntraeger and Hamilton, 2011
	Huckleberry	86 km southwest of Houston, BC	4°C (-10°C to 15°C)	Lighthall et al., 2007
Treatment wetlands	Campbell	Red Lake, Ontario	0.9°C (-20°C to 18°C)	Terrane, 2008
	Musselwhite	North of Thunder Bay, Ontario	2.4°C (-15°C to 18°C)	Terrane, 2008
	United Keno Hill Mine	Elsa, YT	-3.6°C (-27°C to 16°C)	Sobelewski, 1996
	Mt.Milligan	155 km northwest of Prince George	3.5°C (-10°C to 15°C)	Terrane, 2008
	Eagle Gold Project	Mayo, YT	-3.6°C (-27°C to 16°C)	StrataGold, 2014
	Minto Mine	Minto, YT	-2°C (-43°C to 30°C)	Capstone, 2014
	Nico Project	160 km northwest of Yellowknife	-5°C (-27°C to 17°C)	Fortune Minerals, 2011
	• See Appendix A.4H for more examples of cold climate passive treatment systems			

B.4.10.2 Design and Operation of Wetland Water Treatment System

B.4.10.2.1 R2-71

R2-71. In relation to examples of successful similar treatment systems provided in Appendix A.4H (Cold Climate Passive Treatment Systems Literature Review), a discussion on flow rates relative to those for the proposed project.

Constructed wetlands are considered to be one of the most established passive treatment methods for remediating mine-impacted water and have been used by the mining industry since the mid-1980s (Eger and Wagner 2003, Gusek, 2000, ITRC 2003). In flow-controlled systems, the flow rate through the system can be controlled to provide the required retention (treatment) time to optimize the size of the treatment plant. In un-controlled systems, such as treatment wetlands and bioreactors, the systems themselves must be sized to meet the requirements for retention time to achieve the water quality objectives, using the following equations:

$$t = \frac{-\ln\left(\frac{C_f}{C_i}\right)}{k} \quad \& \quad t = \frac{V}{Q}$$

Where:

t = hydraulic retention time

k = first-order treatment rate coefficient for a given constituent/design

C_i = inflow concentration of the constituent

C_f = outflow concentration of the constituent

V = volume of water in the system

Q = flow rate

Retention time in constructed wetlands are often restricted by topography and available area; however, at the Casino Project, the tailings management facility forms the foundation for the treatment wetlands, and as such, the available area is effectively unlimited (i.e., available area is much greater than the retention time requirements to achieve the treatment objectives).

EcoMetrix specifically raised the concern of having an example of a successful, full scale wetland treatment at a flow rate of 220 L/s. The maximum predicted flow from the open pit, is 394 L/s (95th percentile – June of year 148), but the flow rate, on average, is only 21 L/s. To meet CCME guidelines for the protection of aquatic life (CCME, 2007), at the 95th percentile concentrations, a 70 ha wetland would be required at the North TMF, compared to the 7 ha wetland previously estimated in Appendix 4A with regulated flows. However, the sizing of the North TMF wetland is conducted to minimize the load to the South TMF wetland, and is not necessarily required to meet CCME guidelines. However, as described in Appendix B.4G, a 12 ha wetland at the North TMF is able to achieve CCME guidelines for all parameters in an average scenario.

In comparison, wetland treatment technology has been used at the Campbell and Musselwhite mines in Red Lake and north of Thunder Bay, Ontario, respectively, since 1998. The flow rates at those treatment wetlands is on average 85 L/s at the Campbell mine and 180 L/s at the Musselwhite mine for wetlands 22 ha and 42 ha, respectively (Terrane, 2008). A constructed wetland approved at the newly operational Mt.Milligan mine is proposed to be 14.5 ha, with average flows of 20 L/s, comparable to the 21 L/s predicted for the North TMF wetland (Terrane, 2008). The average annual temperatures at these three sites are provided in Table B.4.10-3, and are comparable to the Casino Project with temperatures getting to below -20°C in the winter months. Water quality results from the Campbell and Musselwhite mines are summarized in Table B.4.10-4. Data is summarized from the *Mt.Milligan Copper-Gold Project Environmental Assessment Report V.2.0* (Terrane, 2008).

Table B.4.10-4 Campbell and Musselwhite compared to predicted Casino Water Quality Results

	Casino Project (North TMF Wetland)				**Campbell Mine**		**Musselwhite Mine**	
Size	10 ha		10 ha		22 ha		42 ha	
Flow Rate	21 L/s		55 L/s		85 L/s		180 L/s	
	Concentration (mg/L)							
Parameter	**Inflow (50th/50th)**	**Predicted Outflow**	**Inflow (95th/95th)**	**Predicted Outflow**	**Inflow**	**Measured Outflow**	**Inflow**	**Measured Outflow**
Cd	0.0036	**0.00008**	0.0037	0.00023	n/a	n/a	n/a	n/a
Cu	4.9	**0.035**	5.0	**0.035**	0.057	**0.011**	0.02	**0.003**
Se	0.012	**0.001**	0.012	**0.001**	n/a	n/a	n/a	n/a
U	0.056	**0.015**	0.058	**0.015**	n/a	n/a	n/a	n/a

Bold values are less than CCME guidelines; Inflow (50th/50th) indicates that the model results represent predictions of 50th percentile water quality and 50th percentile flow.

B.4.10.2.2 R2-72

R2-72. In relation to plans on field studies to support and refine the effectiveness of the wetland water treatment system, details on:

a. what benchmarks (e.g. CCME WQO or SSWQO identified in proposal) will serve as the performance objectives for the overall passive treatment system;

b. what performance triggers (i.e. clear indication that the current strategy will not achieve treatment objectives) will be used during the development of the passive treatment system to identify when contingency treatment methods, such as development of bioreactors in the case of the HLF, will need to be investigated.

a. To clarify, as stated in the response to R238, CMC did not present site specific water quality objectives (SSWQO) in the Project Proposal. The purpose for presenting guidelines such as those outlined in the CCME water quality guidelines for the protection of aquatic life (CCME, 2007), or alternative guidelines such as BC MOE or US EPA guidelines was to determine the significance of effects of water quality parameters that have been predicted to exceed CCME guidelines. SSWQOs will be presented during the Type A Water Use Licence application, and will be used to determine appropriately protective limits for discharge to the environment.

   In relation to the wetland water treatment systems, performance objectives will be compared to CCME guidelines initially, until treatment objectives are derived from the approved discharge criteria issued by the Type A Water Use Licence. As detailed in Appendix B.4G, modeling indicates that CCME objectives can be met by the various wetlands, and the wetlands will be sized to accomplish this objective. However, the treatment rate coefficients will need to be refined through pilot-scale (off site), and demonstration-scale (on site) testing, as removal rate coefficients are highly specific and must be developed in a site-specific manner, for each element of interest. The treatment rate coefficients applied in the updated wetland modeling were based on pilot-scale testing conducted at another site in the Yukon and a mine in the Northwest Territories. The model assumed that the CCME concentrations are thermodynamically possible within this system, which will be confirmed in pilot-scale testing.

b. As detailed in the response to R116, a phased design and optimization program is being implemented for the site-specific development of the treatment wetlands. These phases are: 1) site assessment and information gathering including technology selection and conceptual design, 2) bench/laboratory-scale and pilot-scale testing and optimization (controlled environment), 3) on-site demonstration-scale confirmation and optimization, and 4) full-scale implementation. Performance triggers at each phase of development are outlined in Table B.4.10-5, and contingency options are provided. While CMC is confident in the robustness and effectiveness of the proposed treatment strategy, Table B.4.10-5 outlines possible alternatives should the results of the treatment system testwork prove drastically different than those modeled.

Table B.4.10-5 Performance Triggers for Wetland Treatment System Development

Activity	Objective	Performance Triggers for Consideration of Contingency Options	Possible reasons why	Timeline	Contingency options
Literature and water quality modeling	Determine conceptual feasibility of passive water treatment, in context of site-specific aspects.	Constituents requiring decrease in concentration to meet WQO are not deemed treatable based on scientific modeling.	Although the elements in the water are conceptually treatable, the overall water chemistry could negatively affect the treatability.	• First iteration has successfully been completed. All elements requiring treatment are theoretically treatable, with exception of sulphate. • Will need to be refined as water quality modeling is revised.	• Different water sources at site may require different wetland designs • Explore semi-passive treatment options (e.g., metered organics into wetland, addition of iron or manganese sources, vertical flow design, or bioreactor). • Re-evaluate site water management to enhance treatability (e.g., mixing contaminated waters before treatment, or treating before mixing in order to achieve best treatment).
Water periodicity modeling	Determine conceptual feasibility of passive water treatment, in context of seasonality of flows and site-specific aspects	Treatment needed in winter when wetlands frozen.	Seepage and overflow during winter months is sufficient to maintain flows throughout the year (rather than glaciating as happens at other mines in the Yukon).	On-going	• Explore options for water management (holding ponds) • Explore semi-passive treatment options for winter that do not freeze (e.g., vertical flow wetland, bioreactor).
Site assessment	Identify natural latent potential for treatment of water at site (e.g., plants growing in natural water sources with elevated metals concentrations or acidic water, sulphate and selenium-reducing bacteria at site, etc.)	No indications of passive treatment potential at site	• Plants/microbes at site are not conducive to treatment or not tolerant to elevated metals • There are no natural habitats at site with elevated metals that would also be suitable for wetland plant species (e.g., flow rates too high, intermittent drying, metals at site only associated with low pH, etc), but if topography/hydrology changed, would be possible.	August 2015	• Test local plants and microbes in laboratory-, bench-, and/or pilot-scale trials to determine actual treatment potential • Pursue semi-passive options such as bioreactor
Pilot-scale testing (off site)	Evaluate treatment feasibility and develop rate kinetics for passive water treatment in context of site-specific aspects.	• Treatment rates at pilot-scale suggest land area is insufficient to achieve required WQO's. • Constituents considered as theoretically treatable are not decreasing in concentration as expected. • Plants unable to withstand flow rates	• Hydrology of wetland requires adjustment • Soil substrate of wetland requires modification (organics, nutrients) to initiate cycling that will be performed by plants later on. • Flow rates or concentrations too great to achieve full removal extent needed.	Pilot-scale testing iteration 1 will take 12-18 months to complete. Can be initiated anytime after site visit report is complete.	• Second iteration of pilot-scale testing to optimize designs/soils/plants • Consideration of semi-passive water treatment options such as bioreactors or semi-passive wetland designs for enhanced treatment rates (e.g., dosing of organics, amendment additions, vertical flows)
	Evaluate fate and	• Unacceptable metals uptake into	Targeted ranges of explanatory parameters not		• Second iteration of pilot-scale testing to optimize

Activity	Objective	Performance Triggers for Consideration of Contingency Options	Possible reasons why	Timeline	Contingency options
	distribution of removed elements	plants • Load to sediments is elevated and bioavailable	achieved		designs/soils/plants
Demonstration-scale testing (on site)	Confirm rate kinetics for passive water treatment on site and refine timelines for implementation of full-scale system	• Constituents considered as theoretically treatable are not decreasing in concentration as expected. • Plant survival is low	• Longer time for plants to establish • Insufficient rooting depth • Wetland dries out during winter • Materials used on site for construction are outside of specification • Water chemistry is significantly different than modeled/predicted	As soon as pilot-scale testing is complete and water similar to that of closure is available on site (e.g., at water storage pond)	• Revisit pilot scale to test other water chemistries or soil • Consideration of semi-passive water treatment options such as bioreactors or semi-passive wetland designs for enhanced treatment rates (e.g., dosing of organics, amendment additions, vertical flows)

B.4.10.2.3 R2-73

R2-73. Contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required. Details should include:
a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information;
b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed; and
c. a full alternatives assessment to demonstrate how alternative treatment technologies (that do not include wetland systems) were considered.

As detailed in Table B.4.10-3, CMC has included multiple treatment methodologies in the Conceptual Closure and Reclamation Plan (Appendix 4A) that have demonstrated effective use at mine sites comparable to the Casino Project. These are supported by the closure options analysis provided in Table B.4.10-1. Contingency options during the planning and design phase for the wetland treatment systems are provided in Table B.4.10-5.

a. Alternative treatment methodologies that may be employed to improve source water quality include:

Pit lake treatment

- **Chemical Treatment**: In the treatment of acidic pit lake waters, lime is frequently added as a dilute lime solution, to neutralize the acidity (Jensen et al., 2014). However, the impact of lime dosing is only effective if there is an initial acidic load that can be neutralized by lime treatment, and the net input is alkaline (Jensen et al., 2014). However, with excess addition of carbon and lime, the treatment may be permanently effective (ITRC, 2010a). An example of proposed lime treatment of a pit lake is at Lorado site (Nero Lake subaqueous disposal) in Northern Saskatchewan (Jensen et al., 2014), the Barite Hill mine is South Carolina (ITRC, 2010a) and the Copper Basin site in Tennessee (ITRC, 2010a).
- **Biological Treatment:** Enhanced metal removal through biological growth stimulation. This treatment involves the addition of fertilizers and/or carbon sources such as sugar or ethyl alcohol to stimulate algal bloOM&S. The biogenic particles in the algae scavenges metals from the water column and as the plankton dies, settles to the bottom of the pit lake, where, under the highly reducing conditions at the bottom of deep pit lakes, sulphate reducing bacteria precipitate metals as metal sulphides (Laberge, 2010). This treatment was conducted at the Faro Mine Complex in 2002, and reduced zinc from 58 mg/L to 3 mg/L (Laberge, 2010).

Heap Leach Facility

- **Rinsing of Heap Leach Pad:** Upon cessation of supplemental gold recovery at the end of mine life, heaps can be detoxified by rinsing with treated solution and/or freshwater using the solution irrigation system. The water accumulated in the heap is then allowed to draindown until the ore on the heap reaches the long-term estimated moisture content. The heap is then re-contoured and covered to minimize further precipitation infiltration.
- **Biological Destruction:** Bacterial destruction enhances cyanide destruction through the promotion of cyanide-degrading bacteria commonly found already existing in spent heaps. Through the addition of nutrients such as sugars, alcohol and fats, existing bacteria in the heap use the nutrients to transform

cyanide and other metals to stable forms (EBA, 2011). This treatment was successfully used at the Brewery Creek mine in Yukon (EBA, 2011).

- **Capping and Covers:** Various capping and covering techniques are available to amend infiltration characteristics of mine waste piles, such as:
    - Simple soil caps
    - Drainage layers
    - Geotextiles
    - Evapotranspiration covers
    - Impermeable caps
    - Hardened cover
    - Vegetative cover
    - Phytostabilization (ITRC, 2010d)

  The selection of which technique to use depends on the physical parameters of the available borrow materials, annual precipitation, current and future use, and water quality predictions and discharge objectives (ITRC, 2010d).

Effluent Treatment

- **Conventional Treatment:** Conventional water treatment can incorporate chemicals such as lime, sulphides, and/or coagulants to introduce alkalinity, induce precipitation of contaminants and coagulate metal precipitants (ITRC, 2010b). This approach is the most common method for addressing elevated metal concentration in mine waters and is in use all over the world. There are many variations available to adapt the technology to specific conditions of a particular site. At the Casino Project, conventional treatment would most likely incorporate lime-based pH adjustment followed by precipitate settling and metal removal. The main components of the system would be: lime storage, lime conditioning, lime mixing with effluent, settling and precipitate removal in a clarification tank and sludge disposal. A conventional treatment system would require chemical reagents and fuel to be trucked to the site, ongoing power production, operators for the plant, and all associated site infrastructure and logistics support for ongoing site presence. Perpetual treatment has very high capital and on-going maintenance costs.
- **Bioreactors:** Bioreactors utilize the ability of microbes to transform contaminants and to increase pH, typically under anaerobic conditions (ITRC, 2010c). Bioreactors can be designed as open ponds, buried ponds, within tanks, or trenches and are filled with an organic substrate with a mixture of organic materials, and, if neutralization is required, limestone (ITRC, 2010c). Passive bioreactors have low operation and maintenance costs, however, are limited by flow rates, extended periods of severe cold, and pH range (ITRC, 2010c). Bioreactors may also be executed in active treatment systems, which can more readily accommodate high flow rates and pH adjustment, however, as with conventional treatment discussed above, would have ongoing power production, operators for the plant, and all associated site infrastructure and logistics support for ongoing site presence.
- **Constructed Wetlands:** Constructed wetlands are engineered wetlands with drain, anaerobic and aerobic layers with transplanted water loving plants in constructed impoundments rich in organic carbon substrate (Laberge, 2010). Constructed wetlands can decrease of total suspended solids, remove total and dissolved metals, and neutralize acidic waters. Constructed wetlands can be designed for seasonal or year round water treatment, requiring varying degrees of maintenance ranging from passive care to semi-active management. Constructed wetlands can also be built into a treatment train with active treatment systems to reduce overall costs. These options must take into account the water chemistry and flows, but also the overall site objectives and goals of the constructed wetland (Haakensen et al., 2015).

Hundreds of constructed wetlands have been used to treat mine waste water for many years (Laberge, 2010). In the Yukon, experimentation with passive wetlands began in 1995 at the former United Keno Hill Mine (Laberge, 2010), and constructed wetlands are currently approved for implementation at closure in the Yukon at the Minto Mine (Capstone, 2014) and Eagle Gold Mine (StrataGold Corp, 2014) and in the Northwest Territories at the Nico Project (Fortune, 2011).

b. *Conventional water treatment options within the framework of the water treatment plan for temporary and final closure.*

In the event that no other technology could be developed to an adequate reliability level, then conventional water treatment could be used on a temporary or long-term basis. Such a situation is not acceptable to Yukon Government or CMC, therefore, it is the expectation of both organizations that there would be significant research and optimization of the proposed water treatment method. The proposed constructed wetland treatment systems have been modeled to remove contaminants of concern down to acceptable concentrations in the various site waters. However, there remains outstanding questions as to tolerable range of influent chemistry, range of conditions under which good treatment can be achieved (temperature and flow), and achievable water quality. Determining the limits of the wetland system will define the conditions/thresholds under which it could be necessary to use conventional water treatment for part of the year or for a period of years until conditions exist that are suitable for wetland treatment.

There are four time periods where it is conceivable that water quality could be outside the range for which wetland treatment is viable. These are:

i. In the initial closure period (just after end of operations when the pit is filing) when TMF pond water is impacted by contact with waste rock;

ii. When the pit overflows, and the pit pond has not stratified or water quality is worse than expected due to PAG rock on the pit walls;

iii. Early post-closure of HLF as final drain-down occurs; and

iv. If a plume of significantly different quality seepage emerges below the dam.

Scenarios 3 and 4 above may be mitigated through the HLF wetland and WMP wetland contingencies discussed in Appendix B.4G. However, for any of the above scenarios, a supplement to wetland treatment could be required. This could involve a broad range of treatment activities using conventional water treatment. The main aspect of this would be collection of select contaminated water, treating it with chemical reagents in a mixing/conditioning system and then removal of precipitate. Sludge disposal would likely be in the open pit bottom, although construction of a dedicated sludge facility or deep injection into the void space of PAG rock in the TMF are viable alternatives. A conventional treatment system would require chemical reagents and fuel to be trucked to the site, ongoing power production, operators for the plant, and all associated site infrastructure and logistics support for ongoing site presence.

At this stage of the Casino Project, all water quality predictions have been made with conservative or first-flush chemistry values, and the need for conventional water treatment is not expected. The water quality that might necessitate conventional water treatment is outside the range of predictions, and consequently it is not feasible to provide details on plant capacity, chemical requirements or effluent quality. Site water quality will be monitored during operations, and if poorer than expected water quality occurs such that conventional treatment is required, then the plant can be designed at that time, with the commitment to temporary operation, with long-term solutions complying with the objectives of the Yukon Government's *Reclamation and Closure Planning for Quartz Mining Projects* (Government of Yukon, 2013).

c. *Assessment and consideration of alternative treatment technologies*

A rigorous assessment of alternative water treatment technologies was not conducted during the design phase of the Casino Project, as all alternatives which required continuous site presence were rejected as unacceptable. The project team was strongly guided by the objective of the Yukon Government to avoid long-term site presence.

All aspects of the project were designed to avoid or minimize the risk of adverse water quality (see Section 2 of the Conceptual Closure Plan (Appendix 4A) for the list of 16 major design considerations to achieve this objective). However, the notion of zero or negligible impact was identified as unrealistic for the Casino Project. Therefore, some modest level of treatment was expected to mitigate potential downstream impacts. Only passive treatment technologies were considered.

A well-respected and commonly used tool used in the evaluation of passive treatment technologies is the Interstate Technology Research Council (ITRC) Mining Waste Treatment Technology Selection Guidance Document (http://www.itrcweb.org/miningwaste-guidance/). The ITRC Mining Waste Treatment Technology Selection Guidance Document provides an efficient process for identifying appropriate treatment technologies through use of a formal decision matrix and technical backup. These are in the form of technical guidance documents that facilitate more detailed evaluation, design, and implementation of the identified preferred treatment technologies. This process was particularly well suited for incorporation in the assessment of conventional treatment technologies for the reclamation and closure plan. CMC and its consultants also made use of applicable northern climate guidance documents in the decision process, such as those produced by Mine Environment Neutral Drainage (MEND).

The conventional treatment methods of constructed wetlands and bioreactors were selected for the Casino site based on a thorough review of literature for available technologies, as well as application of the ITRC web decision making tools and guidance documents produced by MEND. These have been selected as proven and conventional treatments, but with the realization that they need to be applied in a site-specific manner, through a phased program for design and optimization. Casino Mining Corporation has committed to undertake such a program. Aside from the conventional and proven treatment methods that were selected as primary means of water treatment in closure for this project, several contingency methods of passive water treatment were also identified through the technology review process (Appendix A.4H Cold Climate Passive Treatment Literature Review). In addition to the selection of conventional treatment technologies, contingency passive treatment methods, and a phased research program for the site-specific design, optimization, and implementation of these technologies, the current state of knowledge will be regularly reassessed through CMCs reclamation research program to ensure the technologies being applied are appropriate to the closure objectives of the site.

B.4.10.2.4 R2-74

R2-74. In order to evaluate the potential effects related to the worst case scenario of an ineffective passive treatment, prediction of a worst case scenario of downstream water quality assuming no treatment system. Predictions should extend as far downstream as necessary to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME).

CMC re-iterates that occurrence of zero treatment is not an acceptable outcome for the passive treatment systems, and as such, cannot predict the downstream water quality in this scenario. However, CMC understands the need to assess accidents and malfunctions, and the possible mitigations that may be needed to avoid such occurrences. Evaluation of the variability model, which examined a 52 year dataset, with varying hydrologic conditions (i.e., wet and dry periods) through the water quality model (Appendix A.7B) enables CMC to evaluate the impacts of high flow (i.e., upset) conditions on the passive treatment system. While the flows in Casino Creek can vary from 0.5 m^3/s summer flows in dry years to 1.7 m^3/s in wet years (Figure B.4.10-1), the effect on the downstream water quality (e.g., for copper in Figure B.4.10-2) is muted, due to the system of controlled storage in the water management pond, and a controlled discharge from the TMF spillway. In fact, water quality concentrations are higher in the receiving environment during the low flow periods, when impacts from seepage (which is a constant rate) are greater (Figure B.4.10-2). As such, CMC is considering a supplemental passive treatment system downstream of the water management pond, as described by Contango in Appendix B.4G.

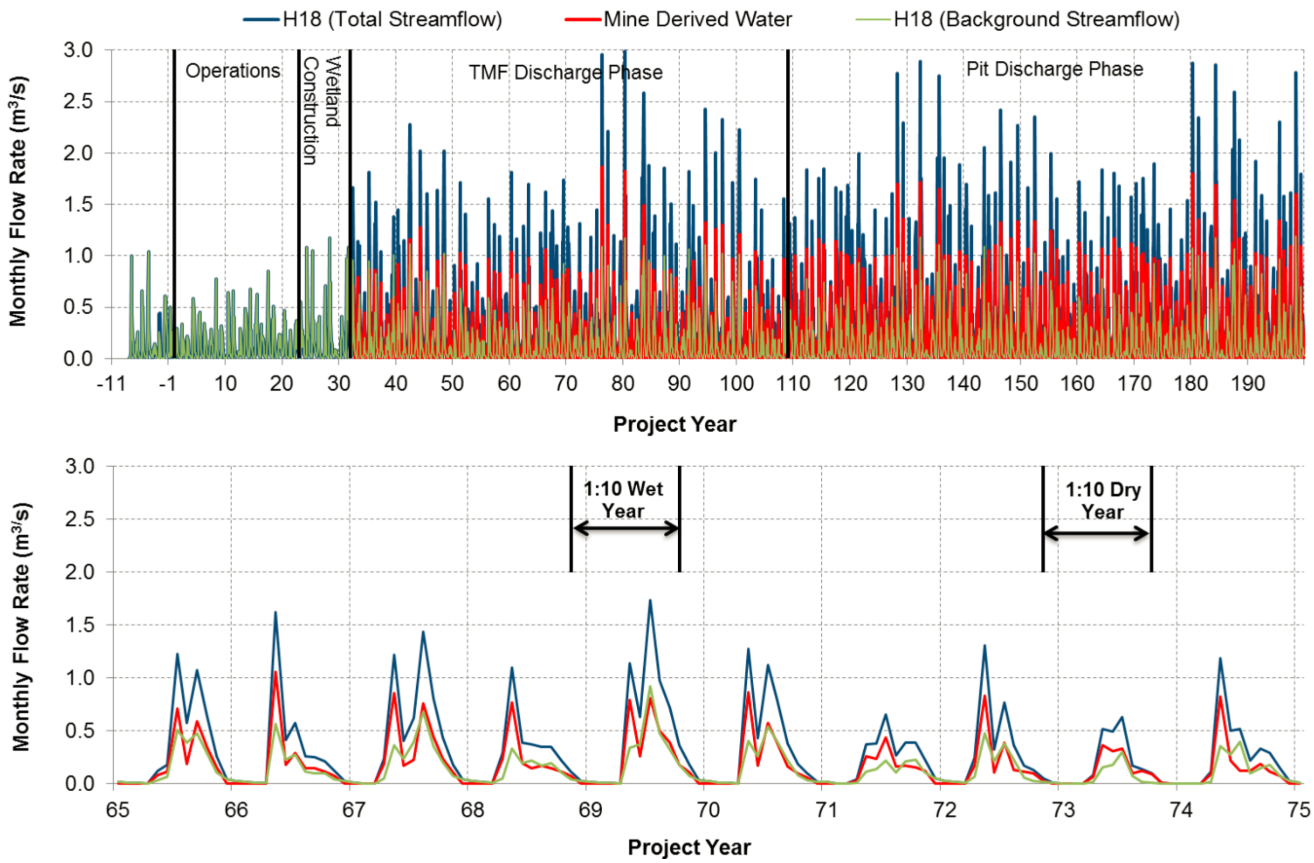


Figure B.4.10-1 Monthly Flow Rate in Casino Creek at H18 (Realization #1)

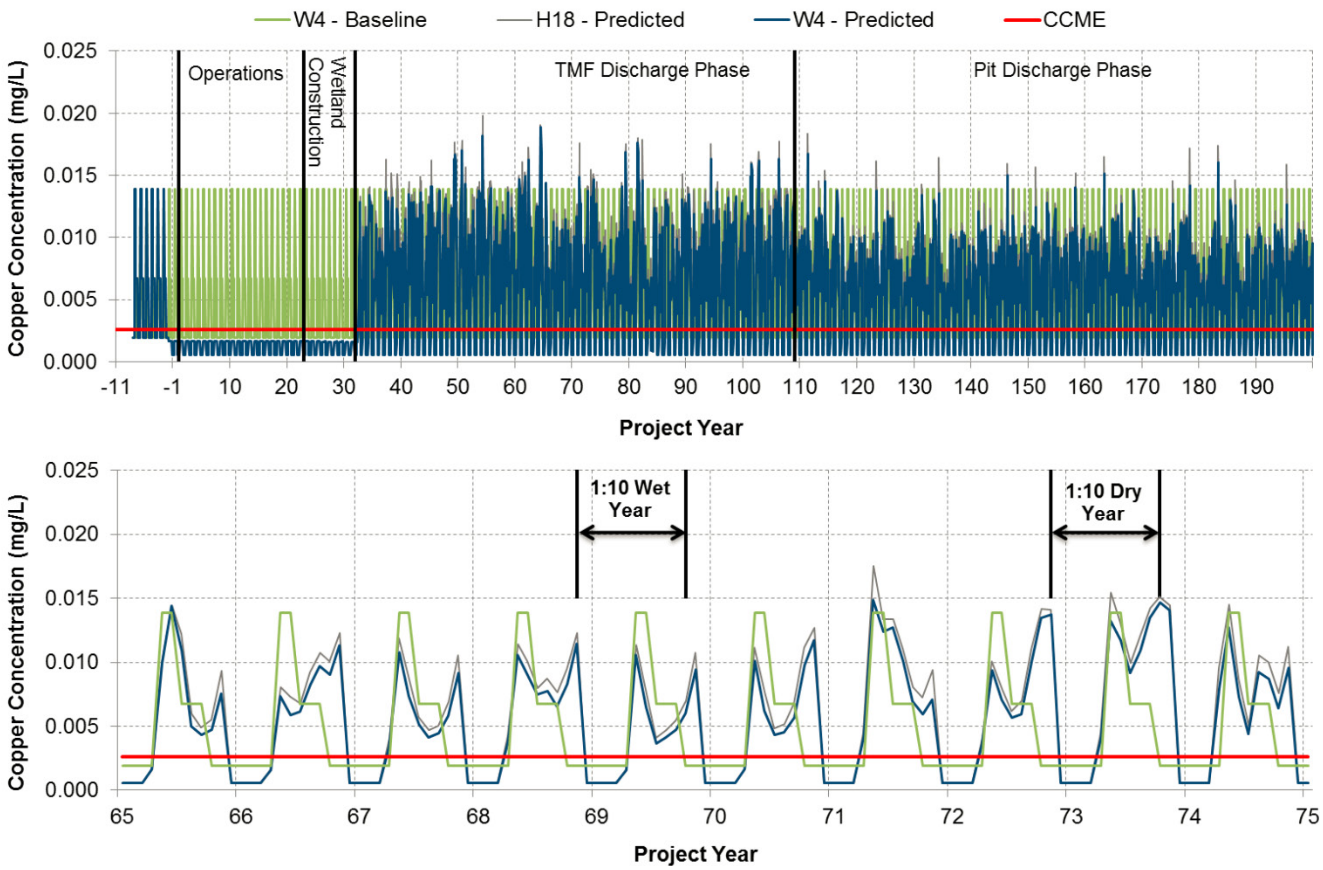


Figure B.4.10-2 Modelled Copper Concentration at H18 and W4 (Realization #1)

To prevent malfunctioning of the passive treatment systems, CMC has included the following mitigation measures in the Closure and Reclamation Plan (Appendix 4A):

- Construct the treatment wetland systems during the active closure phase;
- Continue to pump back TMF seepage to the TMF pond during active closure;
- Validate wetland performance for as many years as is required to produce acceptable discharge water quality. Continue to pump back seepage until wetland performance is validated; and
- Once discharge has commenced from the South TMF wetland, continue to monitor downstream water quality and monitor wetland systems during annual inspections.

Further, as summarized in the response to R121, while there is a high level of confidence that the proposed systems will address the water treatment goals of this project, as an added measure of conservatism the phased program of testwork is being developed in the context of additional passive contingency, alternative, or additional treatment options that could be implemented should it be deemed necessary, and may include:

- Allocation of greater area for treatment wetlands than expected to be needed, providing for additional wetland treatment areas if needed.
- Testing of multiple wetland designs at pilot-scale to refine optimal site-specific design and operation strategy.
- Control of flow from Open Pit with solar powered valve.

- Treatment of HLF draindown by bioreactor prior to pumping to Open Pit.
- In-pit treatment prior to discharge of Open Pit to TMF.
- Added treatment wetland for HLF seepage to TMF.
- Construction of demonstration-scale treatment wetland at WMP early in operations, with retention of this treatment capacity in closure.
- Enhancing wetland treatment by periodic dosing of electron donors (e.g., ethanol, methanol, straw, wood chips).
- Incorporation of materials with iron in conveyance channels and wetland construction materials to promote targeted cation-anion balances.
- Strategic co-management of water sources and treatment locations (e.g., HLF, Open Pit, TMF, WMP).
- Strategic incorporation of spillways/conveyance channels to promote glaciation in winter months.
- Sizing of North TMF wetland assuming no regulation of flows coming from open pit and also no application of a bioreactor during draindown period.
- Evaluation of possibility of designing South TMF wetland to treat for water, assuming North TMF wetland not constructed.
- Evaluation of timing for when to build the North TMF wetland.

Further, an assessment of the current wetland treatment design has been conducted by Contango Strategies (Appendix B.4G), which outlines some contingency measures available to CMC should the North and South treatment wetlands do not perform as designed. These include:

- Construction of a wetland downstream of the Water Management Pond;
- Construction of a wetland at the toe of the HLF;
- Amended sizing of the wetlands based on the updated variability water quality model (Appendix A.7B); and
- A plan for laboratory and field work to verify the assumptions in the conceptual plan.

As such, due to the multiple approaches available to CMC to prevent impacts to the downstream receiving environment, CMC is confident in the ability of the passive treatment systems to meet the downstream water quality objectives.

B.4.10.2.5 R2-75

R2-75. A discussion and rationale on how the design of the north end of the tailings management facility wetlands will accommodate a range of possible flows from the pit lake. Identify how residence time can be controlled when flows are expected to be so highly variable, and how the proposed control valves could be relied upon in such a remote area.

A technical memo has been provided by Contango Strategies, which describes the analysis undertaken to develop conceptual sizing for the constructed wetland treatment systems. This memo includes an assumption of no flow control from the Open Pit and also conservatively assumed no freezing of the open pit lake water overflow in winter (i.e., winter operation of the wetland systems). This memo is provided in Appendix B.4G.

B.4.10.2.6 R2-76

R2-76. Details and design considerations for the remotely operated solar powered decant valves. Details should include:

a. contingency planning related to malfunctions, inappropriate feedback and interaction; and

b. examples where such systems are effectively used in similar northern or cold climate conditions.

Contango Strategies has conducted an evaluation of the conceptual treatment wetland system design (Appendix B.4G) and identified that the North TMF wetland is sufficiently robust to receive flows from the Open Pit without any control of the discharge. However, in response to request R2-76, details of a remotely operated solar powered decant valve system are provided below.

A system which has the capacity to control, power and communicate (monitor) remotely a valve actuator that will in turn regulate the outflow from the open pit is currently available technology. This system could involve solar panels to provide the required energy, with supporting automated generators and fuel cell, and satellite communications to transmit data and operating signals. In addition, the system would report water level and valve position through satellite communication. It is assumed that the equipment will be serviced annually, but otherwise the system will be able to operate unattended.

An electronic control system will be required to open and close the valve. It will consist of several sub-components, including: solar panels to collect energy, bank of batteries to store the energy, motor control system to run the electric motor which opens and closes the valve on the pipe, an instrumentation system to record data on water level, water temperature, and flow rate in the pipe, and finally, a communications element to allow remote operation of the whole system. The communication system will use existing satellite phone technology.

a. Contingency aspects of the design are:

- Valve type will default to “closed” if there is a power failure or upset in the control system.
- Any power failure or system interruption would lead to an alert at the off-site control center. Personnel would be sent, likely by helicopter, to make repairs as necessary.
- In the event of an extreme upset, where the intake structure is damaged or somehow the pipeline becomes blocked, it would be possible to install a temporary siphon or barge system (depending on freeboard to pit invert) to remove pit water until repairs could be made. This would require equipment and possibly a small generator to be mobilized to the site.

b. The remotely controlled system for gravity discharge from the pit to the TMF is the option which best meets the principles and approaches for reclamation and closure planning outlined by the Yukon Government in the Reclamation and Closure Planning guidance (Yukon Government, 2013). This approach may be considered “new” as the electronic capacity for such a system did not exist a decade ago (except for satellite operations), and only recently have mine closure objectives modified so as to avoid long-term site presence. CMC is unaware of any other site that has a similar in active use. At a high level, the proposed system is akin to the currently available technologies for remote operation of household items using a cell phone. The system will require solar energy capture and storage for remote operation. The recently approved Fortune – Nico Project in NWT has envisioned a similar concept for the post-closure management of seepage from the TMF (Fortune Minerals, 2013).

B.4.10.3 Open Pit Stability

B.4.10.3.1 R2-77

R2-77. Details regarding potential impacts to pit water quality, and demonstrate water treatment capabilities in the TMF are sufficient, if a pit wall fails and there is a spike in metals and/or acidity in pit water.

To evaluate the impacts of pit wall failure on pit lake water quality, the GoldSim water quality model (Appendix A.7B) was run simulating a 2.1 Mt slide of the pit walls into the pit shortly after initial pit discharge (i.e., Year 120). The following steps were carried out to evaluate water quality impacts using the GoldSim water quality model:

Determine time during the post-closure model simulation when the event occurs: In general, pit lake water quality improves over the simulation after initial discharge from the pit. Therefore, the model assumed the pit wall failure occurs shortly after initial discharge, or Year 120, a few years after initial discharge.

Calculate mass of rock failure from the highwall: The 2.1 Mt slide was modelled after the 2.1 Mt landslide that occurred in the Berkley pit in Montana, resulting in a landslide generated wave. A 2.1 Mt slide would be a very large event (~20% of the total 1 km^2 of highwall) so this is considered a conservative evaluation. While the 2.1 Mt is somewhat arbitrary it allows a presentation of scale. A 2.1 Mt block would require a large section of either the north or south high wall to fail to the 4 m depth of the blast influenced zone, which while not completely impossible (since something similar occurred in Montana), a series of smaller failures would be much more likely. The impact to water quality and flood wave would be significantly reduced for smaller failures. The response to R128 in SIR-A addressed pit wall failure and the resulting landslide generated wave.

Determine the composition of rock (geochemical rock units) in the failure: Two polygons with planar areas equal to 0.21 km^2 were superimposed on the pit wall lithology (Figure B.4.10-3). Composition of the slide material was assumed to equal 50% SUP / 30% HYP / 20% CAP, based on the proportion of the total amount of each type of wall rock in the highwall.

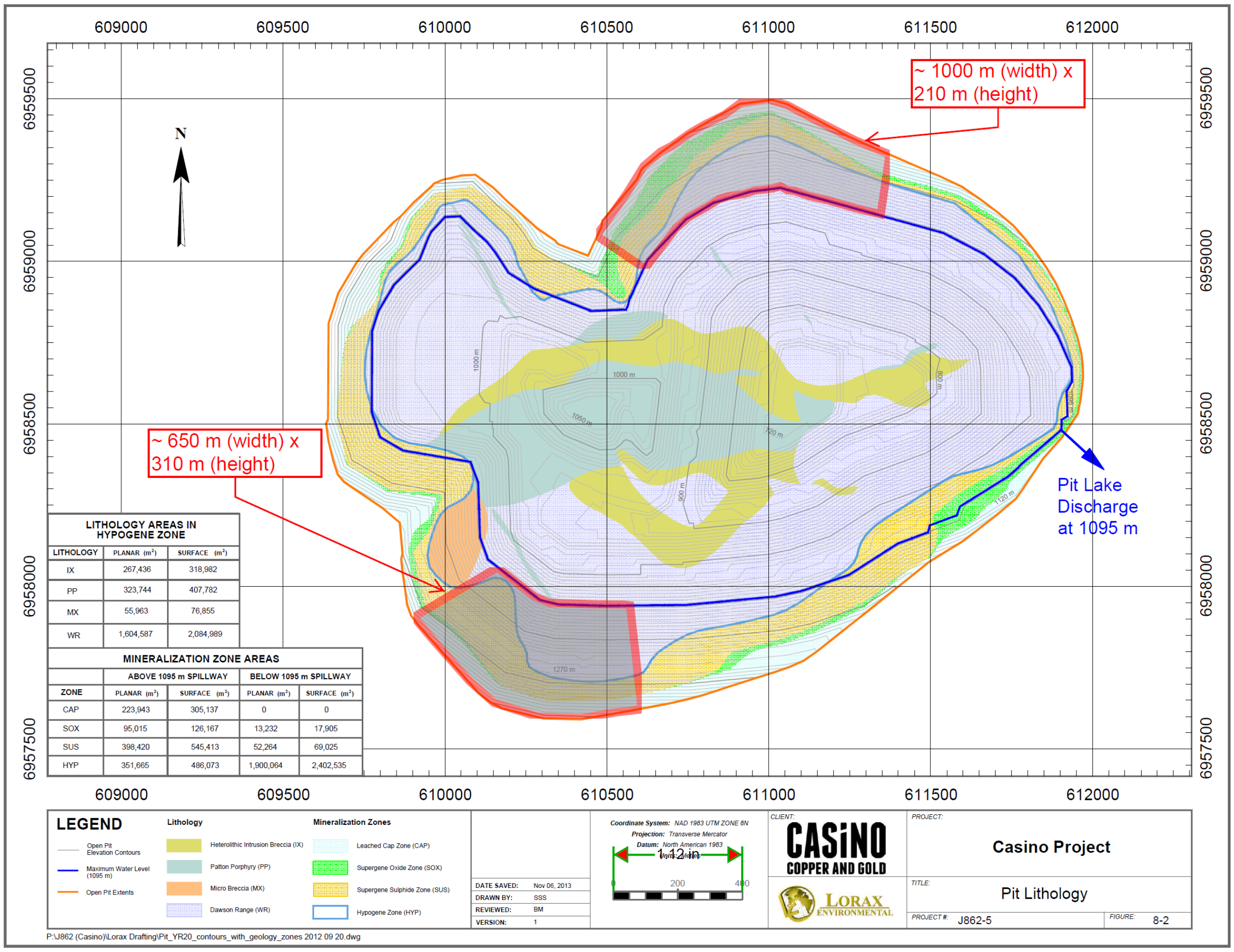


Figure B.4.10-3 Modeled Pit Wall Failure Areas

Calculate the proportion of neutral and acidic rock based on exposure time: The amount of build-up of oxidation by-products on the wall rock prior to the failure event was calculated from the values in Table 8-10 from the Lorax (2013) source term report (Appendix 7D), provided in Table B.4.10-6.

Table B.4.10-6 Available Load from Sub-Aqueous Casino Pit Wall per Year of Sub-Aerial Exposure (Table 8-10 from Lorax, 2013, Proposal Appendix 7D)

Parameter	Unit	HYP Neutral	SUP Neutral	CAP -	HYP Acidic	SUP Acidic
Sulphate	mg/m²/yr	102000	109000	24500	360000	131000
Acidity	mg/m²/yr	78.3	257	1930	274000	75300
Cl	mg/m²/yr	1040	1020	203	2440	491
F	mg/m²/yr	406	971	66	677	515
Br	mg/m²/yr	1560	1530	162	731	673
Ag	mg/m²/yr	0.00417	0.0104	0.0276	0.0895	0.0443
Al	mg/m²/yr	1.04	1.46	285	36100	8110
As	mg/m²/yr	2.54	3.31	0.221	3.36	0.72

Parameter	Unit	HYP Neutral	SUP Neutral	CAP -	HYP Acidic	SUP Acidic
Sb	$mg/m^2/yr$	2.51	5.78	0.196	0.911	0.449
Ba	$mg/m^2/yr$	42.7	91.8	24.3	11.2	1.89
Cd	$mg/m^2/yr$	0.0893	0.0478	0.138	4.05	6.52
Ca	$mg/m^2/yr$	40600	42600	6990	14400	17700
Cr	$mg/m^2/yr$	0.208	0.583	0.324	10.6	1.23
Co	$mg/m^2/yr$	0.516	1.51	4.55	83.9	19.6
Cu	$mg/m^2/yr$	7.15	25.3	370	9390	9830
Fe	$mg/m^2/yr$	6.25	24.2	14.2	24800	8800
Pb	$mg/m^2/yr$	0.19	0.185	0.124	0.63	0.266
Mg	$mg/m^2/yr$	4250	3820	1190	15000	2400
Mn	$mg/m^2/yr$	30.6	101	57.9	317	37.8
Hg	$mg/m^2/yr$	0.00625	0.0104	0.00545	0.0244	0.0224
Mo	$mg/m^2/yr$	66.7	24.6	0.265	0.654	0.0665
Ni	$mg/m^2/yr$	0.78	1.11	1.46	47	7.09
K	$mg/m^2/yr$	3170	3160	1780	580	276
Se	$mg/m^2/yr$	0.964	1.12	0.405	2.21	3.19
Na	$mg/m^2/yr$	298	307	573	145	98.2
Tl	$mg/m^2/yr$	0.0208	0.104	0.0493	0.102	0.0449
U	$mg/m^2/yr$	11.6	13.4	0.453	102	74.3
Zn	$mg/m^2/yr$	9.4	17	13.4	788	634

Calculate loading into pit based on loading rates and exposure time: The wall rock flushing loading rates are in terms of m^2 of wall rock submerged (Table B.4.10-6). To convert mass to planar area of wall rock the 3.8 m thick blast zone was assumed to slide (0.9 m + 2.9 m thick layers), equal to 14,000 kg/m^2 (Table B.4.10-7), or ~0.07 m^2/t. This was rounded up to 0.1 m^2/t for conservativeness. Therefore 2.1 Mt corresponds to about 0.21 km^2 of planar area of failure in this assessment.

Table B.4.10-7 Physical Scaling Factors (Table 8-5 from Lorax, 2013, Proposal Appendix 7D)

Scaling Factors	Unit	Blast Damaged	Blast Fractured
Thickness	M	0.9	2.9
Average Wall Slope	Degree	45	45
Mass (CAP)	kg/m^2	3,207	10,335
Mass (SUP)	kg/m^2	3,309	10,663
Mass (HYP)	kg/m^2	3,373	10,868
% of reactive material – ¼"	-	20%	5%
% of material flushed	-	75%	50%

Apply loading rates to simulate the flush of built-up oxidation by-products to calculate mass load into the pit lake: The amount of hypogene and supergene that had gone acidic by the time of the failure event was calculated using the relationships provided in Figure B.4.10-4 and Figure B.4.10-5.

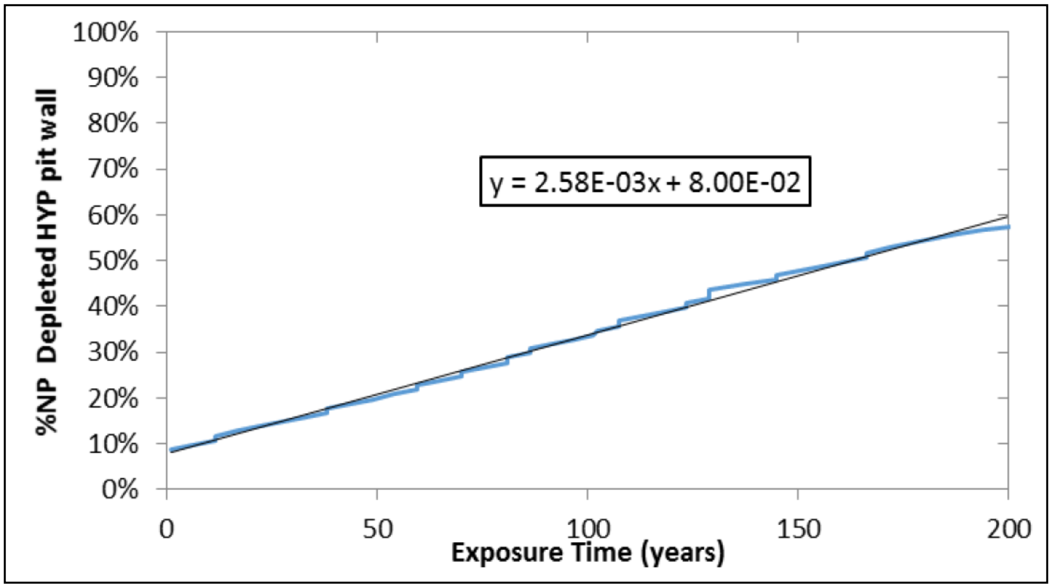


Figure B.4.10-4 Rate that HYP wall rock becomes depleted in NP as a function of exposure time (Figure 8-7 from Lorax, 2013, Proposal Appendix 7D)

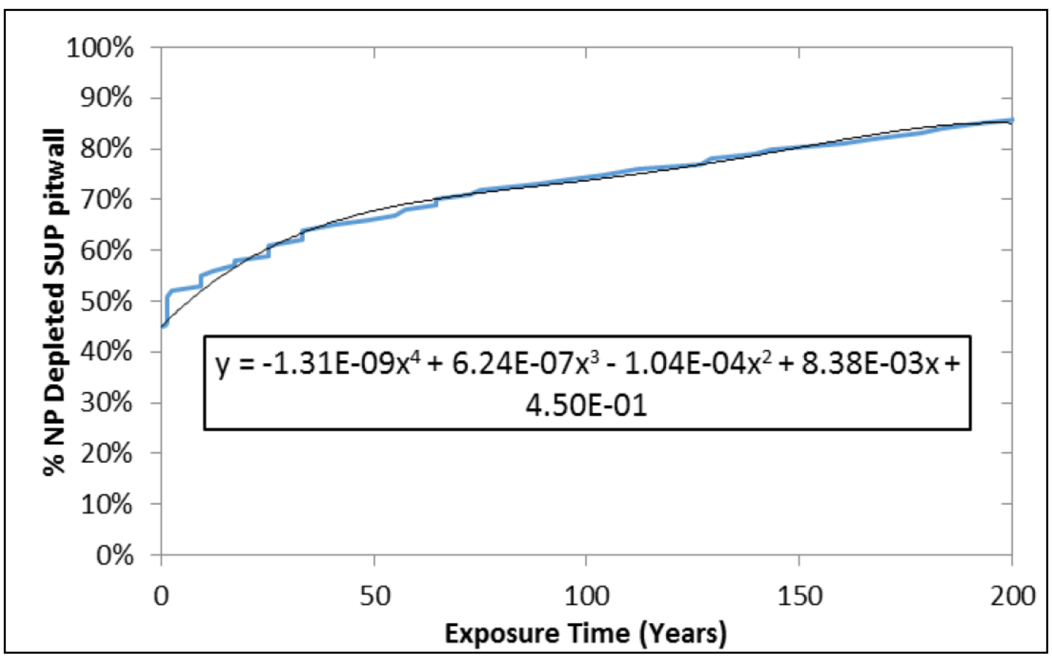


Figure B.4.10-5 Rate that SUP wall rock becomes depleted in NP as a function of exposure time (Figure 8-8 from Lorax, 2013, Proposal Appendix 7D)

Run the model, and compare with base case scenario: The results of the wall failure on pit wall water quality pH and sulphate, cadmium, copper and selenium concentrations are provided in Figure B.4.10-6 through Figure B.4.10-10. The pit wall failure scenario (orange line) is compared to the pit water quality provided in the Water

Quality Model (Appendix A.7B). Note the zoomed in y-axis to enable examination of the wall failure impact. The pit wall failure results in minor increases in the concentrations of sulphate, and metals, and would increase the long-term concentrations in the pit lake. The pH in the pit lake dips to 6.08 immediately after the failure (Figure B.4.10-6), but increases back to the value before the failure (6.20) within 4 years.

The incremental loading flushed in to the lake is mostly diluted by the pit lake and the spike in concentrations will be relatively small. The modeled pH and metal concentration ranges are well within the concentrations treatable by the North TMF treatment wetland.

The failure would also result in a temporary increase in water level of about 0.4 m. This will be well within the range of flows acceptable to the North TMF wetland. A discussion on the North TMF wetland management of variable flows is provided in the response to R2-75 above.

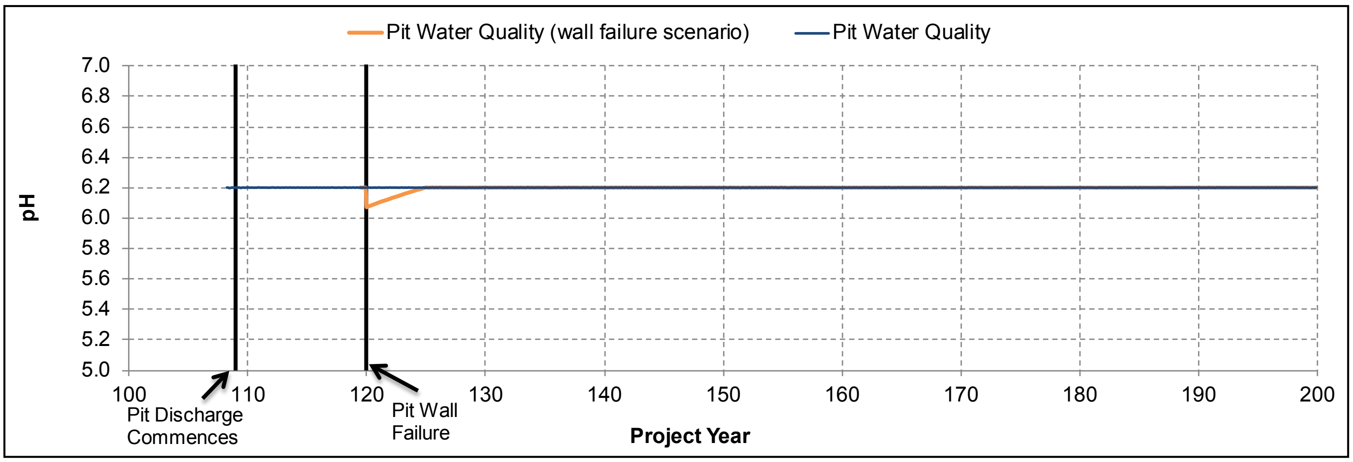


Figure B.4.10-6 Effect of Pit Wall Failure on pH

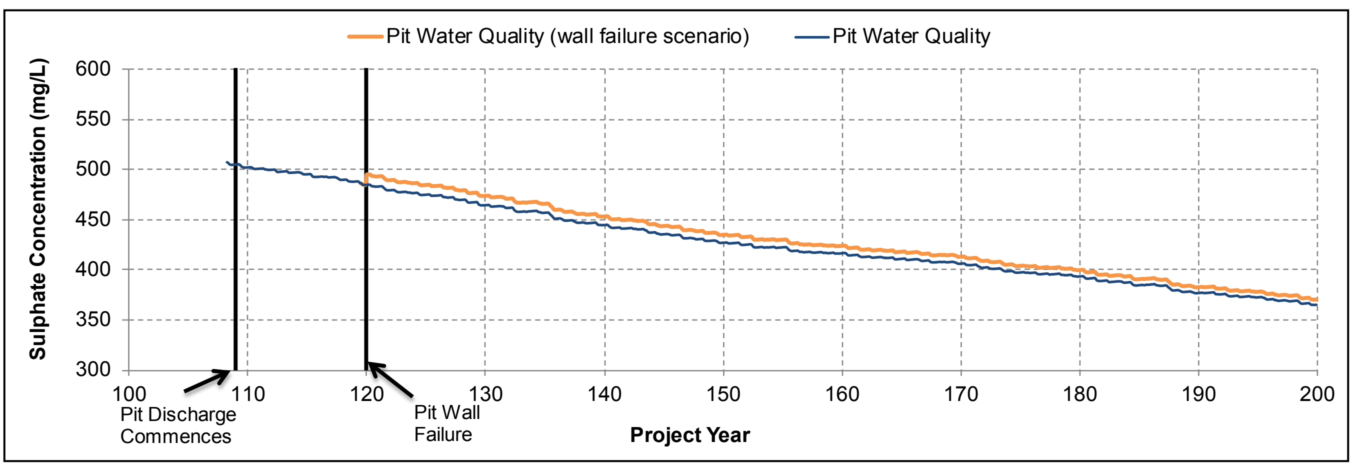


Figure B.4.10-7 Effect of Pit Wall Failure on Sulphate Concentration

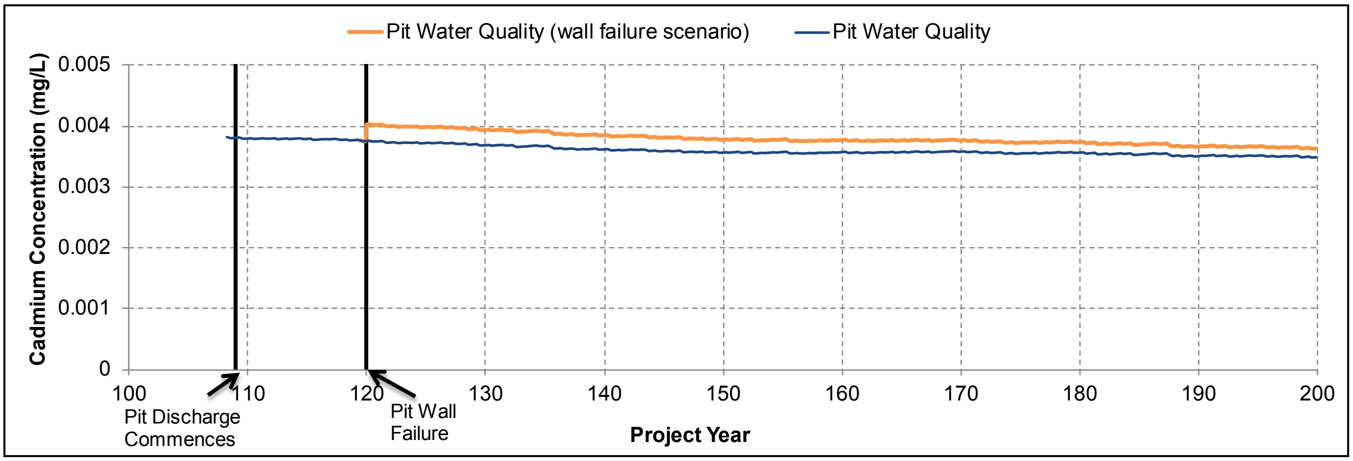


Figure B.4.10-8 Effect of Pit Wall Failure on Cadmium Concentration

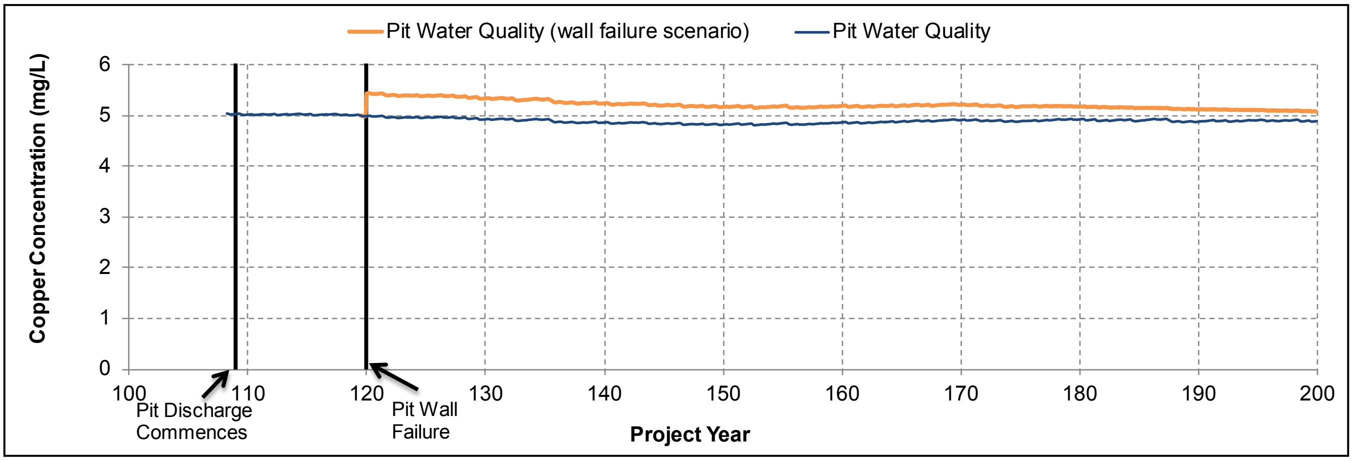


Figure B.4.10-9 Effect of Pit Wall Failure on Copper Concentration

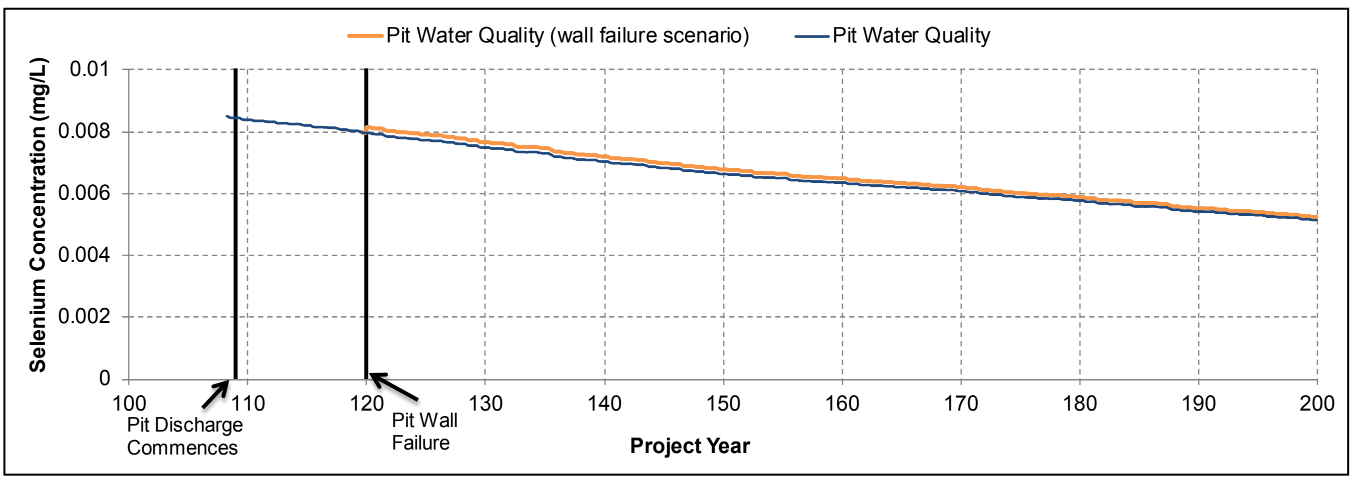


Figure B.4.10-10 Effect of Pit Wall Failure on Selenium Concentration

B.4.10.4 HLF Closure and Cyanide

B.4.10.4.1 R2-78

R2-78. Examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.

Key comparable heap leaching sites are the Brewery Creek Mine, which operated and was closed in the Yukon, and the Fort Knox Mine in Alaska, which is still operating. However, there are many heap leach facilities that have been operated and successfully closed at sizes comparable to the Casino Project in other locations (Table B.4.10-8). Of note are the large number of heap leach operations located in northern Nevada that have been operated and closed in an environment that experiences freezing temperatures every year.

Table B.4.10-8 Examples of Gold Heap Leach Operations where Heap Rinsing has been Successfully Implemented

Mine	Location	Heap Size	Rinsate	Reference
Casino Project	Yukon	157.5 Mt 8 m lifts 150 ha surface area	Freshwater followed by Inco/SO_2 treatment	
Fort Knox	Alaska	150 Mt	Freshwater with discharge to TSF. Possible treatment options being investigated include engineered wetlands reverse osmosis, oxide scavenging, chemical reduction, and biologically remediated reduction.	Fairbanks Gold Mining, 2013
Mesquite Mine	California	• 1985 – 2001: 140 Mt • 2007 – 2014: 74 Mt • 7 Leach Pads • 23 m high (6 m lifts) • 37 ha	Freshwater	US EPA, 1994 RPA, 2014b
Goldstrike Mine	Nevada	• 50 Mt • 100 ha surface area	Water followed by hydrogen peroxide and sodium hypochlorite treatment	Sengupta, 1993 Zhan, et. al., 2013
Gold Quarry	Nevada	• 44.5 Mt • 81 ha • 245 m centres	Solution recirculation with treatment by carbon adsorption columns	NDEP, 2012
Castle Mountain	California	• 31 Mt • 1.8 Mt processed through mill • Tails agglomerated into the leach pad	Freshwater	RPA, 2014a

Mine	Location	Heap Size	Rinsate	Reference
Brewery Creek	Yukon	• 10.4 Mt • Three 10 m lifts	Freshwater rinsing with nutrient addition	EBA, 2011 Tetra Tech EBA, 2014
Borealis Mine	Nevada	• 726,000 t • 100,000 m pad • 37 m stack height	Freshwater	Sengupta, 1993
Kendall Mine	Montana	• 82,000 t • 1 ha • Compacted clay liner • 2 lifts	Freshwater followed by alkaline chlorination using calcium hypochlorite	Poell, 1994
Others: **Nevada** • Relief Canyon • Pinson • Pebble • Alligator Ridge • Round Mountain • Northumberland • Round Mountain • Illapah	California • Carson Hill • Standard Hill	New Mexico • Ortiz		Leong and Majumdar, 2009

Italics indicate mines not yet in closure

B.4.10.4.2 R2-79

R2-79. A description how the liner in the HLF will be perforated following completion of the rinsing stage. Include a description of how drainage flowing from the HLF through the perforated liner will be captured by the TMF.

The HLF liner will be perforated by drilling from the top of the heap leach until the liner has been perforated. All drainage from the valley the HLF is located in drains to the TMF, there are no other routes for drainage.

B.4.10.5 HLF and Cover Material

B.4.10.5.1 R2-80

R2-80. Details on the design of the HLF cover. Details should include:
a. details of construction materials and methods being proposed (e.g. on-site borrow material and/or geosynthetic liner) and supported by on-site characterization;
b. consideration of other mine-site facility requirements for low-permeability material; and

c. stability and long-term maintenance requirements if incorporating a geosynthetic liner.

a. Details of Heap Cover Materials and Methods

The HLF cover is expected to be composed of local soils with modest capacity to reduce infiltration. The establishment of vegetation will reduce the long-term infiltration and also improve erosion resistance. Based on the expectation of relatively poor cover material, the infiltration prediction for the HLF is has been selected (for modeling) at a relatively high value of 20% of MAP.

It is expected that through additional investigation, sufficient local soils will be available for the HLF cover. As a contingency, a low permeability cover, such as LLDPE, may be placed on parts of the HLF where slopes are flat enough that long-term stability can be achieved. This is likely to be slopes flatter than 5:1 (ref: Faro – Grum Sulphide Cell), and therefore limited to only the top and select benches of the HLF.

Final design of the cover will depend upon water quality, available cover materials, and integration of HLF effluent into the site water quality prediction. In the event that the post-closure impacts from the HLF are predicted to be unacceptable, then one or more of several contingencies will be used. These include:

- Extended rinsing;
- Expanded anaerobic treatment cell; and
- Discharge of HLF seepage to the pit for dilution and/or containment if the pit stratifies. This would be conducted until loading decreases to acceptable levels.

b. Other Mine Components Potentially Needing Low Permeability Cover

In the mine plan as proposed by CMC, no mine site facilities are expected to require a low permeability cover requiring borrowed material other than the HLF.

c. Stability and Long-Term Performance of Geosynthetic Covers

Geosynthetic materials are not part of the long-term closure plan for Casino. They are considered as a contingency option if operational monitoring indicates that the proposed soil covers will not be adequate. If they are needed to provide long-term environmental protection, then only highly durable materials such as LLDPE and HDPE will be used. While there is no certainty as to the long-term service life of these materials a range of 500 plus years seems to be generally accepted.

B.4.10.6 TMF Winter Seepage Mitigation Pond

B.4.10.6.1 R2-81

R2-81. Feasibility level design details for the water management pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed. Details should include:
a. details on how CMC will ensure that all groundwater seepage is collected in the water management pond as designed and modelled;
b. what monitoring will be set up to ensure that the water management pond is performing as predicted, including groundwater and seepage monitoring; and
c. contingencies for all project phases, in case the water management pond does not perform as expected, including if groundwater/seepage is found to by-pass the water management pond.

The water management pond (WMP) is well situated in the valley to collect seepage that naturally drains to the area below the TMF embankment. The WMP cut-off wall will consist of a grout curtain keyed into bedrock to intercept all seepage from the upstream area and force it to surface where it will drain by gravity into the storage pond. Cut off walls are typically made from grouted curtains injected into the ground substructure. The installation of grout curtains for seepage reduction and seepage control is a common practice (Powers et al., 2007). The grout mix is typically comprised of high sulphate-resistant cement with bentonite (to minimize bleed), silica fume (to fill small voids and thus reduce permeability), superplasticizer (to reduce water content, reduce bleed, and increase strength while providing desired viscosity), Whelan gum (to bind excess water and reduce washout of cement and fines), and clean water. The dimensions of the cut-off wall will depend on the distance to the confining layer of low hydraulic conductivity, based on site investigations.

In general, grouting is conducted using a phased approach with the need for secondary and tertiary injection holes dependent on the results of primary injection. Grout curtains may be constructed via boreholes initially drilled to the full wall depth, or in a borehole which is drilled in stages to the desired wall depth. Between stages the borehole is injected with grout. Grout quality is evaluated by Marsh cone viscosity or viscometer and American Petroleum Institute (API) pressure filter bleed resistance and testing by Lugeon water pressure tests in verification drill holes.

a. *Details on process to ensure groundwater seepage to WMP:* The flows from the cut-off wall to the WMP will be monitored via continuous flow meters to verify the water quantity predictions. Downstream monitoring will be compared to the baseline aquatic environment to evaluate the magnitude of effects on the receiving environment, and provide feedback for optimizations of the system. As the WMP and cut-off wall will be constructed during the construction phase of the project, and operated throughout the operations phase, ample time will be available to verify the performance of the groundwater seepage collection system prior to closure of the site.

b. *WMP monitoring:* On-going water quantity and quality monitoring will be required to assess the effectiveness of the Water Management System. Seepage quantity and quality will be monitored throughout the construction and operations phases to understand time influenced changes to the sub-surface flow. Groundwater will be monitored in wells situated downstream of the Main Embankment and West Saddle Embankment and downstream of the WMP. Surface water monitoring will also be conducted downstream of the WMP. Collected water quality will be compared to the aggregated baseline chemistry and to water quality predictions to determine if actual water chemistry has deviated from that predicted.

   Downstream seepage beyond the water management pond will be monitored through visual observation of upwelling flow and through water quality monitoring at station W28 (confluence of Brynelson and Casino Creek, same station at hydrology station H18 – see details in the response to R242). If upwelling water is identified downstream of the water management pond, and upstream of Brynelson, it will be assumed to be seepage, and monitoring and effects analysis under the Metal Mine Effluent Regulations (MMER) will be applied.

c. *Contingencies:* Contingencies may include:

   - **Groundwater monitoring wells:** A network of monitoring wells will be situated along the downgradient boundary of the TMF and groundwater will be sampled to monitor the groundwater quality. If the results of groundwater monitoring indicate that additional mitigation measures are required, groundwater pumping wells can be installed so that groundwater is pumped back into the TMF while secondary mitigation measures are implemented.

- **Secondary and tertiary injection holes in cut-off wall:** The cut-off wall may be re-enforced by additional grouting phases on either the upstream or downstream sides or further into the valley walls.
- **Seepage interception tunnels:** The tunnels act to intercept flow paths and direct seepage into the water management pond instead of allowing these flows to bypass the WMP and grout curtain. This interception will be achieved by drawdown of the phreatic surface within the cut-off wall by a network of drain holes drilled upward and downward from the collection tunnels. The tunnels will be graded at 2% and will have portals just above the normal pond level of the WMP.

B.4.10.6.2 R2-82

R2-82. Additional details about the water management pond dam should include:
a. cross-sections;
b. construction materials;
c. consequence of failure classification;
d. detailed foundation characterization; and
e. monitoring and maintenance requirements.

During operations, seepage water from the TMF will be collected by a Water Management System, which consists of an under-drain system and a surface ditch system, both of which discharge into a water management pond located downstream of the Main Embankment. Seepage collected in the pond will be pumped back into the TMF. The Water Management System has been designed to accommodate seepage originating from the TMF, water recovered from cyclone sand embankment construction and surface runoff.

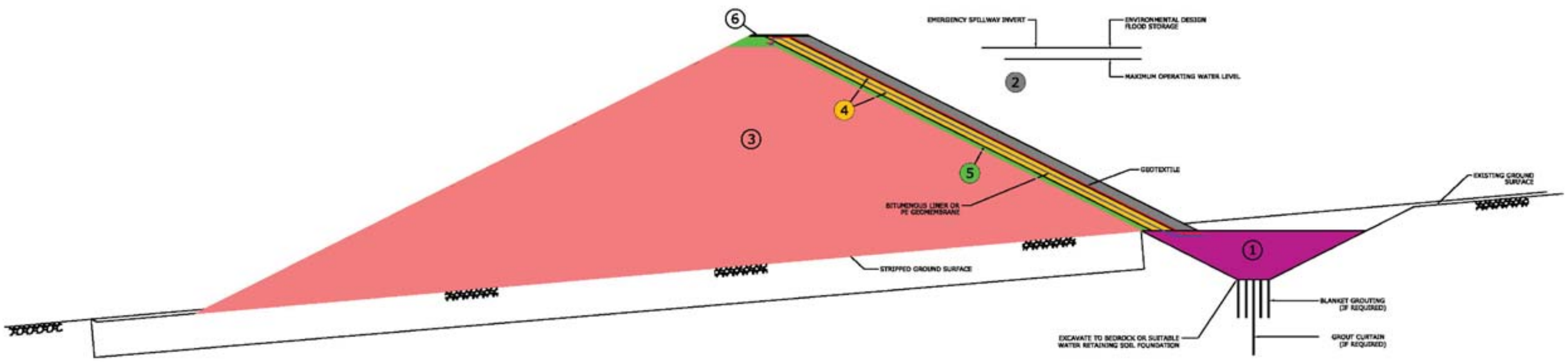
During operations, the water management pond (WMP) will operate as a dry-pond and is sized to manage the 1 in 10 year 24-hour storm event. Any storm events greater than the 1 in 10 year will discharge through the spillway channel, which will be sized to safely pass flood flows up to and including the 200 year flood. The pump station to return the water stored in the pond back to the TMF will be controlled through level controls. Supplemental booster pump stations will be required as the TMF embankment height increases.

During the closure phase, the WMP will transition to a storage and discharge system that collects seepage during the winter, and discharges to Casino Creek in the spring and summer (in relation to the flows in Brynelson Creek and the discharge from the TMF spillway)..

a. A typical cross-section for the water management pond (WMP) is provided on Figure B.4.10-11. The final design of the water management pond will depend on the verified geotechnical conditions in the area (i.e., depth of ice-rich soil), and on the ultimate configuration of the TMF (i.e., may also have changes to slope angle, affecting the location of the WMP). Verification of the design will be conducted during the detailed design phase of the Project, following the site investigation phase and verification of the groundwater recharge rates.

CASINO

Figure B.4.10-11: Seepage Dam for TMF



TYPICAL CROSS-SECTION OF WATER MANAGEMENT DAM

NTS

NON-WOVEN GEOTEXTILE

BITUMINOUS LINER OR PE GEOMEMBRANE

GROUTING (if required)

DAM ZONES

1 KEY TRENCH
2 UPSTREAM (U/S) SHELL
3 DOWNSTREAM (D/S) SHELL
4 FILTER / BEDDING
5 TRANSITION
6 ROAD SURFACE

Authors: H.Brown and J.Corman
Date: 14/12/2015

b. *WMP construction materials:* Preliminary design for the water management pond indicates that the dam will be approximately 10 m high, made of similar material to the starter tailings dam, i.e., Suitable rockfill from local borrow sources, supplemented by available non-reactive (leach cap) waste rock material from pre-production stripping. The core may be supplemented with compacted material and asphalt, if required. A drainage blanket will be constructed below the downstream portion of the dam to maintain a low phreatic surface for stability. The foundation and abutments may be grouted along the centreline to reduce seepage under the dam.

Construction of the WMP dam will consist of:

- Excavation of unsuitable material (average 20 m depth);
- Backfilling/pond slope construction;
- Installation of the liner system: bedding layer, leak detection layer/drainage gravel layer and primary geomembrane (60 mil LLDPE);
- Installation of the pipeline from the WMP to the TMF (HDPE DR9 700 mm);
- Construction of the pond spillway and discharge channel (approximately 472 m) including placement of excavation and erosion protection;
- Installation of the pump station; and
- Construction of drainage ditching (construction and engineered lining/energy dissipation 2.5 – 6 m wide).

c. The WMP dam is designed based on criteria specified for a dam classified as “low” in accordance with the CDA Dam Safety Guidelines (2007). The dam will be designed to meet the seismic and inflow design flood criteria for this dam classification.

d. There are four geotechnical drill holes in the area of the WMP as well as several test pits dug in 1993, 1994, 2011 and 2012 (Figure B.4.10-12 and Figure B.4.10-13). A thermistor was installed in the 2012 drillhole.

The depth to bedrock is considerably larger near the valley bottom where slopes are gentler in the area of the WMP. Drillhole HD12-03 was drilled near the valley bottom and has an overburden thickness of approximately 21 m. This material is classified as colluvial apron, which has a higher fines and organic content than the colluvial veneer, and is mostly frozen and ice rich. The colluvial apron is underlain by alluvium closer to Casino Creek. The alluvium is coarse grained and comprised of interbedded sands and gravelly sands with cobbles. It is typically overlain by frozen, organic-rich colluvial apron, except near the creek where the alluvium is non-frozen and at surface. The alluvium is generally at surface in tributary valleys, where it consists of highly saturated, ice rich, fine grained sands and clayey silts. Ice-rich silty frozen soils were found in the top six meters in DH12-03.

Further details can be found in Appendix 7C Hydrogeology Baseline Report and results of monitoring conducted in 2013 and 2014 are provided in Appendix A.7M, including the results of thermistor monitoring in DH12-03.

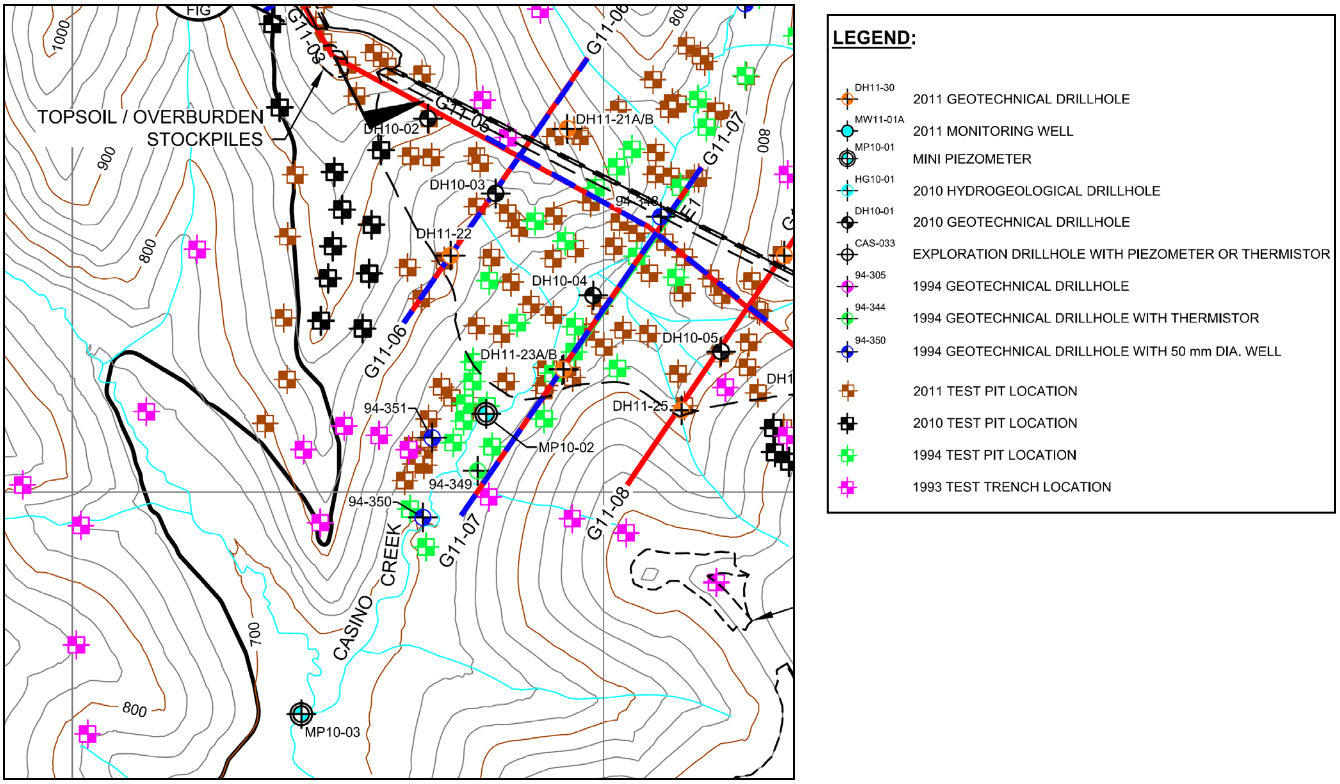


Figure B.4.10-12 Geotechnical Investigations in the WMP area (1994 – 2011)

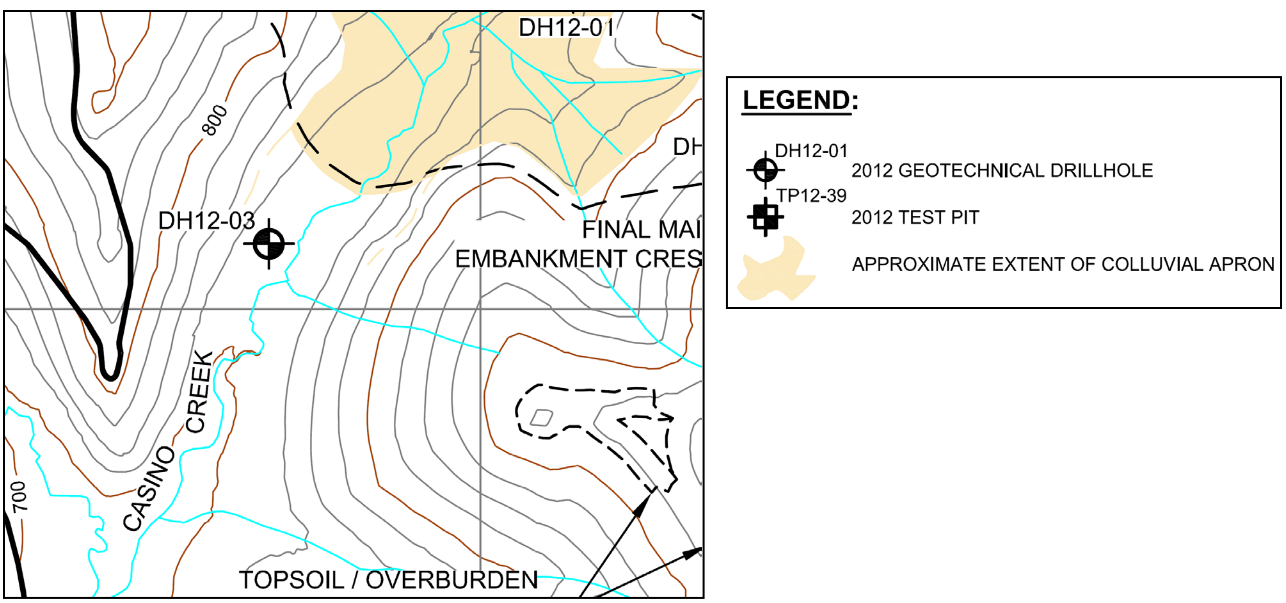


Figure B.4.10-13 Geotechnical Investigations in the WMP area (2012)

e. *Monitoring and maintenance requirements*:

On-going water quantity and quality monitoring will be required to assess the effectiveness of the Water Management System. Seepage quantity and quality will be monitored throughout the construction and operations phase to understand time influenced changes to the sub-surface flow. Groundwater will be monitored in wells situated downstream of the Main Embankment and West Saddle Embankment and downstream of the WMP. Surface water monitoring will also be conducted downstream of the WMP. Collected water quality will be compared to the aggregated baseline chemistry and to water quality predictions to determine if actual water chemistry has deviated from that predicted.

Downstream seepage beyond the water management pond will be monitored through visual observation of upwelling flow and through water quality monitoring at station W28 (confluence of Brynelson and Casino Creek, same station at hydrology station H18 – see details in the response to R242). If upwelling water is identified downstream of the water management pond, and upstream of Brynelson, it will be assumed to be seepage, and monitoring and effects analysis under the Metal Mine Effluent Regulations (MMER) will be applied.

Monitoring of the structural integrity of the dam will be in accordance with the Canadian Dam Association guidelines.

B.4.10.7 Temporary or Early Closure

B.4.10.7.1 R2-83

R2-83. Contingency measures or alternatives that may be required in the event of early closure if passive treatment system field trials have not been completed or are shown to be unsuccessful. Details should include:
a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information;
b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed.

In the event of early closure, the closure plan as described in the Conceptual Closure and Reclamation Plan (Appendix 4A - CCRP) will be implemented, along with the following early closure specific activities:

- Pit dewatering will cease 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 (assuming early closure occurs at a time when the pit outline has intercepted Canadian Creek);
- All LGO stockpiles will be processed as needed for TMF reclamation (minimum 1 m cover on all PAG waste 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 tailings higher than 1 m below the invert elevation will be relocated such that a final cover of minimum 1 m of water is provided;
- Erosion protection will be placed on exposed sand areas of the dam;

- Water in the TMF will be temporarily pumped to the pit to lower the pond level for construction of the wetlands;
- 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 cyanide destruction plant and used to rinse the heap. Drain-down water will be processed in the cyanide destruction plant, through the bio-reactor for selenium removal and then pumped the pit; and
- All infrastructure will be removed as per the closure plan.

a. *Alternative treatment methodology:* In the event that the wetland treatment systems are not yet fully developed, then conventional water treatment could be used on a temporary basis. Conventional (i.e., active) water treatment is not a viable long-term solution, as it is in contravention of the stated policy of the Yukon Government that "reliance on long term active treatment is not considered acceptable for reclamation and closure planning" (Yukon Government, 2006). This applies for any closure scenario, be it planned closure for final mine footprint, or early closure. A robust schedule of testwork will be conducted to establish criteria for the passive treatment systems, such as sizing and composition, and long-term field trials will be conducted to verify these criteria prior to installation. CMC has already initiated the design of the wetland treatment system (see Appendix B.4G), the treatment system will be designed well in advance of any closure scenario. Additionally, comprehensive monitoring following installation will be conducted to ensure that the systems are functioning appropriately, and are sufficiently protective of the receiving environment. CMC will be required to achieve closure objectives, regardless of the timing of closure.

   All aspects of the project were designed to avoid or minimize the risk of adverse water quality (see Section 2 of the Conceptual Closure Plan (Appendix 4A) for the list of 16 major design considerations to achieve this objective). However, the notion of zero or negligible impact was identified as unrealistic for the Casino Project. Therefore, some modest level of treatment was expected to mitigate potential downstream impacts. Only passive treatment technologies were considered.

   The proposed constructed wetland treatment systems have been modeled to remove contaminants of concern down to acceptable concentrations in the various site waters. However, there remains outstanding questions as to tolerable range of influent chemistry, range of conditions under which good treatment can be achieved (temperature and flow), and achievable water quality. Determining the limits of the wetland system will define the conditions/thresholds under which it could be necessary to use conventional water treatment for part of the year or for a period of years until conditions exist that are suitable for wetland treatment.

b. *Use of conventional water treatment:* As discussed in (a), conventional water treatment could be used on a temporary basis only. Should temporary active treatment be required, the sulfur dioxide-air cyanide destruction plant that will be on-site to treat effluent solutions from the HLF may be modified to treat for parameters of concern should discharge be required prior to refinement of the wetland treatment systems.

B.4.10.8 Mine Reclamation and Security

B.4.10.8.1 R2-84

R2-84. Update the CCRP and security estimates based on the Government of Yukon's updated guidance document: Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).

CMC has developed the Conceptual Closure and Reclamation Plan (CCRP) in accordance with the Yukon Mine Reclamation and Closure Policy (Yukon Government, 2006), as is the Reclamation and Closure Planning for Quartz Mining Projects (Yukon Government, 2013). However, the Reclamation and Closure Planning for Quartz Mining Projects Guide, states that it “focuses on RCPs [Reclamation and Closure Plans] that will be provided in accordance with QML [Quartz Mining Licence] and WL [Water Licence] processes”. The CCRP provided in Appendix 4A has *not* been submitted in support of a QML and/or WL application, and hence is not required to meet the guidelines outlined in the Reclamation and Closure Planning for Quartz Mining Projects Guide.

Additionally, the Proponents Guide to Information Requirements for Executive Committee Project Submission (YESAB, 2005), requires that the Proponent:

> Present and describe financial security requirements for closure. Decommissioning plans at a conceptual level should be costed for an estimation of mine reclamation bonding requirements. The proponent should submit a security proposal to address the liability at the site (Section H.18, page 58).

The information on costs, as it relates to financial security for closure was provided in the response to R144 in SIR-A (Section A.4.11.13.2).

CMC re-iterates that the CCRP provided in Appendix 4A is appropriate for the level of assessment at the YESAB assessment phase, and that the plan will continue to be refined as the Project progresses through the YESAB assessment through consultation with stakeholders, and as such should not be expected to meet the requirements for Projects that have already completed that process. A complete Reclamation and Closure Plan will be submitted as required by the Yukon Government and Yukon Water Board, once the fully assessed Project has been confirmed through the YESAA process.

B.4.10.8.2 R2-85

R2-85. Additional justification and discussion on security estimates based on new information generated by questions throughout this report. Details should include:
a. all major mine components;
b. all reclamation and closure stages;
c. consideration of temporary or early closure;
d. consideration of accidents and malfunctions, including the implications of structural and non-structural failures of the TMF dam; and
e. consideration of effects of the environment.

A discussion on security estimates can be found below.

a. *Cost estimate per major mine component:* CSP2 has noted that the building closure total does not account for all estimates under decommissioning of buildings – which is correct. Additionally, Table A.4.11-11 did not include the values for project management (5% of the total), engineering (5% of the total) or contingency (20% of the total), which made up the initial estimate of $145M. Table A.4.11-11 has been updated for the correct total for decommissioning of buildings and the missing project management, engineering and contingency values added for transparency in Table B.4.10-9, as well as to reflect updates in the post-closure monitoring, as per the response to R2-28.

Table B.4.10-9 Feasibility Reclamation and Closure Cost Estimate (Updated)

Component	Cost Estimate
Open Pit	
Access control	$108,307
Spillway construction	$52,906
Pit flooding (assumes lime addition)	$1,670,000
Open Pit Closure Total	**$1,831,213**
Tailings Management Facility	
Rip rap for stabilization	$344,463
Wetland development; vegetation of beach	$13,340,674
Pump TMF water to pit to establish wetlands	$4,500,000
Spillway construction	$688,496
Removal of operations phase infrastructure	$70,731
Instrumentation installation	$200,000
Tailings Management Facility Closure Total	**$19,144,364**
Ore and Overburden Stockpiles and Cover for HLF	
Topsoil and vegetation of stockpiles	$3,119,179
Low grade ore stockpile relocation to open pit, re-contouring and vegetation	$30,675,491
Stockpile Closure Total	**$33,794,669**
Decommissioning of Buildings	
Building decontamination and hazardous materials removal	$73,920
Demolition of buildings and piping	$4,780,604
Grade and contour	$4,651,275
Reclamation of roads (site roads, airstrip access road, pipeline road, Freegold Road Extension)	$878,006
Buildings Closure Total	**$10,383,805**
Hazardous Materials	
Hazardous materials audit (Phase I & Phase II)	$300,000
Disposal of hazardous materials	$500,000
Contaminated soil removal	$270,458
Hazardous Materials Closure Total	**$1,070,458**
Landfill Closure	
Place soil cover	$23,958
Vegetate	$2,169
Landfill Closure Total	**$26,127**
Mobilization of Equipment	
Mobilization of equipment from Edmonton	$283,829

Component	Cost Estimate
Mobilization of workers	$696,000
Mobilize miscellaneous supplies	$1,500,000
Worker accommodations	$4,680,000
Pump TMF seepage to pit	$622,200
Care and maintenance for 5 year closure period	$3,072,192
Mobilization Total	**$10,854,221**
Post-closure Monitoring and Maintenance	
Bi-annual water quality sampling	$100,000
Compile data on flows, runoff, water quality for reporting and ongoing management of water control system	$50,000
Tailings Management Facility	
Dam and spillway geotechnical inspections: Annual Inspection	$9,000
Dam and spillway geotechnical inspections: Dam Safety Review	$2,000
Event driven inspection	$10,000
Event driven repairs (e.g., repair rip rap in spillway, repair erosion on face of dam after major rain event, repair dam crest to correct settlement from an earthquake, repair berms in wetland due to settlement or high flow damage)	$200,000
Wetland maintenance and monitoring	$50,000
Open Pit	
Operation of water control system (remote control of valves)	$2,000
Inspection of energy system (solar cells, batteries, etc.)	$2,000
Replacement of energy system components	$200
Inspection of piping/valves, repair/replacement as needed	$2,000
Passive treatment of pit water	$500,000
Heap Leach Facility	
Inspect/repair erosion on face of dam after major rain event	$50,000
Provide nutrients for bio-reactor	$2,000
Other Requirements	
Transportation	$40,000
Power and heat	$25,000
General administrative expenses	$10,000
Post-Closure Monitoring and Maintenance Total	**$1,054,200**
Discount rate	3.50%
Number of year for post-closure activity	200 years
Present Value	**$30,089,041**
Project Management (5%)	**$5,359,695**

Component	Cost Estimate
Engineering (5%)	**$5,359,695**
Contingency (25%)	**$26,798,475**
Total	**$144,711,763**

The Executive Committee has noted that the cost estimate seems general in nature and excludes the following components, which CMC has clarified below each bullet.

- Reclamation of the heap leach facility including detoxification, draindown, and closure.
  - Detoxification and draindown of the heap leach facility is planned to occur following the cessation of leaching in Year 18 and take a total of 10 years (5 years for rinsing and 5 years for drain down). The detoxification is included in the operational costs of the mine and hence is excluded from the closure cost estimate. There are no additional costs associated with the draindown as the heap is simply allowed to drain naturally.
  - Cover and removal of the liner in the events pond and breaching of the HLF liner was included in the costs for the Ore and Overburden Stockpiles (i.e., $3,119,179). This has been corrected in Table B.4.10-9.
- Decommissioning of the Freegold Road Extension.
  - Decommissioning (i.e., scarify and install water breaks and vegetate) of the Freegold Road Extension was incorporated into the “Decommissioning of Buildings” cost estimate under “Reclaim Roads”; however, was missing a portion of the road. This has been clarified and updated in Table B.4.10-9.
- Topsoil and vegetation for the tailings beach, embankment, building sites.
  - The vegetation of the beach for erosion control was included in the cost under “Tailings Management Facility: Wetland development”, and was estimated at $125,454. This has been clarified in Table B.4.10-9.
  - The closure cost included $344,463 for rip rap to stabilize the TMF embankment. As described in the CCRP, the embankment cover was to be either topsoil (approximately 0.5 Mm3) and vegetation; or a 0.3 m deep cover of rip-rap. The closure cost estimate considered the rip-rap cover. This cost is considered to be sufficient to consider either the topsoil or rip-rap cover.
- Removal of contaminated material from all stockpile areas.
  - The closure cost considered the “Ore and Overburden Stockpiles and Cover for HLF: Low grade ore stockpile relocation to open pit, re-contouring and vegetation” for a cost of $30,675,491. This included removal of 5% of LGO piles to the open pit of $24,283,261. The remaining $6,392,230 considered contouring the reclaimed area and placing topsoil on the ore stockpile footprints.
- Landfill and waste disposal.
  - Hazardous material disposal is included in the “Hazardous Materials” section in the closure estimate and totals $1,070,458.
  - Cover and revegetation of the landfill was missing from the closure cost estimate, and has been updated in Table B.4.10-9.

EMR and HSS have requested updates to the post-closure care and maintenance values. This has been conducted in the response to R2-28, and the updated values of $1M per year provided in Table B.4.10-9 has been assigned to post-closure care (i.e., annual geo-technical inspections, surface water sampling, groundwater sampling, receiving environment sampling, transportation to site and annual passive treatment of pit water). This is comparable to the estimate that EMR provided for the Minto Mine (i.e., $800,000). In comparison to the Wolverine Mine, the most recent Reclamation and Closure Plan (V2015-06) has a requirement for $655,800 for compliance monitoring and reporting and $100,000 for closure maintenance, which totals $755,800.

While not mentioned in ARR No.2, the closure cost estimate in Table A.4.11-11 also included the construction of the Winter Mitigation Storage Pond and groundwater collection system, originally proposed to be installed at closure. As CMC has now committed to constructing these systems during the construction phase, these items have been removed from the closure cost in Table B.4.10-9.

The updated Closure cost estimate is updated to $144M.

b. *Reclamation and closure stages:* All reclamation and closure stages (i.e., active closure and post-closure) have been included in the preliminary estimate provided in Table B.4.10-9. However, CMC re-iterates that this estimate is a feasibility level estimate only, and will be refined as the Project develops.

c. *Temporary or early closure considerations:* Temporary or early closure may be conducted in instances where economic conditions are not conducive to the continuation of mineral extraction activities. The economics of the Casino Project are such that the Project is viable at a very low copper and gold price, and hence has robust economics with minimal risk of shut-down due to changing prices. However, as part of the Reclamation and Closure Plan to be submitted as part of the QML and WL applications, temporary closure plans will be described. These plans will include the following items, as per the Reclamation and Closure Planning for Quartz Mining Projects (Yukon Government, 2013), to ensure public health and safety and protect the environment and manage risks:

- The cost to maintain facilities substantially intact and in good working order.
- Continuation of site maintenance, monitoring, and reporting.
- Interim water and solution management plan.

Costs associated with early closure are considered to be comparable to the costs for final closure.

d. Consideration of malfunction and related implications: The Reclamation and Closure Planning for Quartz Mining Projects guide (Yukon Government, 2013) requires the assessment of costs to permanently monitor and maintain water conveyance and/or containment facilities. These costs have been provided in Table B.4.10-9. The Reclamation and Closure Planning for Quartz Mining Projects guide does not require costing of accidents and malfunctions, including structural and non-structural failures, but does require an assessment of uncertainty and risk management, with adaptive management plans to outline processes for comparing performance to thresholds, and descriptions of specific actions to be taken in response to threshold exceedances. CMC will provide adaptive management plans as required in the applications for the Quartz Mining and Water Use licences.

e. Consideration of effects on the environment: Effects on the environment are considered in the closure cost estimate through the on-going monitoring and maintenance of the site, which will include event-driven maintenance of site facilities following large environmental events such as large storms, earthquake, and forest fire.

B.4.11 WASTE MANAGEMENT

B.4.11.1 R2-86

R2-86. Location, size, volume, and hydrology of the landfill site

The responses relating to the proposed landfill site are as follows:

Location and Hydrology

The proposed location for the landfill and waste management area is provided in Figure B.4.11-1, north of the TMF. The location is on a ridge above the heap leach facility, in an area dominated by hillslope colluvium and weathered bedrock (see Figure 2.1 in Appendix 7C Hydrogeology Baseline Report). The underlying structure is the Whitehorse Suite, granodiorite, granite, quartz diorite and diorite (Figure 2.2 in Appendix 7C). There are no creeks or streams in the area, as it is on a hillslope, and the inferred groundwater table is approximately 125 m below the ground surface and flows down towards the tailings management facility (Figure 4.1 in Appendix 7C).

Size and Volume

The size of the landfill has been estimated using an estimate of waste production per person of 0.0146 m^3/day during construction and 0.0097 m^3/day during operations. Additionally, the amount of waste sent to incineration (e.g., combustible and putrescible waste) was estimated at 2.24 kg/person/day during construction and 3.01 kg/person/day during operations. These estimates result in storage requirement of ~100,000 m^3 of waste (Table B.4.11-1), plus ~20,000 m^3 of soil cover required at intervals to prevent dispersal by wind or interactions with birds. This estimate results in a 120,000 m^3 landfill, 10 m high, and 110 m long by 110 m wide for storage of non-incinerated waste over the life of the Project.

Table B.4.11-1 Landfill Requirements through Construction, Operations and Closure Phases

Waste	**Construction**	**Operations**	**Closure**	**Total**
Project Year	**4 Years**	**22 Years**	**3 Years**	
Waste to landfill (m^3/year)	5,400	2,500	5,400	92,800 m^3
Waste to Incinerator (tonnes/year)	820	770	820	22,680 tonnes

CASINO

Figure B.4.11-1: Proposed Landfill

Legend

- proposed line facilities
- proposed polygon facilites
- proposed landfill
- proposed landfill (20m fence)

Date: 14/12/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

B.4.11.2 R2-87

R2-87. Anticipated volume of landfill space required for different waste streams.

As per CMC Waste Management Plan (Appendix A.22A), the landfill at the Casino Project will be rated a "Class 2" facility, which is a waste disposal site where waste is buried and/or incinerated and which serves a population of less than 13,000 people (Yukon Environment, 2014). Non-putrescible, non-hazardous waste not incinerated or recycled will be disposed of in the on-site landfill.

The composition of materials in the landfill is expected to be a mix of the following materials:

- Ash;
- Incinerator residue;
- Construction waste;
- Plastics or synthetics;
- Rubber and rubber coated products; and
- Siding, and inert wastes arising from mine related operations.

The following materials are not accepted in the landfill:

- Hazardous waste;
- Putrescible waste;
- Food waste or waste containing food residues;
- Oily waste including oil filters or used absorbent pads;
- Used oil, fuels, lubricants or solvents;
- Grease and sludge;
- Asbestos;
- Aerosol cans;
- Paint products;
- Chemical waste; and
- Lead acid batteries and salvageable or recyclable materials such as drums, vehicles and tanks.

Incineration will be utilized to reduce the volume of burnable waste by 80- 90%; this reduces the waste streams and reduces wildlife attractants. CMC intends to use a two stage design incinerator, designed and engineered to suit the mines specific needs. Operators will be trained by the manufacturer in aspects of operation, maintenance and safety. Ash will be generated from the incineration of the following materials:

- Food waste;
- Food contaminated packaging;
- Putrescible waste;
- Paper waste;

- Cardboard; and
- Wood waste (skids, pallets, crates).

Please refer to the Waste and Hazardous Materials Management Plan (Appendix A.22A) for more details.

B.4.11.3 R2-88

R2-88. A description of the liner and/or leachate collection system proposed, including details for maintenance, operation, and closure.

The landfill at the Casino Project will be rated a "Class 2" facility, which is a waste disposal site where waste is buried and/or incinerated and which serves a population of less than 13,000 people (Environment Yukon, 2014). Therefore, the landfill must be constructed to one of the two following specifications:

1. The facility must be constructed on a natural or constructed substrate that will support natural attenuation of landfill leachate. Modeling must be conducted to demonstrate that leachate will attenuate to the extent that all contaminants will be below the applicable standards in the Contaminated Sites Regulation at the points of contact with all relevant receptors.
2. If a natural or constructed substrate to support natural attenuation of landfill leachate is not available, the facility must be constructed with a leachate collection system that must have a minimum permeability of 1×10^{-3} cm/s and must be of an appropriate thickness and design, with piping as needed to facilitate the movement of leachate to a collection point.

Waste disposal facilities are required to develop a 10-year solid waste management plan describing in detail their design, construction, operation, upgrading, closure and post-closure plans. During operation and renewal, environmental protection officers have the ability to conduct inspections and will be provided any requested information.

CMC will conduct further investigations in the detailed design phase and will provide exact details regarding liner and leachate collections systems during the application process for the required permits. Engineering services will be contracted from a qualified landfill design provider, during the course of this engineering process issues such as attenuation, hydrology, final size and volume and management/maintenance of the facility will be determined. The designed liner system will conform to applicable regulations.

All non-hazardous waste materials will be decommissioned according to the Solid Waste Regulations of the *Environment Act*. Once landfilling is complete, waste will be buried beneath leached heap rock and covered by 0.5 m of topsoil and revegetated.

B.4.12 CLIMATE CHANGE REPORT

B.4.12.1 R2-121

R2-121. Clarification on how the design for the TMF accounts for climate variation in perpetuity, beyond the construction and operation phases of the mine.

Periodic assessment of the facilities will include the impact of the effects of climate change, as described in the responses to R2-2, R2-27, R2-61 and others. This is typical practice, as prescribed by the Mining Association of Canada. The assessments would include realized and projected climate change to address climate variability.

CMC has stated that monitoring of the TMF will need to continue well past the closure period, and has projected monitoring for 200 years post-closure.

The design of the TMF is robust and is adaptable to uncertainties in a number of ways, for example:

- Increases in IDF can be accommodated by increased freeboard during operating phase;
- Increase in IDF during post-closure can be accommodated by increased freeboard or incremental increase in spillway width;
- Increase in annual inflow to TMF during operations can be accommodated by reduction in the fresh water make-up from the Yukon river;
- Decrease in annual inflow to the TMF can be mitigated by increasing pumped water from the Yukon river;
- Please also refer to the responses to R-259 & R-261 for discussion on uplift factors to be applied to peak design flows, consistent with APEGBC;
- Refer to R2-04 for discussion on variability of climate and its effect on water balance.

Please see response to R2–2 to understand how climate change is addressed under “change management”.

B.4.12.2 R2-122

R2-122. After the application of a maximum 25 percent increase in flow to all relevant baseline information, a comprehensive description of resulting changes to the tailings management facility, open pit, water management pond, heap leach facility, and diversion ditches. This should include consideration of project effects, and mitigations.

Please refer to response R2 -121 and R2 - 02

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B.6 – TERRAIN FEATURES

B.6.1 INTRODUCTION

Section 6 of the Proposal summarized the effects assessment conducted for terrain features at the Project. Terrain features were selected as a Valued Component (VC) by Casino Mining Corporation (CMC) for the Casino Project (the Project) because of their importance to regional and localized ecological processes. The Proposal defines terrain features as the geological surface features, topography, and layers of mineral and organic materials covering the underlying bedrock geology. The assessment focused on potential effects of the Project to three unique types of terrain features: 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 Proposal concluded that the potential effects of the Project on existing terrain features are considered to be adverse and irreversible; however, the adverse residual effect is considered Not Significant, since the effects will be on individual terrain features and localized to the Project footprint.

The effect of terrain instability on the project was assessment in Section 20 of the proposal. The terrain hazards assessment incorporated terrain mapping, terrain stability mapping and a preliminary assessment of potentially hazardous permafrost-related features. 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.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has eight requests related to information presented in Section 6 Terrain Features and Section 20 Effects of the Environment on the Project: Terrain Instability of the Project Proposal and Section A.6 Terrain Features of the SIR-A. These requests and the corresponding sections of the SIR where the responses can be found are outlined in Figure B.6.1-1.

Figure B.6.1-1 Requests for Supplementary Information Related to Terrain Features

Request #	Request for Supplementary Information	Response
R2-89	Clarification if permafrost berms will be used for tailing ponds and if so, how they will be managed to ensure they are secure.	Section B.6.2.1.1
R2-90	A description of the mitigations that will be used with respect to valley slopes and permafrost.	Section B.6.2.1.2
R2-91	A geothermal analysis and associated methodology that predicts response to the proposed TMF and associated infrastructure on	Section B.6.3.1.1

Request #	Request for Supplementary Information	Response
	permafrost conditions, considering the following: a. Heat generated from the waste rock and processed ore after disposal. b. Potential for solifluction, active layer detachment flows and similar mass wasting processes to occur at slope adjacent areas and embankments. c. Freezing and thawing of mine tailings and embankment soil. d. If the TMF is founded on permafrost soils that are too deep to excavate, creep deformation of those permafrost soils a result of the placement of the TMF should be considered. e. Characterization of the subgrade under any containment structures is critical. Issues of geothermal state (frozen or unfrozen), ground temperature, unfrozen water content, salinity, creep strength and others may be important as part of the assessment process. f. Effects of the proposed project on geothermal regime.	
R2-92	Additional details in relation to temperatures data, trends and ground temperature monitoring for the Freegold Road Extension including: a. A discussion regarding possible warming trend in the near surface based on the available ground temperature data. For example: Does the post 1994 ground temperature data exhibit any warming trend in the near surface temperatures? Is the active layer thickening? b. If thermistors were installed in 2011 and 2012, up to four years of ground temperature data has been collected. Please report on this data. c. If the 1994 thermistor cables are in the same location as the 2011 and 2012 thermistor cables. Please combine the data and provide some inferences as to long-term trends in mean annual ground temperatures. d. The installation of thermistor strings to monitor ground temperatures and develop “trumpet curves” is an appropriate development by CMC. These data should be used to establish baseline mean annual ground temperatures values.	Section B.6.4.1.1
R2-93	A reference to the legend used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers.	Section B.6.5.1.1
R2-94	A Hazard Map and associated methodology that: a. Predicts the type, nature, frequency and magnitude of all hazards in the study area. b. Where the study area is bound by moderate to steep slopes please modify the terrain map and the terrain stability map to include upslope areas (to the height of land). Note: In the case of the road, this only need apply to the side of the valley that supports the road. c. Where the study area is bound by moderate to steep slopes please increase the detail of the mapping to capture areas commonly associated with hazards such as gullies but not currently mapped. d. From the map above, if appropriate, identify specific risks to the project. e. From the map above, if appropriate, identify specific risks to the environment from the project. f. Based on the risk identified in response to the questions above, please provide general options and considerations for engineering design to mitigate the identified risks.	Section B.6.5.1.2
R2-95	Additional details in relation to terrain hazards assessment including: a. Table 1, Table 2, Figure 1, and Figure 2 referenced to in the Fluvial Geomorphology report.	Section B.6.6.1.1

Request #	Request for Supplementary Information	Response
	b. More detail on river ice buildup, ice jams, and thermokarst processes in relation to the proposed Freegold Road extension, Airstrip Access Road. c. Watershed characteristics (watershed area, watershed length, relief, and melton ratio) for each road crossing of a side channel feeding into the main valley and provide comment on dominant depositional process at each crossing. d. A correlation of lateral migration rate descriptors to an actual measured rate of migration (i.e. low = 0 to 0.1 m/year).	
R2-96	A soil erosion potential analysis for the LSA that includes the component of thermal erosion where permafrost is identified as being present.	Section B.6.6.1.2

B.6.2 PERMAFROST

B.6.2.1.1 R2-89

R2-89. Clarification if permafrost berms will be used for tailing ponds and if so, how they will be managed to ensure they are secure.

Permafrost berms are not proposed for the tailings management facility (TMF).

In relation to the TMF area, permafrost is discontinuous over the TMF embankment area, and is primarily present at the valley bottom, north-facing slopes and shaded areas. The ridges at higher elevations and upper slopes on the west abutment are southeast-facing, and are generally free of permafrost except for some local shaded areas. Permafrost is common in the northwest-facing east abutment area, where test pits were terminated at shallow depths in frozen colluvium and residual soils. Permafrost occurs as thin ice lenses in fine grained soils and as small ice wedges in broken rock.

Permafrost is abundant in the organic, silty colluvial apron of the Casino Creek and tributary valley bottoms. The overburden is generally saturated and frozen in these areas, with high ice contents. The site investigation data also indicated ground ice close to tributaries leading to Casino Creek. Alluvium lies at surface in very close proximity to Casino Creek, where it is not frozen as indicated by the presence of tall grasses and willows, and the absence of thick mosses. These areas are discontinuous and likely result from the historic shifting of the creek channel which acts to maintain a thawed region under the creek.

As it relates to construction of major infrastructure, thawing of ice-rich soils may lead to excessive settlements, and loss of strength. The ice-rich soils typically exhibit very low strengths when thawed, and flow even under very flat slopes. Two gelifluction lobes that were observed within the colluvial apron in the TMF embankment area are evidence of this potential for instability. Ice-rich soils also have the potential for long term creep displacements. Additionally, disturbance or removal of the vegetative cover may result in the melting of permafrost and the development of unstable conditions. Frozen overburden and bedrock that are underlying part of the tailings impoundment and embankments are expected to thaw over time, as the tailings and water stored in the TMF will act as a heat source.

Other mechanisms through which permafrost may impact the stability of mine infrastructure includes ground ice. Ground ice is not expected to be significant in bedrock which will likely provide a stable foundation for the embankments. Preferential seepage paths may develop when ice filled discontinuities thaw. If monitoring indicates that this is occurring, the bedrock may have to be steamed and grouted during foundation preparation.

Therefore, foundation preparation for the TMF embankments will involve the stripping of topsoil and vegetation and the removal of all talus boulders. The topsoil will be stockpiled for reclamation purposes. The underlying frozen soils will be excavated down to a competent, stable bedrock or non-frost susceptible overburden foundation. Ice-rich and frost-susceptible materials will be removed to spoil and are expected to be unsuitable for use as borrow in embankment construction. The ice-rich spoil material will be placed in the TMF impoundment.

The embankment footprint area that covers colluvial apron or other ice-rich overburden will be excavated to competent foundation, absent of frost susceptible soil. The removed material will be replaced with core, filter or shell zone material, depending on the location relative to the embankment. The average thickness of the colluvial apron is expected to be approximately 10 metres based on the findings of the site investigations.

A low permeability cut-off is required beneath the core zone of the Main Embankment and West Saddle Embankment at locations where no colluvial apron or other ice rich soil is present, to provide an effective seepage control barrier. The seepage cut-off trench will extend through the foundation soils and key into competent bedrock, at an average depth of about three meters for both the Main and West Embankment.

Further details on the foundation preparation of the TMF embankment are provided in Appendix A.4D.

B.6.2.1.2 R2-90

R2-90. A description of the mitigations that will be used with respect to valley slopes and permafrost.

Engineering considerations to be incorporated into detailed design with respect to permafrost are described below.

Access Road

- In areas where the alignments traverse areas of known or suspected ice-rich soils, permafrost degradation effects can be mitigated by constructing the road/air strip on an embankment of non frost susceptible fill.
- The natural vegetation cover of sphagnum moss should be kept in place, wherever possible, to provide the maximum protection to the thermal regime. Winter construction is preferred in these areas.
- For summer construction, woven geotextile may need to be laid over thaw unstable ground, prior to placement of the fill.
- To mitigate sedimentation and erosion in areas of silty and organic soils (e.g., colluvial aprons and organic swamps on the flood plains of major watercourses), such soils should be left in place, wherever possible, with the surface cover of sphagnum moss intact and the road constructed on an embankment of non-frost susceptible fill.
- Develop robust erosion and sediment control plans in any areas where soils are to be disturbed.
- In areas where solifuction is particularly prevalent (e.g., moderate, north-facing colluvial slopes), the road should be constructed on an embankment that effectively buttresses the natural slope.
- Where the access road alignment traverses a solufuction lobe in, the alignment may need to be re-routed slightly upslope or downslope.
- Minimize cut slopes to mitigate the risk of permafrost degradation.
- Detailed drainage design for the road should consider the shallow permafrost table in the north-facing colluvial mid-slopes and the colluvial aprons.

Airstrip

- Complete additional boreholes along the airstrip alignment as part of the detailed design to further investigate the extent of ice-rich soils and to facilitate the installation of thermistors.
- Incorporate additional measures into the detailed design of the airstrip to management expected surface and shallow subsurface water flows and limit long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice (e.g., flattening or buttressing the side slopes of the embankment).
- Implement drainage measures to prevent water 'ponding' at the upslope toe of the embankment.
- Monitor the performance throughout the design-life of the airstrip against to-be-determined performance criteria.

Mine Site

- The surface water management strategies implemented should prevent water accumulating in the natural terrain adjacent to the proposed facilities in areas of known or suspected ice-rich soils. Ditching at the toe of embankments should be avoided in areas of known or suspected ice-rich soils.
- Ice-rich portions of the colluvial apron deposits within the proposed footprint area of the tailings embankment will need to be removed prior to the construction of the embankment, and replaced with non-frost susceptible fill.
- Additional site investigation is required in order to enhance the understanding of the ground conditions at the proposed embankment site and to facilitate a reasonably accurate estimate of the volume of unsuitable material needing to be removed, spoiled and replaced.
- In areas mapped "potentially unstable" and "unstable", the natural vegetation cover should be kept in place to provide the maximum protection to the thermal regime. For summer construction, a woven geotextile may need to be laid over thaw unstable ground, prior to placement of fill. In areas where vegetation needs to be removed, winter construction is recommended for the initial lifts.

To prevent impacts due to permafrost degradation on the short term and long term stability of proposed mine infrastructure, the footprints of the mine infrastructure will be stripped of the surficial soils that may otherwise contribute to instability. In general, construction and site preparation techniques on permafrost require frozen, organic and ice-rich colluvium and residual soils to be ripped, blasted and/or excavated to competent, non-frost susceptible bedrock for subgrade preparation. All ice-rich overburden and heavily weathered rock will be removed to prevent potential thaw-settlement resulting from melting permafrost. The exposed bedrock will provide a thaw-stable foundation for mine infrastructure.

In support of future refinement in the Project design and future construction activities, ground temperature data are currently being collected at a number of locations across the site using thermistor strings and data loggers that were installed in vertical drillholes. Continued monitoring in the operations phase will allow for identification of real-time changes in permafrost conditions that may be connected with climate change. The need for additional mitigations for permafrost degradation to ensure the stability of the slopes of the upper Casino Creek valley will be assessed in detailed design taking into account the additional ground temperature data currently being collected.

During operations, monitoring of site facilities will include vibrating wire type piezometers installed in the embankment fill, foundations and tailings deposit to measure pore water pressures during initial placement, throughout operations and postclosure. The piezometers will be distributed throughout the various foundation and fill zones to provide a spectrum of monitoring data. Thermistors may be required to determine the temperature profile to supplement piezometer data. The piezometer and thermistor leads will be appropriately routed to read-out panels for ease of monitoring. Movement monuments will be installed on the embankment crest following the completion of selective embankment raises to monitor deflections along the slope and crest of the embankment. Periodic surveying of the monument locations will provide early warning of movements and possible acceleration of movement which often occurs prior to failure.

Valley slopes in the area of the tailings management facility no excavated to bedrock are known to be primarily comprised of colluvial veneer. The nature of colluvium, i.e. material that has been transported down slopes, causes local variations in the composition. The downslope migration also causes organic material to be included in the deposit at some locations. The organic content generally increases down-slope. On north facing slopes, the colluvial veneer is mostly frozen.

Climate warming may lead to thawing of the north facing valley slopes, and the thawing may be exacerbated, to some extent, by the placement of tailings and PAG waste rock. Thaw flows and solifluction lobes may develop locally (particularly in the restricted north-facing slopes). The impacts of thawing of the frozen north slopes will be contained within the TMF, and retained by the TMF embankment, which is constructed on competent bedrock. Additionally, CMC will prepare a Permafrost Management Plan (PMP) that will be submitted as part of the Quartz Mining Licence application. Other requirements for definition of permafrost management and site preparation details as part of the Quartz Mining Licence application include the Site Characterization Plan (soil and bedrock section), Environmental Monitoring, Surveillance and Reporting Plan (terrestrial monitoring section), Mine Development and Operations Plan (site preparation section), Mill Development and Operations Plan (site preparation section), Heap Leach and Process Facilities Plan (site preparation and construction quality assurance/quality control section), Tailings Management Plan (site preparation and construction quality assurance/quality control section), and in the Waste Rock and Overburden Management Plan (foundation conditions and construction quality assurance/quality control section).

B.6.3 THERMAL EROSION MODELING

B.6.3.1.1 R2-91

R2-91. A geothermal analysis and associated methodology that predicts response to the proposed TMF and associated infrastructure on permafrost conditions, considering the following:

a. Heat generated from the waste rock and processed ore after disposal.

b. Potential for solifluction, active layer detachment flows and similar mass wasting processes to occur at slope adjacent areas and embankments.

c. Freezing and thawing of mine tailings and embankment soil.

d. If the TMF is founded on permafrost soils that are too deep to excavate, creep deformation of those permafrost soils a result of the placement of the TMF should be considered.

e. Characterization of the subgrade under any containment structures is critical. Issues of geothermal state (frozen or unfrozen), ground temperature, unfrozen water content, salinity, creep strength and others may be important as part of the assessment process.

f. Effects of the proposed project on geothermal regime.

Further geothermal analysis has not been conducted for the proposed TMF, for reasons described below.

Geotechnical site investigation programs were conducted in the area of the TMF in 1993, 1994, 2010, 2011 and 2012. The programs included drillholes and test pits to investigate the geotechnical characteristics and foundation conditions. The programs included 27 geotechnical drillholes in the TMF area, in situ packer, falling head permeability tests, shut-in pressure tests, groundwater monitoring well, test pit samples with subsequent laboratory testowork for particle size, moisture content, Atterberg limits, specific gravity, flexible wall permeability triaxial shear and compaction tests. Further details on the site investigation results are provided in Appendix A.4D.

The results of the geotechnical site investigation programs indicated that permafrost is discontinuous over the TMF embankment area, and is primarily present at the valley bottom, north-facing slopes and shaded areas. The ridges at higher elevations and upper slopes on the west abutment are southeast-facing, and are generally free of permafrost except for some local shaded areas.

Permafrost is common in the northwest-facing east abutment area, where test pits were terminated at shallow depths in frozen colluvium and residual soils. Permafrost occurs here as thin ice lenses in fine grained soils and as small ice wedges in broken rock.

Permafrost is abundant in the organic, silty colluvial apron of the Casino Creek and tributary valley bottoms. The overburden is generally saturated and frozen in these areas, with high ice contents. Massive ice layers were encountered in the colluvial apron in DH11-23A. The massive ice was also identified in the ground penetrating radar (GPR) data in more than half of the survey line length along the valley bottom. The GPR data also indicated ground ice close to tributaries leading to Casino Creek. Alluvium lies at surface in very close proximity to Casino Creek, where it is not frozen due to the presence of a talik (permanently unfrozen ground). Permafrost is also absent in localized areas along Casino valley as indicated by the presence of tall grasses and willows, and the absence of thick mosses. These areas are discontinuous and likely result from the historic shifting of the creek channel which acts to maintain a thawed region under the creek.

This information lead to the following conclusions on the impact of permafrost:

- Thawing of ice-rich soils may lead to excessive settlements, and loss of strength. The ice-rich soils typically exhibit very low strengths when thawed, and flow even under very flat slopes. Two gelifluction lobes that were observed within the colluvial apron in the TMF embankment area are evidence of this potential for instability. Ice-rich soils also have the potential for long term creep displacements.
- Disturbance or removal of the vegetative cover may result in the melting of permafrost and the development of unstable conditions. Frozen overburden and bedrock that are underlying part of the tailings impoundment and embankments are expected to thaw over time, as the tailings and water stored in the TMF will act as a heat source. It is therefore recommended that all ice-rich overburden encountered during construction be removed along the entire foundation of the TMF embankments.
- Ground ice is not expected to be significant in bedrock which will provide a stable foundation for the embankments. Preferential seepage paths may develop when ice filled discontinuities thaw.
- Permafrost has an important effect on hydrogeology. Saturated frozen soil and rock have a much lower permeability when frozen compared to a thawed or unfrozen state. In situ hydraulic conductivity test results showing very low hydraulic conductivities potentially indicate frozen soil or rock.

Mitigation measures incorporated into the design of the TMF embankment are as follows:

- Bedrock may have to be steamed and grouted if ground ice is significant in bedrock.
- Permafrost and frost susceptible materials should be avoided when sourcing core zone borrow materials.

Recommendations for future studies include:

- Thermistors installed during the 2011 and 2012 site investigations will provide a better understanding of the thermal regime in the bedrock.
- Additional site investigations will be required to confirm the characteristics of the overburden and bedrock, and the extent of permafrost within the TMF embankment area.
- Thermal modelling may also be required to predict the effect of the proposed TMF on foundation conditions, depending on the results of the additional site investigations and the thermistor monitoring.

Geothermal analyses are an important part of the design process. If foundation conditions are suspected to be susceptible to the effects of thermal erosion, after the removal of permafrost to non-frost susceptible bedrock, additional site investigation and detailed thermal analysis will be completed and additional mitigations measures will be applied if required.

Results of on-going geothermal analysis will be incorporated into the Permafrost Management Plan that will be submitted as part of the Quartz Mining Licence application. Other requirements for definition of permafrost management and site preparation details as part of the Quartz Mining Licence application include the Site Characterization Plan (soil and bedrock section), Environmental Monitoring, Surveillance and Reporting Plan (terrestrial monitoring section), Mine Development and Operations Plan (site preparation section), Mill Development and Operations Plan (site preparation section), Heap Leach and Process Facilities Plan (site preparation and construction quality assurance/quality control section), Tailings Management Plan (site preparation and construction quality assurance/quality control section), and in the Waste Rock and Overburden Management Plan (foundation conditions and construction quality assurance/quality control section).

B.6.4 GROUND THERMAL CONDITION AND PERMAFROST TEMPERATURE MONITORING

B.6.4.1.1 R2-92

R2-92. Additional details in relation to temperatures data, trends and ground temperature monitoring for the Freegold Road Extension including:
a. A discussion regarding possible warming trend in the near surface based on the available ground temperature data. For example: Does the post 1994 ground temperature data exhibit any warming trend in the near surface temperatures? Is the active layer thickening?
b. If thermistors were installed in 2011 and 2012, up to four years of ground temperature data has been collected. Please report on this data.
c. If the 1994 thermistor cables are in the same location as the 2011 and 2012 thermistor cables. Please combine the data and provide some inferences as to long-term trends in mean annual ground temperatures.
d. The installation of thermistor strings to monitor ground temperatures and develop "trumpet curves" is an appropriate development by CMC. These data should be used to establish baseline mean annual ground temperatures values.

The introduction to request R2-92 in ARR-2 comments on the ground temperature data, trends and ground temperature monitoring for the Freegold Road Extension, however, questions a. through d. relate to thermistors installed in and around the mine site. To clarify, a geotechnical site investigation is *planned* for the Freegold Road Extension and may include the installation of thermistors to monitor ground temperature, but has not yet been completed. The plan includes installation of thermistors in the swamp areas on the valley floors where the permafrost table is expected to be close to ground surface and the potential is greater for massive ground ice. The thermistor data for these areas will be used to analyze the permafrost conditions and design the insulating embankment upon which the road is to be constructed. The plan also includes installation of thermistors at several bridge sites to determine the permafrost conditions and to investigate the possibility of frost jacking of piles.

The responses to questions a. through d. as they relate to thermal monitoring around the mine site are provided below:

a. Six thermistor strings were installed in drillholes in June through August 1994. Data at each of these locations was only manually downloaded once or twice per month until December 1994 or January 1995. All of the six 1994 thermistor strings have been reportedly damaged or lost and none are currently functioning (Appendix 7C). The available ground temperature readings for thermistor cables installed in 1994 are provided in Figure B.6.4-1 through Figure B.6.4-6, for each sampling month. Temperatures below zero were recorded in the deposit area at 94-321, 94-331, and 94-334, and downstream of the proposed TMF Embankment at 94-349. Recorded temperatures were above zero at sensors 94-344 and 94-355 located in Casino Creek Valley.

   The Executive Committee has requested that temperature data from 1994 thermistor sites be compared against adjacent locations with existing data sets, such as at 94-349 and DH12-03, to assess impacts of recent climate warming. While the two thermistor strings 94-349 and DH12-03 are the closest together of the 1994 and more recent thermistor installations, they are located approximately 260 m apart and on opposite sides of Casino Creek valley. The inferred base of permafrost at 94-349 was 29 mbgs based on the available 1994 data (Figure B.6.4-5). The inferred base of permafrost at DH12-03 is 43 mbgs based on data collected from 2012 to 2014 (Figure B.6.4-7). Since comparison of the two data sets shows the opposite trend as would be expected due to climate warming, impacts of recent climate warming are unable to be inferred by their comparison. Unfortunately, no other 1994 thermistor locations are proximal to locations where temperature data has been more recently recorded.

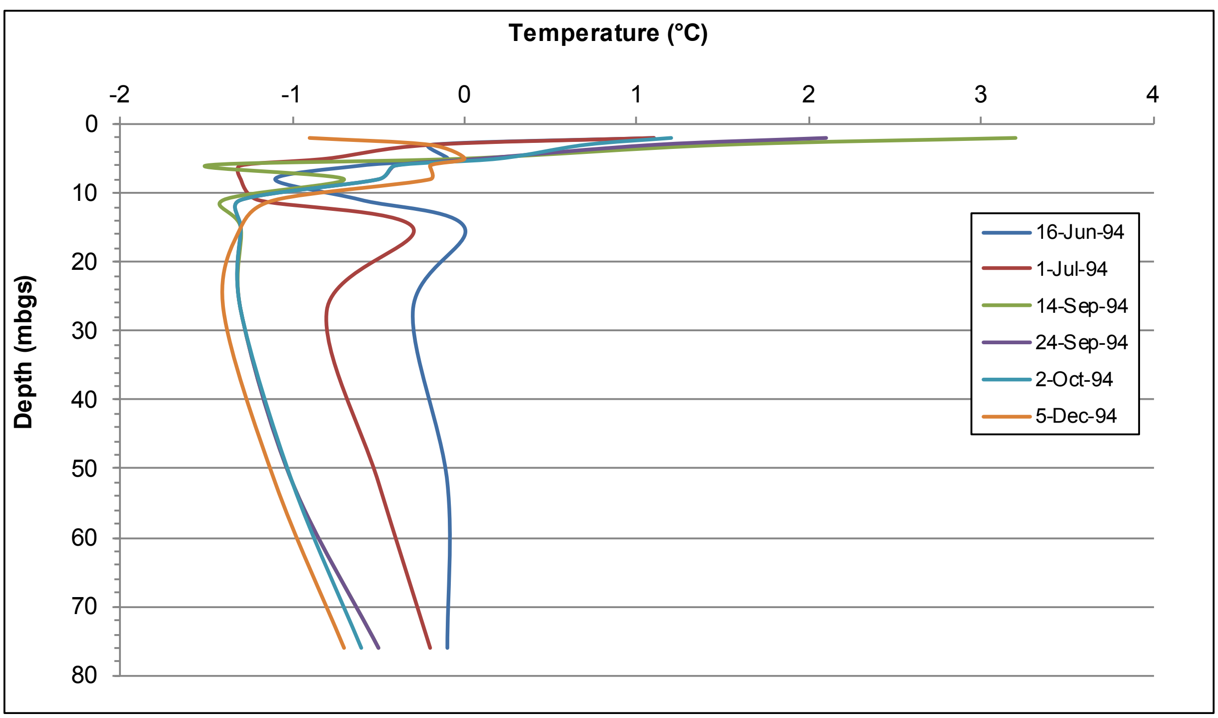

Figure B.6.4-1 Ground Temperature with Depth at 94-321

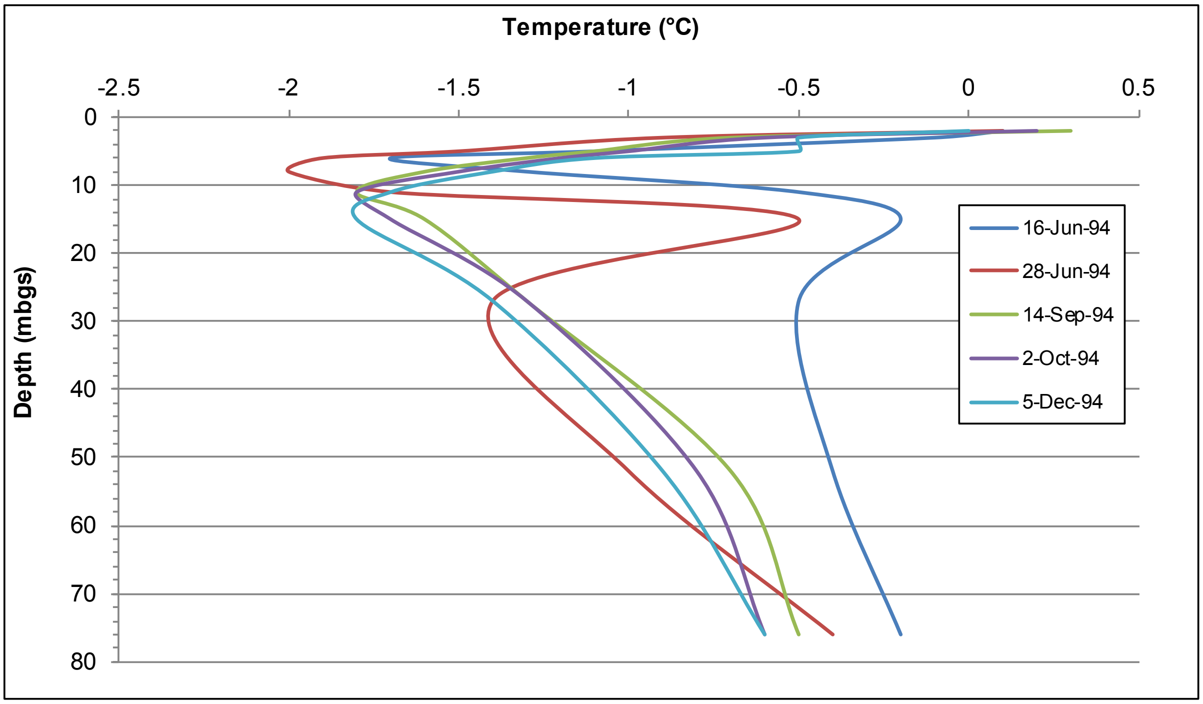

Figure B.6.4-2 Ground Temperature with Depth at 94-331

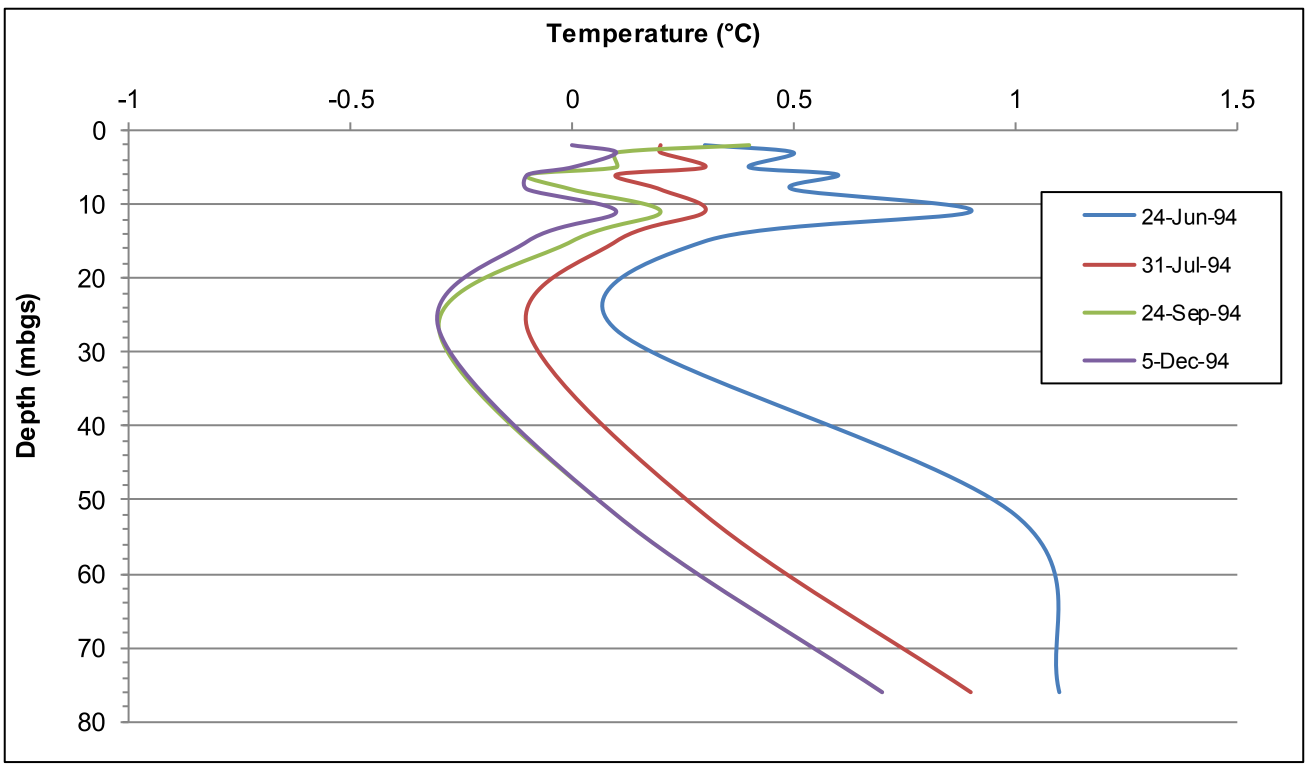

Figure B.6.4-3 Ground Temperature with Depth at 94-334

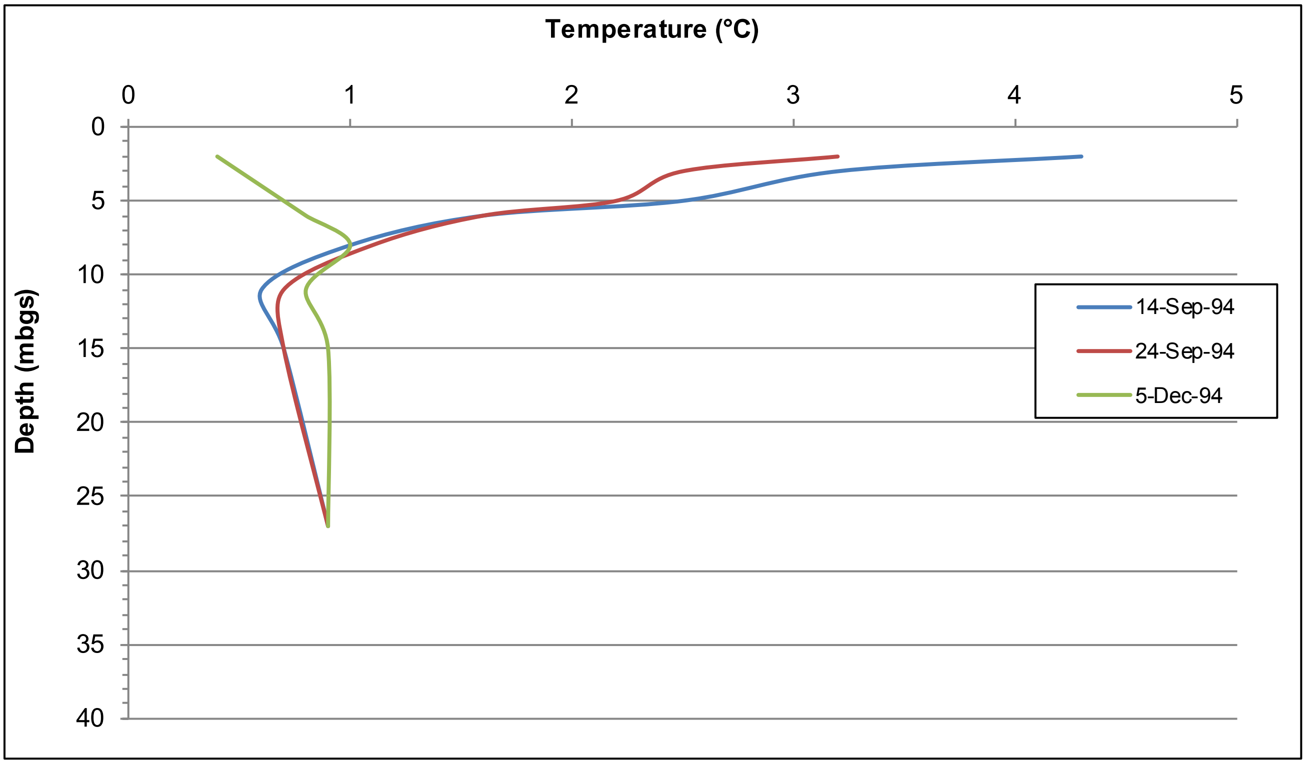

Figure B.6.4-4 Ground Temperature with Depth at 94-344

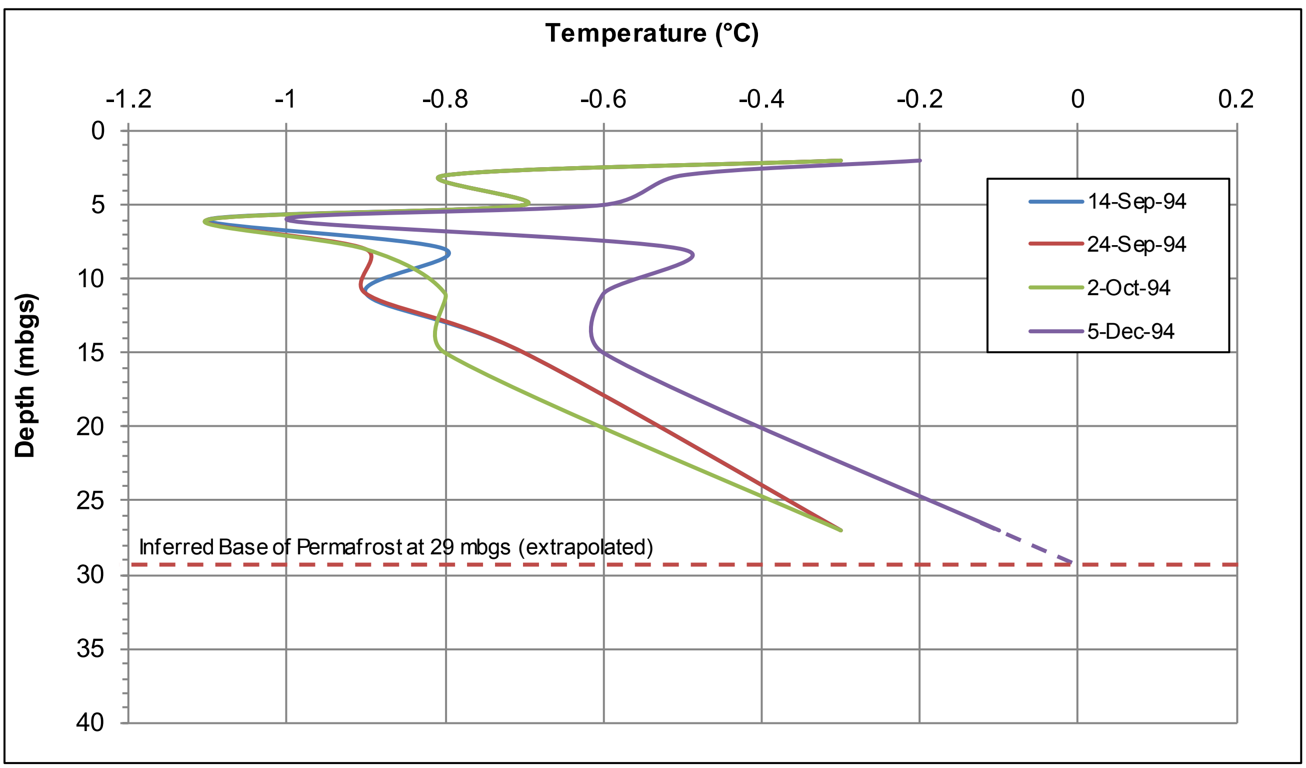

Figure B.6.4-5 Ground Temperature with Depth at 94-349

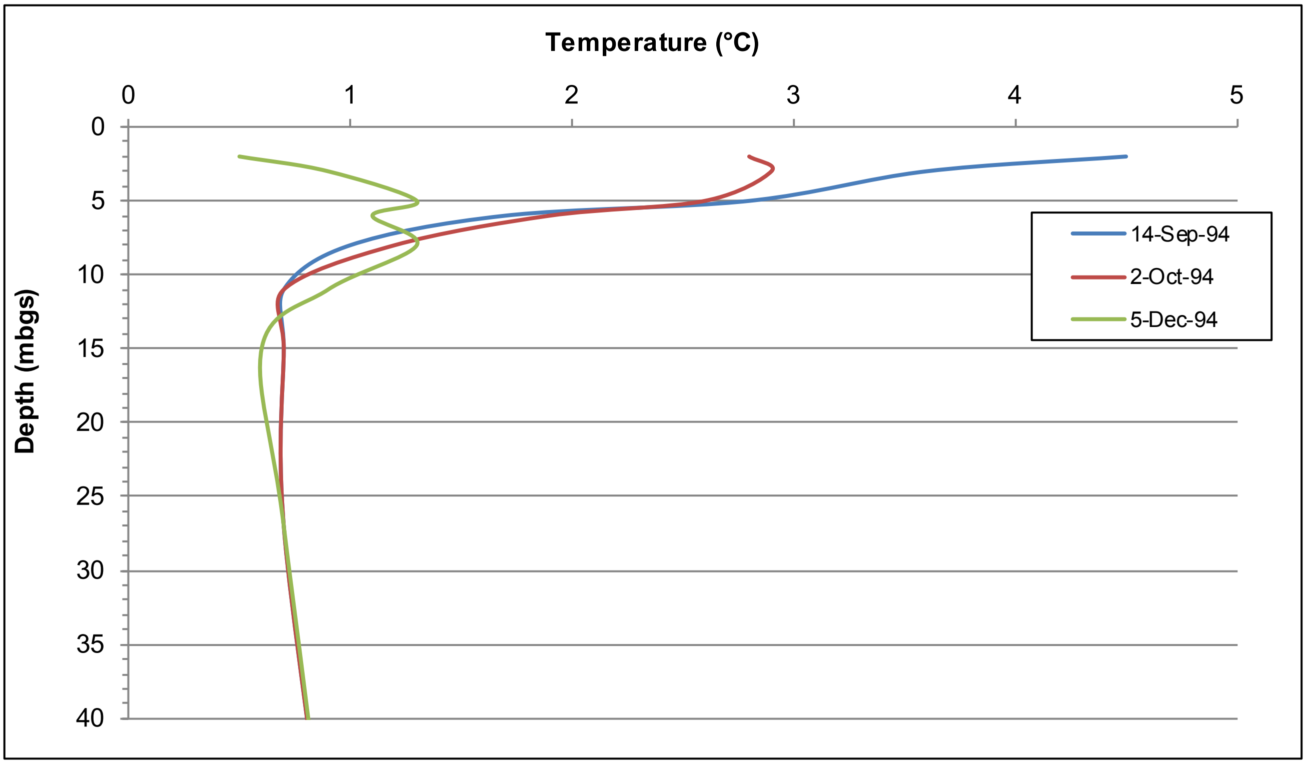

Figure B.6.4-6 Ground Temperature with Depth at 94-355

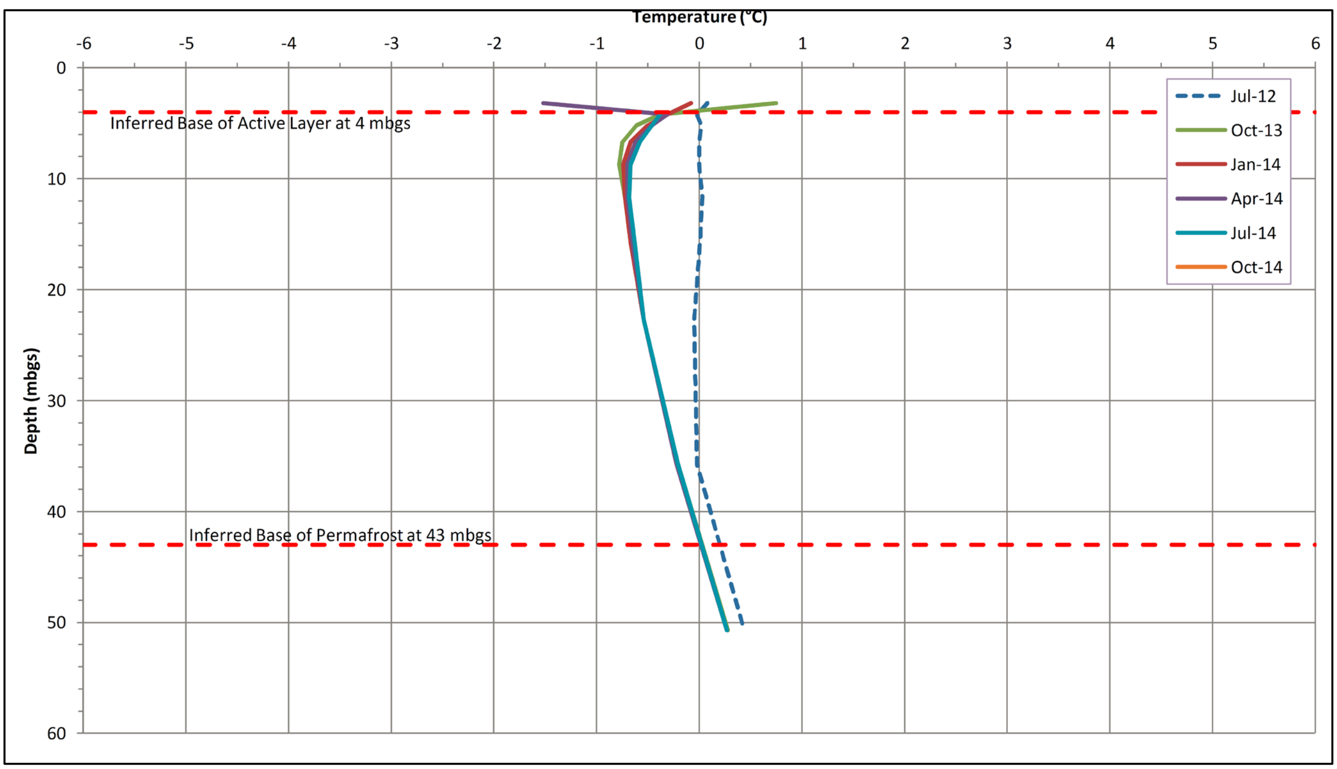

Figure B.6.4-7 Ground Temperature with Depth at DH12-03

b. Updated thermistor data is provided in the 2013-2014 Groundwater Data Report, provided in Appendix A.7M, specifically Appendix D of that report.

c. The locations of all installed thermistors are shown in Figure B.6.4-8. No 1994 thermistor locations are proximal to locations where temperature data has been more recently recorded. Therefore, inferences as to long-term trends in mean annual ground temperatures are not possible.

d. Hydrogeology data in and around the mine site, including continuous groundwater level and ground temperature monitoring, and groundwater quality sampling continues to be collected as part of the on-going environmental monitoring program. Baseline studies will be updated and provided in the applications for Quartz Mining and Water Use Licences.

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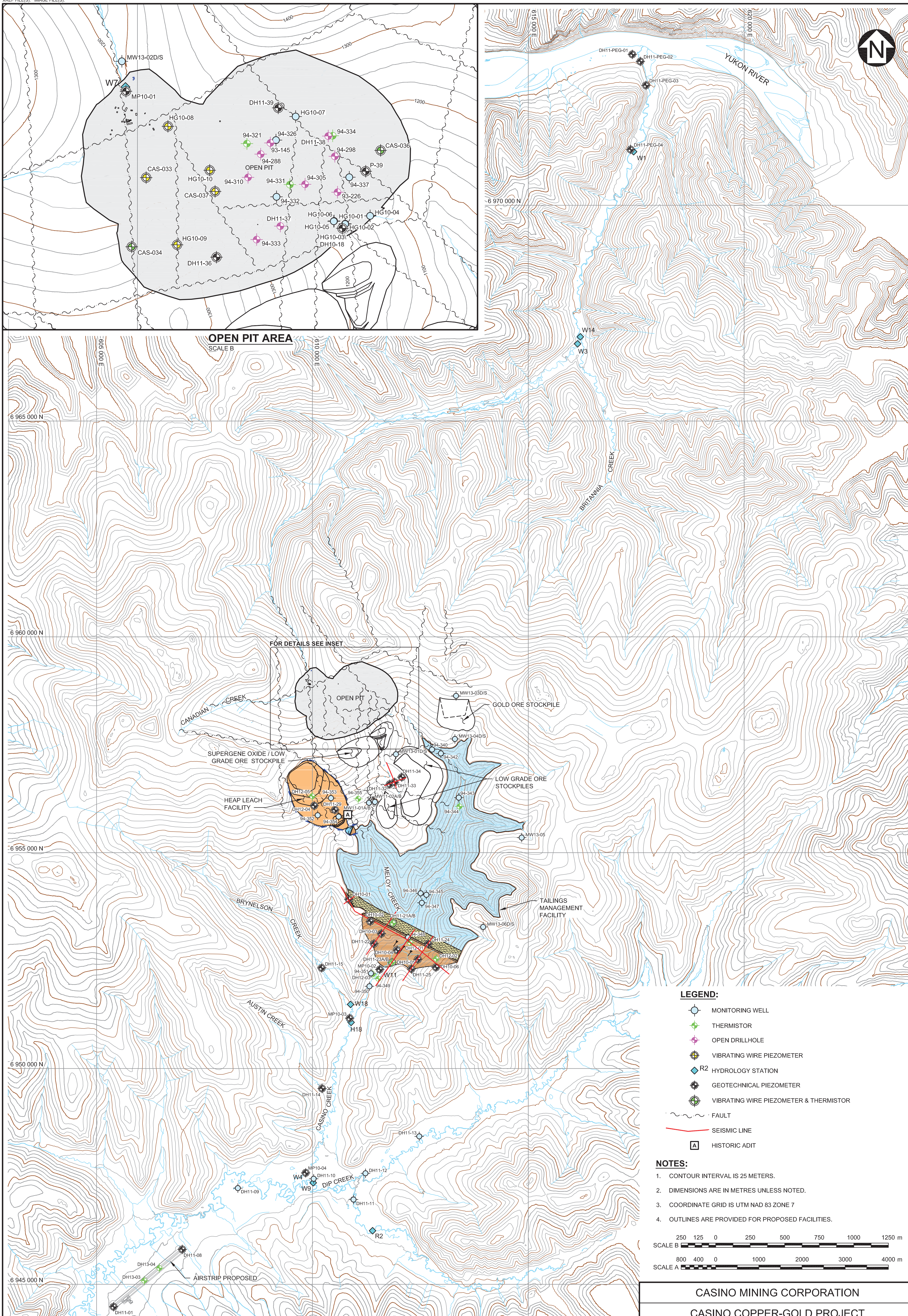

LEGEND:

- MONITORING WELL
- THERMISTOR
- OPEN DRILLHOLE
- VIBRATING WIRE PIEZOMETER
- R2 HYDROLOGY STATION
- GEOTECHNICAL PIEZOMETER
- VIBRATING WIRE PIEZOMETER & THERMISTOR
- FAULT
- SEISMIC LINE
- A HISTORIC ADIT

NOTES:

1. CONTOUR INTERVAL IS 25 METERS.
2. DIMENSIONS ARE IN METRES UNLESS NOTED.
3. COORDINATE GRID IS UTM NAD 83 ZONE 7
4. OUTLINES ARE PROVIDED FOR PROPOSED FACILITIES.

SCALE B: 250 125 0 250 500 750 1000 1250 m
SCALE A: 800 400 0 1000 2000 3000 4000 m

CASINO MINING CORPORATION

CASINO COPPER-GOLD PROJECT

Hydrogeological Instrumentation Locations

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-325/17	1

Figure B.6.4-8 — REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	18DEC'14	ISSUED WITH REPORT	KTD	TAM	CAS	KJB

B.6.5 SURFICIAL GEOLOGY AND TERRAIN MAPPING METHODS AND MAPS

B.6.5.1.1 R2-93

R2-93. A reference to the legend used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers.

The terrain unit integers are an adaptation to Howes and Kenk (1997). The Terrain Classification System for British Columbia (Howes and Kenk, 1997) is a terrain mapping standard issued by the Government of British Columbia, Ministry of Environment (MOE). A field card of codes is issued by the MOE to assist map users in reading terrain labels, and is reproduced below for ease of use (the original can be sourced from https://www.for.gov.bc.ca/hts/risc/pubs/teecolo/terclass/fieldcar.htm#anchor510868).

Table B.6.5-1 Terrain Classification System for British Columbia Codes and Descriptions

TEXTURE			
Symbol	**Name**	**Size (mm)**	**Other Characteristics**
a	blocks	>256	angular particles
b	boulders	>256	rounded & subrounded particles
k	cobble	64-256	rounded & subrounded particles
p	pebbles	Feb-64	rounded & subrounded particles
s	sand	2-.062	
z	silt	.062-.002	
c	clay	<.002	
d	mixed fragments	>2	mix of rounded and angular particles
g	gravel	>2	mix of boulders, cobbles and pebbles
x	angular fragments	>2	mix of rubble and blocks
r	rubble	2-256	angular particles
m	mud	<.062	mix of clay and silt
y	shells	-	shells or shell fragments
e	fibric		well-preserved fibre; (40%) identified after rubbing
u	mesic		intermediate decomposition between fibric and mesic
h	humic		decomposed organic material; (10%) identified after rubbing

SURFICIAL MATERIALS			
Symbol	**Name**	**(Assumed Status of Formative Process)**	**Description**
A	anthropogenic	(A)	Man-made or man-modified material
C	colluvial	(A)	Products of mass wastage
D	weathered rock	(A)	In situ bedrock

E	eolian	(I)	Materials deposited by wind action
F	fluvial	(I)	River deposits
F^G	glaciofluvial	(I)	Fluvial materials deposited by meltwater streams
I	ice	(A)	Permanent snow, glaciers and icefields
L	lacustrine	(I)	Lake sediments; includes littoral deposits
L^G	glaciolacustrine	(I)	Sediments deposited in glacial lakes
M	morainal	(I)	Material deposited directly by glaciers
O	organic	(A)	Accumulation/decay of vegetative matter
R	bedrock	(-)	Outcrops/rocks covered by less then 10 cm
U	undifferentiated	(-)	Layered sequence; three materials or more
V	volcanic	(I)	Unconsolidated pyroclastic sediments
W	marine	(I)	Marine sediments; incudes littoral deposits
W^G	glaciomarine	(I)	Sediments of glacial origin deposited in a marine environment

QUALIFIERS

Symbol	**Name**	**Description**
G	glacial	Used to qualify surficial material where there is evidence that glacier ice affected the mode of deposition of material
A	active	Used to qualify surficial material and geomorphological
I	inactive	processes with regard to their current state of activity

SURFACE EXPRESSION

Symbol	**Name**	**Description**
a	moderate slope	Unidirectional surface; 16 to 26°.
b	blanket	A mantle of unconsolidated materials; >1m thick.
c	cone	A cone or sector of a cone; >15°.
d	depression	A sharply demarked hollow.
f	fan	A sector of a cone ; up to 15°.
h	hummocky	Hillocks and hollows, irregular plan; 15 to 35°.
j	gentle slope	Unidirectional surface; 4 to 15°.
k	moderately steep	Unidirectional surface; 27 to 35°.
m	rolling	Elongate hillocks; parallel in plan; 3 to 15°.
p	plain	Unidirectional surface; 0 to 3°.
r	ridged	Elongate hillocks; parallel in plan; 15 to 35°.
s	steep	Steep slopes; >35°.
t	terraced	Step-like topography.
u	undulating	Hillocks and hollows; irregular in plan; 0 to 15°.
v	veneer	Mantle of unconsolidated material; 10cm to 1m thick.

w	mantle of variable thickness	Suficial material of variable thickness; (0 to about 3 m).
x	thin veneer	Similar to veneer; (2-20 cm thick).

GEOMORPHOLOGICAL PROCESSES			
Symbol	**Name**	**(Assumed Process Status)**	**Description**
A	avalanches	(A)	Terrain modified by snow avalanches
B	braiding	(A)	Diverging/converging channels; unvegetated bars
C	cryoturbation	(A)	Sediment modified by frost heaving and churning
D	deflation	(A)	Removal of sand and silt by wind action
E	channeled	(I)	Channel formation by glacial meltwater
F	slow mass movement	(A)	Slow down-slope movement of masses of cohesive or non-cohesive material and/or bedrock
H	kettled	(I)	Depressions due to the melting of buried glacier ice
I	irregular channel	(A)	A single, clearly defined main channel displaying irregular turns and bends
J	Anastomosing channel	(A)	A channel zone where channels diverge and converge around vegetated islands
K	karst	(A)	Processes associated with the solution of carbonates
L	surface seepage	(A)	Abundant surface seepage
M	meandering channels	(A)	Channels characterized by regular patterns of bends with uniformed amplitude and wave length
N	nivation	(A)	Erosion beneath and along the margin of snow patches
P	piping	(A)	Subterranean erosion by flowing water
R	rapid mass movement	(A)	Rapid downslope movement of dry, moist or saturated debris
S	solifluction	(A)	Slow downslope movement of saturated overburden across a frozen or otherwise impermeable substrate
U	inundation	(A)	Seasonally under water due to high watertable
V	gully erosion	(A)	Parallel/subparallel ravines due to erosion by various processes
W	washing	(A)	Removal of fines by waves and running water
X	permafrost	(A)	Processes controlled by the presence of permafrost
Z	periglacial processes	(A)	Solifluction, cryoturbation and nivation processes occurring within a single unit

B.6.5.1.2 R2-94

R2-94. A Hazard Map and associated methodology that:

a. Predicts the type, nature, frequency and magnitude of all hazards in the study area.

b. Where the study area is bound by moderate to steep slopes please modify the terrain map and the terrain stability map to include upslope areas (to the height of land). Note: In the case of the

road, this only need apply to the side of the valley that supports the road.

c. Where the study area is bound by moderate to steep slopes please increase the detail of the mapping to capture areas commonly associated with hazards such as gullies but not currently mapped.

d. From the map above, if appropriate, identify specific risks to the project.

e. From the map above, if appropriate, identify specific risks to the environment from the project.

f. Based on the risk identified in response to the questions above, please provide general options and considerations for engineering design to mitigate the identified risks.

Terrain mapping and terrain stability mapping was conducted to predict the potential for landslides, snow avalanches and permafrost disturbances, and the results are provided in Appendices 6B, 6D and 6E and summarized in Section 20.3.2. 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. However, 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, which include:

- 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.
- 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.
- 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.

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.

Along the road route, minor slope instability and erosion of embankments can be monitored and mitigated quickly to prevent sediment delivery to watercourses. Project components, activities and critical services are not likely to be interrupted. In an unlikely worst-case scenario, differential settlement of air strip embankments, road embankments and bridge foundations may occur. Complete shutdown of Project components, activities and critical services may occur for more than one week.

In consideration of the above, the responses to requests a. through f. are provided below.

a. A terrain hazards assessment was carried out for the Casino mine site, Freegold Road Extension, and the Casino Airstrip (Appendices 6B, 6D and 6E). 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.

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 B.6.5-2 summarizes the potential likelihoods of occurrences of terrain instability based on the terrain stability mapping exercise for the Project.

Table B.6.5-2 Potential Likelihoods of Occurrences of Terrain Instability

<table>
<tr><th>Locations</th><th>Stable Terrain (%)</th><th>Potentially Unstable Terrain (%)</th><th>Unstable Terrain (%)</th><th>Occurrence Type</th><th>Likelihood</th></tr>
<tr><td rowspan="2">Mine Site</td><td rowspan="2">86.5</td><td rowspan="2">13</td><td rowspan="2">0.5</td><td>Landslides and avalanches</td><td>Negligible</td></tr>
<tr><td>Permafrost degredation</td><td>High</td></tr>
<tr><td rowspan="2">Airstrip and Airstrip Access Road</td><td rowspan="2">95</td><td rowspan="2">5</td><td rowspan="2">0</td><td>Landslides and avalanches</td><td>Negligible</td></tr>
<tr><td>Permafrost degredation</td><td>High</td></tr>
<tr><td rowspan="2">Freegold Road Extension</td><td rowspan="2">88</td><td rowspan="2">9</td><td rowspan="2">3</td><td>Landslides and avalanches</td><td>Low</td></tr>
<tr><td>Permafrost degredation</td><td>High</td></tr>
</table>

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 (Appendix 6B). 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 (Appendix 6B). 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 subsurface 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.

b. The Terrain Hazards Assessment conducted for the proposed access road and airstrip corridors comprised an approximately 1.5 to 2.5 km-wide corridor, corresponding approximately to the extent of the project LiDAR Survey. The scope of work included Air Photo Interpretation (API), analysing slope angle maps, undertaking field proofing and developing terrain hazards maps for the site. The mapping included terrain mapping based on the Terrain Classification System for British Columbia (Howes and Kenk, 1997), terrain stability mapping, delineation of past landslides and identification of potentially hazardous permafrost features.

   The API was undertaken by inspecting 1:20,000 scale colour air photos, taken in September 2009, with a stereoscope. Slope angle maps of the terrain in the vicinity of the road alignments were prepared from the 5 m LiDAR contours using the ArcView Geographic Information System (GIS) software package with the '3d-Analyst' extension. The slope angle classes used correspond with those in the Terrain Classification System for British Columbia (Howes and Kenk, 1997). Terrain stability mapping was undertaken by integrating the terrain mapping with the slope angle maps and the corresponding slope aspect.

Terrain mapping was undertaken based on the Terrain Classification System for British Columbia, as detailed in Howes and Kenk (1997). The maps were developed from the API with the aid of the slope angle maps. The terrain units were identified based upon the morphology, the presence and nature of soil or rock exposures, as well as vegetation associations. The terrain mapping was refined, based on the findings of the field truthing. The mapping was conducted to TSIL 'D', requiring between 1% and 20% of the terrain polygons to be field truthed.

SNC-Lavalin has seemingly interpreted the borders of the mapping on sheets 6 through 17 in Appendix 6B as a "buffer"; however, in fact the border is simply the limit of the 1:20,000 scale colour air photos available for the Project. In areas where landslides were identified in the areas upslope from the Local Study Area (LSA) boundary, the LSA for terrain mapping was extended up to the top of the catchment. CMC considers the mapping provided in Appendix 6B and 7D appropriate for environmental assessment and comparable to other terrain and terrain stability mapping conducted for other mine projects (e.g., Kitsault Project – Avanti, 2011, KSM Project - Seabridge Gold, 2013). As the main hazard identified by the mapping is due to degradation of permafrost, and not landslides or avalanches, no further studies were necessary to predict the potential impacts of terrain hazards on the Project (Section 20.3.2) or to define mitigation measures.

c. Terrain and terrain stability mapping is provided in Appendices 6B and 6D. The primary objective of the terrain stability mapping was to analyse the terrain stability in relation to the proposed development. Terrain stability refers to the likelihood of a landslide initiating in a terrain polygon following road construction activities and timber harvesting. Terrain stability class criteria were developed for the Study Area. Terrain stability was evaluated based on the slope angle, the slope aspect, the surficial geology, the permafrost conditions and the presence of gullied terrain.

   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). CMC considers the mapping provided in Appendix 6B and 7D appropriate for environmental assessment and comparable to other terrain and terrain stability mapping conducted for other mine projects (e.g., Kitsault Project – Avanti, 2011, KSM Project - Seabridge Gold, 2013). As the main hazard identified by the mapping is due to degradation of permafrost, and not landslides or avalanches, no further studies were necessary to predict the potential impacts of terrain hazards on the Project (Section 20.3.2) or to define mitigation measures.

d. Risks to the Project from terrain instability were provided in Section 20.3.2 of the Project Proposal, and are supported by Appendices 6B and 6D.

e. Risks to the environment from the Project are defined in Section 6 of the Project Proposal, supported by Appendix 6A.

f. Following the terrain mapping and terrain hazard assessments conducted for the mine site and access roads and airstrip, engineering considerations to be incorporated into detailed design are described below.

   Access Road

   - In areas where the alignments traverse areas of known or suspected ice-rich soils, permafrost degradation effects can be mitigated by constructing the road/air strip on an embankment of non frost susceptible fill.

- The natural vegetation cover of sphagnum moss should be kept in place, wherever possible, to provide the maximum protection to the thermal regime. Winter construction is preferred in these areas.
- For summer construction, woven geotextile may need to be laid over thaw unstable ground, prior to placement of the fill.
- To mitigate sedimentation and erosion in areas of silty and organic soils (e.g., colluvial aprons and organic swamps on the flood plains of major watercourses), such soils should be left in place, wherever possible, with the surface cover of sphagnum moss intact and the road constructed on an embankment of non-frost susceptible fill.
- Develop robust erosion and sediment control plans in any areas where soils are to be disturbed.
- At Big Creek (15+800), the presence of a thick cover of colluvium on steep slopes in this area may have implications for the design of the proposed cut slopes and cut slope stabilization measures may need to be implemented in the detailed design.
- Natural slopes at 62+500 appear to be susceptible to ongoing instability due to river bank erosion, excavation of the colluvial veneer may be required at a point approximately 20 m above the elevation of the creek where the slope angle tapers off slightly and continues down slope to the proposed alignment. A stable road prism could then be developed in bedrock.
- Detailed design should include terrain stability assessments at 15+800 and 62+500, where there is the possibility of encroachment into the riparian zone.
- In areas where solifuction is particularly prevalent (e.g., moderate, north-facing colluvial slopes), the road should be constructed on an embankment that effectively buttresses the natural slope.
- Where the access road alignment traverses a solufuction lobe in, the alignment may need to be re-routed slightly.
- Minimize cut slopes to mitigate the risk of permafrost degradation.
- Detailed drainage design for the road should consider the shallow permafrost table in the north-facing colluvial mid-slopes and the colluvial aprons.

Airstrip

- Complete additional boreholes along the airstrip alignment as part of the detailed design to further investigate the extent of ice-rich soils and to facilitate the installation of thermistors.
- Incorporate additional measures into the detailed design of the airstrip to manage expected surface and shallow subsurface water flows and limit long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice (e.g., flattening or buttressing the side slopes of the embankment).
- Implement drainage measures to prevent water ‘ponding’ at the upslope toe of the embankment.
- Monitor the performance throughout the design-life of the airstrip against to-be-determined performance criteria.

Mine Site

- The surface water management strategies implemented should prevent water accumulating in the natural terrain adjacent to the proposed facilities in areas of known or suspected ice-rich soils. Ditching at the toe of embankments should be avoided in areas of known or suspected ice-rich soils.
- Detailed design of the Heap Leach Facility and the Supergene Oxide Ore Stockpile should account for natural seasonal sub-surface seepage flows within the active layer and seasonal surface flows.
- Ice-rich portions of the colluvial apron deposits within the proposed footprint area of the tailings embankment will need to be removed prior to the construction of the embankment, and replaced with non-frost susceptible fill.
- Additional site investigation is required in order to enhance the understanding of the ground conditions at the proposed embankment site and to facilitate a reasonably accurate estimate of the volume of unsuitable material needing to be removed, spoiled and replaced.
- In areas mapped “potentially unstable” and “unstable”, the natural vegetation cover should be kept in place to provide the maximum protection to the thermal regime. For summer construction, a woven geotextile may need to be laid over thaw unstable ground, prior to placement of fill. In areas where vegetation needs to be removed, winter construction is recommended for the initial lifts.

A Terrain Stability Assessment will be conducted during the detailed design phase, and will include:

- Confirmation of the design cut slope angles and the scope of any necessary mitigation measures.
- For those areas identified in the terrain stability mapping as “potentially unstable” and/or close to areas of “unstable” terrain, analysis of the landslide risks and, where necessary, recommendation of measures to mitigate risk.
- Determination of the extent of the necessary landslide mitigation and erosion and sediment control measures required between 86+000 and 95+000 including shallow soil sampling holes to better understand sub-surface conditions ahead of construction.
- Overview of possible snow avalanche hazards along the alignments by a snow avalanche specialist.

B.6.6 TERRAIN HAZARDS ASSESSMENT

B.6.6.1.1 R2-95

R2-95. Additional details in relation to terrain hazards assessment including:
a. Table 1, Table 2, Figure 1, and Figure 2 referenced to in the Fluvial Geomorphology report.
b. More detail on river ice buildup, ice jams, and thermokarst processes in relation to the proposed Freegold Road extension, Airstrip Access Road.
c. Watershed characteristics (watershed area, watershed length, relief, and melton ratio) for each road crossing of a side channel feeding into the main valley and provide comment on dominant depositional process at each crossing.
d. A correlation of lateral migration rate descriptors to an actual measured rate of migration (i.e. low = 0 to 0.1 m/year).

a. Table 1, Table 2, Figure 1 and Figure 2 referenced in the Fluvial Geomorphology report (Appendix 6E) are provided in Appendix B.6A.

b. River ice buildup, ice jams and thermokarst processes are incorporated into the detailed field investigations and topographic site surveys required for detailed road engineering. The fluvial geomorphological hazards described in the Fluvial Geomorphology report (Appendix 6E) correspond to possible risks that are considered as part of detailed road and crossing design.

c. Detailed field investigations and topographic site surveys will be conducted for all bridge crossings, and will include watershed area details. For comparison, detailed field investigations for the 27 major bridge crossings along the Freegold Road and extension were conducted in 2011, and the resulting hydro-technical analysis was used to prepare the conceptual bridge designs provided in Appendix 4B. Bridge lengths and minimum deck elevations are determined from hydro-technical analysis, environmental requirements, geotechnical information and road/stream alignment. The hydro-technical analysis for each crossing consisted of two phases: a hydrologic analysis to estimate the design flow that each crossing structure must accommodate during the 1:100 year return event; and a hydraulic analysis to predict the water surface elevation and water velocity for the design flow, detailed below.

Hydrologic Analysis

In order to estimate the design flow for each crossing, a regional flood frequency analysis was performed using information from the Water Survey of Canada (WSC) and Yukon Environment – Water Resources Branch. In order to confirm the results, flows were then estimated using the procedures outlined in the Design Flood Estimating Guidelines for the Yukon Territory (Janowicz, 1989).

Watershed Delineation and GIS Analysis

Watershed delineation and GIS analysis was based on the National Topographic Series (NTS) 1:50,000 scale digital maps. The digital elevation models (DEM) used to generate contours and delineate watershed boundaries were the 30 m resolution DEM dataset generated and distributed by Environment Yukon – Geomatics. Geographic information system (GIS) was used to delineate the upstream watershed boundary for each crossing and calculate the resulting watershed area. Other physiographic parameters such as average overland slope, maximum, minimum and average elevation, and the longest flow path were also obtained. Similar analysis was performed for the WSC and Yukon Environment stream gauge locations in the area.

Hydraulic Analysis

Detailed site surveys were conducted at each crossing location and digital terrain models were developed from the site surveys. This information, along with the estimated flows at each crossing, formed the basis for the hydraulic analysis. The hydraulic analysis was then completed using in-house software to confirm water surface elevation and water velocity through the proposed structures hydraulic opening. A freeboard allowance ranging from 0.6 m to 1.0 m was provided at each crossing based on the typical potential for bedload and debris movement.

d. The descriptors used to describe meander migration in the Fluvial Geomorphology report (Appendix 6E) (e.g., modest, substantial, low) are qualitative descriptors and provide relative descriptions, and not actual measured rates of migrations. As the fluvial hazards assessment was conducted entirely from desktop information sources (e.g., 1949, 1989 and 2009 air photos), a quantitative rate of lateral migration is not possible to calculate. More detailed analysis, with field inspections, will be carried out as part of the detailed design studies for the proposed roads and crossings, as described above for part c. Please note also that the assessment took account of the channel avulsion hazard as well the meander migration rate and it can be misleading to focus attention on the meander migration rate.

B.6.6.1.2 R2-96

R2-96. A soil erosion potential analysis for the LSA that includes the component of thermal erosion where permafrost is identified as being present.

Soil erosion potential analysis has not been conducted separately, however, conclusions can be made from the terrain hazards assessment provided in Appendices 6B and 6D. The terrain mapping highlighted the widespread occurrence of silty and organic soils. These soils, which predominantly comprise colluvial apron and loess deposits, tend to be ice-rich and are expected to be especially prone to erosion and instability upon disturbance. A thaw flow was observed at the site of the proposed Tailings Embankment, where an access track had been formed on a colluvial apron with a natural slope angle of less than 25%.

The terrain stability mapping highlighted significant areas of ‘potentially unstable’ terrain and local areas of ‘unstable’ terrain at the site of the proposed Tailings Management Facility, related to the interpreted presence of silt-rich and ice-rich soils. Similarly, areas of ‘potentially unstable’ terrain were identified, locally, at the sites of the proposed Stockpiles, Heap Leach Facility and Open Pit. The surficial soils at the sites of the proposed Tailings Embankment and Open Pit are expected to be especially prone to erosion and instability upon disturbance.

Extensive and deep ice-rich colluvial apron deposits with bodies of massive ground ice have been identified at the site of the proposed Tailings Embankment that will need to be excavated in order to limit differential settlement of the embankment and mitigate the possibility of piping within the embankment foundations. A thick deposit of silt and ice-rich re-worked loess was identified in the north part of the footprint of the proposed Open Pit. The conventional strategy of cutting slopes at shallower angles requires a large area of land disruption in such terrain and has been found to result in increased erosion. The preferred management technique for dealing with mine cuts in ice-rich soils is to allow natural degradation of the permafrost slopes and slumping of the cuts to aid in reclamation. In areas where ice-rich soils at the site need to be excavated, robust sediment and erosion control plans will be developed.

Mitigations to be incorporated into detailed design and construction of the mine components and access road as they relate to permafrost include:

Access Road

- In areas where the alignments traverse areas of known or suspected ice-rich soils, permafrost degradation effects can be mitigated by constructing the road/air strip on an embankment of non frost susceptible fill.
- The natural vegetation cover of sphagnum moss should be kept in place, wherever possible, to provide the maximum protection to the thermal regime. Winter construction is preferred in these areas.
- For summer construction, woven geotextile may need to be laid over thaw unstable ground, prior to placement of the fill.
- To mitigate sedimentation and erosion in areas of silty and organic soils (e.g., colluvial aprons and organic swamps on the flood plains of major watercourses), such soils should be left in place, wherever possible, with the surface cover of sphagnum moss intact and the road constructed on an embankment of non-frost susceptible fill.
- Develop robust erosion and sediment control plans in any areas where soils are to be disturbed.
- In areas where solifuction is particularly prevalent (e.g., moderate, north-facing colluvial slopes), the road should be constructed on an embankment that effectively buttresses the natural slope.

- Where the access road alignment traverses a solufuction lobe in, the alignment may need to be re-routed slightly upslope or downslope.
- Minimize cut slopes to mitigate the risk of permafrost degradation.
- Detailed drainage design for the road should consider the shallow permafrost table in the north-facing colluvial mid-slopes and the colluvial aprons.

Airstrip

- Complete additional boreholes along the airstrip alignment as part of the detailed design to further investigate the extent of ice-rich soils and to facilitate the installation of thermistors.
- Incorporate additional measures into the detailed design of the airstrip to management expected surface and shallow subsurface water flows and limit long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice (e.g., flattening or buttressing the side slopes of the embankment).
- Implement drainage measures to prevent water 'ponding' at the upslope toe of the embankment.
- Monitor the performance throughout the design-life of the airstrip against to-be-determined performance criteria.

Mine Site

- The surface water management strategies implemented should prevent water accumulating in the natural terrain adjacent to the proposed facilities in areas of known or suspected ice-rich soils. Ditching at the toe of embankments should be avoided in areas of known or suspected ice-rich soils.
- Ice-rich portions of the colluvial apron deposits within the proposed footprint area of the tailings embankment will need to be removed prior to the construction of the embankment, and replaced with non-frost susceptible fill.
- Additional site investigation is required in order to enhance the understanding of the ground conditions at the proposed embankment site and to facilitate a reasonably accurate estimate of the volume of unsuitable material needing to be removed, spoiled and replaced.
- In areas mapped "potentially unstable" and "unstable", the natural vegetation cover should be kept in place to provide the maximum protection to the thermal regime. For summer construction, a woven geotextile may need to be laid over thaw unstable ground, prior to placement of fill. In areas where vegetation needs to be removed, winter construction is recommended for the initial lifts.

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APPENDICES

Appendix B.7A Updated Baseline Water Quality Statistics

B.7 – WATER QUALITY AND QUANTITY

B.7.1 INTRODUCTION

Section 7 of the Proposal, and supporting appendices, evaluated potential effects of the Project on water quality, and included an assessment of surface water, groundwater and sediment quality to determine the potential effects on fish and aquatic resources, wildlife and human health. The indicators selected to assess changes in water quality were acidity, alkalinity, metals, sulphate, cyanide and nutrients. The risk assessment found that no significant water quality changes or cumulative effects were 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.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 24 requests for supplementary information related to Section 7 Water Quality and Section A.7 of the Project Proposal and SIR. These requests, and the sections in which the responses are provided, are outlined below in Table B.7.1-1.

Table B.7.1-1 Requests for Supplementary Information Related to Water Quality and Quantity

Request #	Request for Supplementary Information	Response
R2-97	An analysis regarding dataset robustness. This should include verifying the distribution of the data and if necessary, characterize the data in an alternative appropriate manner (e.g. characterize the data as percentiles).	Section B.7.2.1
R2-98	Clarification if at any time, the rate of water removal, for the Project, from the Yukon River will cause the water level on the river at the Canada – US border to drop by more than 3 cm.	Section B.7.3.1
R2-99	Update Tables A.7.6-2 and A.7.6-3 to include samples broken down by alteration type. Details should include an accounting or discussion at minimum for each of the lithology types making up the lithologic unit, not only the dominant lithology within each unit. Data in Table A.7.6-3 should include NAG rock.	Section B.7.4.1
R2-100	Additional statistics (e.g. demonstrating variability within groupings) should be provided to demonstrate robustness in the geochemical data.	Section B.7.4.2
R2-101	Results of sensitivity analysis and gap analysis of geochemical characterization program.	Section B.7.4.3
R2-102	Additional explanation as to why the Phase I and Phase II Geochemical Assessment Reports are no longer relevant. Details should include what the old geologic interpretations (and rock units) were as related to the new geologic interpretation, and what other lithologies or rock units were and are thought to exist for the project site.	Section B.7.4.4

Request #	Request for Supplementary Information	Response
R2-103	Provide a quantitative analysis (e.g. using the mine plan waste delivery linked to geochemical data and loading model) to support the approach to waste disposal in the TMF. Consideration should be given to waste type, exposure times prior to inundation, and blending of waste materials.	Section B.7.4.5
R2-104	Provide clear criteria or targets for the "mixing criteria" identified for waste materials.	Section B.7.4.6
R2-105	Indication whether there is any veining or intrusion along fault zones introducing unique or added mineralization or alterations introduced such that the FZ "lithology" was considered as important, initially.	Section B.7.4.7
R2-106	Shake flask data, number of samples, and other summary statistics for each of the lithologies and alteration types. Ensure all of the tables providing pertinent data are updated.	Section B.7.4.8
R2-107	Identification when results of additional metallurgical test work on heap leach facility ore and residue will be available. Provide a discussion on uncertainties in the absence of this information.	Section B.7.4.9
R2-108	For the Freegold Road upgrade and extension provide additional details and information on: a. all geological materials, including estimates of volumes, that will be excavated, exposed or otherwise disturbed; b. geochemical characterization, analysis, and interpretation on representative samples for those geological materials; and, c. consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.	Section B.7.4.10
R2-109	For airstrip borrow sources provide additional details and information on: a. why airstrip borrow samples and barge landing borrow samples were grouped together in the summary description of geochemical results given their location at opposite ends of the project footprint; b. provide justification on how representative these samples are of the borrow material specifically intended for airstrip construction and expansion (i.e. does the geochemical analysis of the airstrip borrow site account for areas which will be disturbed in the construction of the airstrip?); c. details on the short-term metal leaching potential for the material proposed for use at the airstrip; and d. details on mitigation is being proposed to prevent release of metals and sediments to local receiving water.	Section B.7.4.11
R2-110	Clarify whether waste rock from previous mining operations will be used in construction of the Freegold Road. If yes, outline a plan to characterize the ARD/ML potential with results provided during the assessment process.	Section B.7.4.12
R2-111	An analysis or model of how groundwater movement and hydraulic conductivity results from the groundwater model may be influenced by permafrost at the model's scale.	Section B.7.5.1
R2-112	An analysis of the effects of permafrost degradation to groundwater movement and hydraulic conductivity, building off of R2-111 above.	Section B.7.5.2
R2-113	Clarification on the most recent inferred permafrost spatial distribution (figure 2.3 of appendix 7C or figure 3.4 of appendix 7E).	Section B.7.5.3
R2-114	Discussion and display of how the recharge and permafrost areas differ between the data used in the groundwater model and the most recent data.	Section B.7.5.4
R2-115	Analysis of potential effects due to the loss of upgradient areas due to the creation of	Section

Request #	Request for Supplementary Information	Response
	the open pit.	B.7.5.5
R2-116	An analysis to justify modelling the hydrogeologic system at the Casino Mine using a porous media approach rather than a discrete fracture system approach.	Section B.7.5.6
R2-117	Clarification on if, and how much, groundwater will flow into Brynelson Creek and its tributaries from the TMF and an analysis of any potential effects.	Section B.7.5.7
R2-118	Discussion and comparison of 2013 and 2014 water quality baseline data collected with water quality baseline data used in the water quality model. Discuss variations in the data and where necessary, implications to the predictions from the water quality model.	Section B.7.6.1
R2-119	Provide a discussion on how water quality predictions in the tailings management facility pond and water management pond will address the requirements under the Metal Mining Effluent Regulations with regards to radium-226.	Section B.7.7.1
R2-120	A detailed description and characterization of the conditions of core material used in kinetic test work. Details should include: a. storage conditions (e.g. degree of exposure to moisture); and b. state of weathered core relative to release of contaminants of potential concern.	Section B.7.8.1

B.7.2 WATER AND SEDIMENT QUALITY BASELINE

B.7.2.1 R2-97

R2-97. An analysis regarding dataset robustness. This should include verifying the distribution of the data and if necessary, characterize the data in an alternative appropriate manner (e.g. characterize the data as percentiles).

The surface water quality statistics (previously provided in Appendix 7A and updated in Appendix A.7D) has been further updated to include the 25th and 75th percentile values for the dataset in Appendix B.7A. For demonstrative purposes, the statistical criteria were evaluated for parameters of concern: conductivity, sulphate, F, Cd, Cu, Fe, Mo, Se, U and Zn, at stations W4, W5 and W16, and are shown in Figure B.7.2-1 through Figure B.7.2-10.

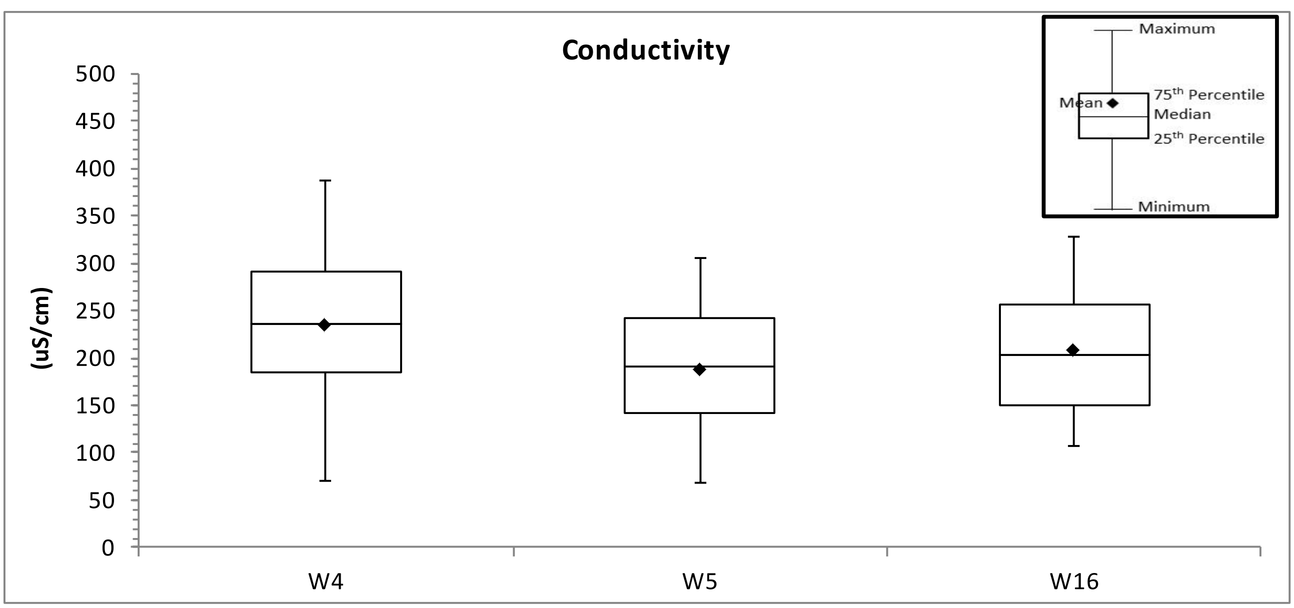


Figure B.7.2-1 Statistical Evaluation of Conductivity for Stations W4, W5 and W16

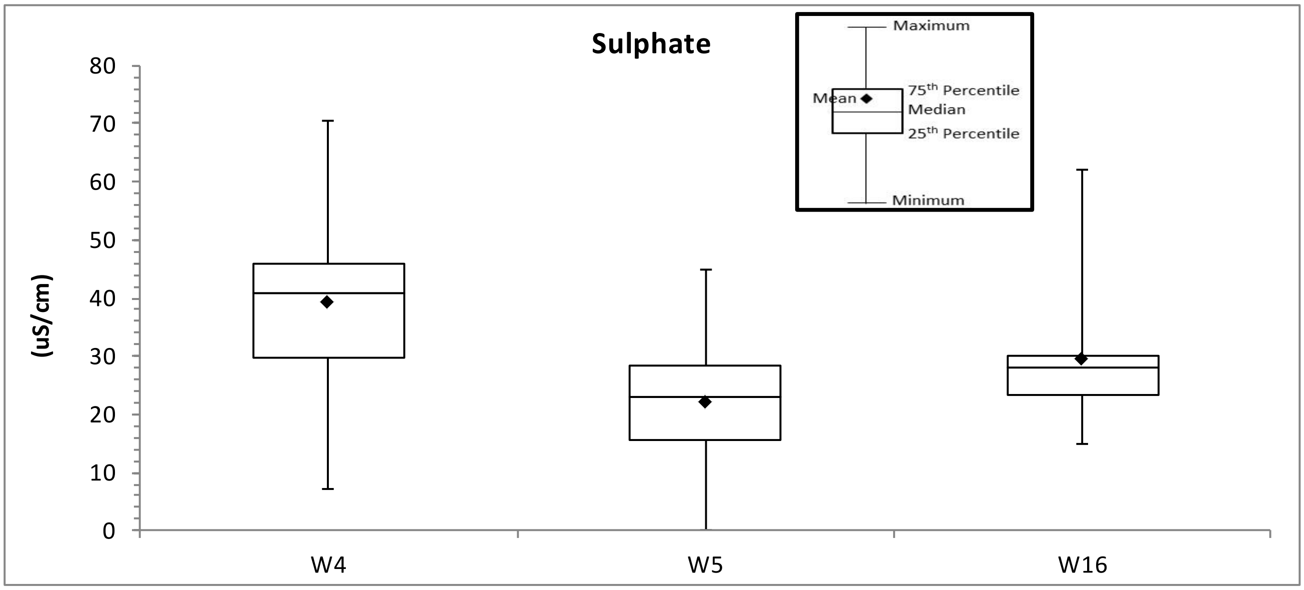


Figure B.7.2-2 Statistical Evaluation of Sulphate for Stations W4, W5 and W16

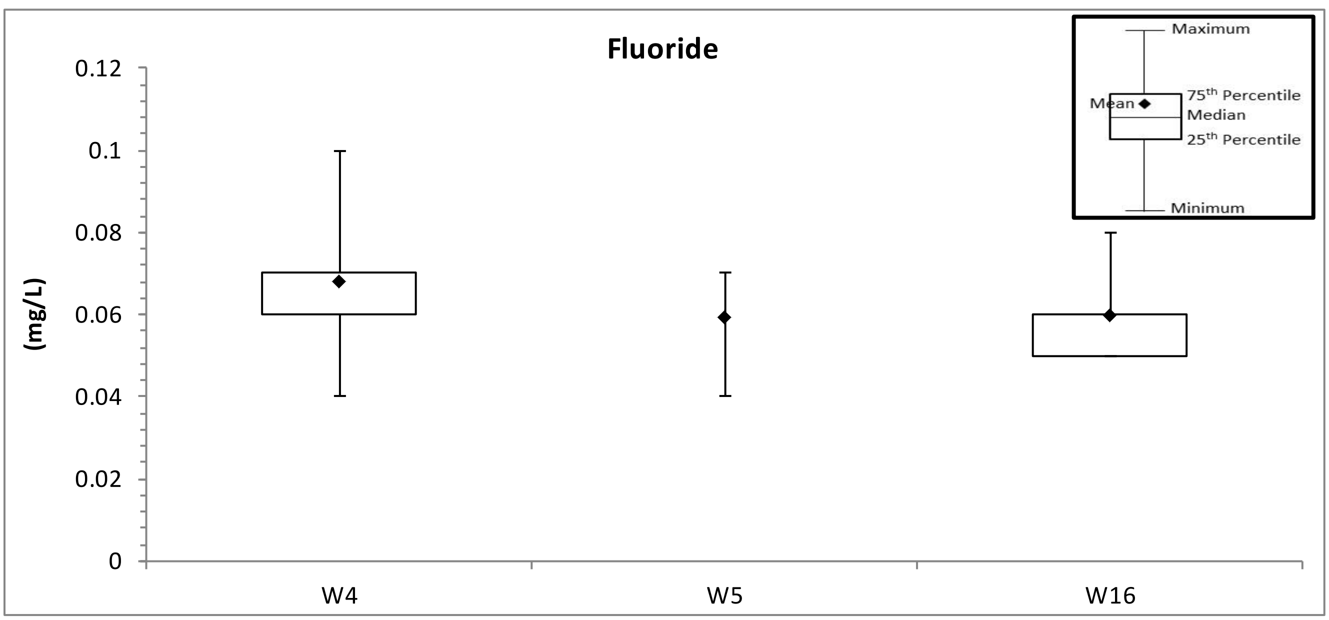


Figure B.7.2-3 Statistical Evaluation of Fluoride for Stations W4, W5 and W16

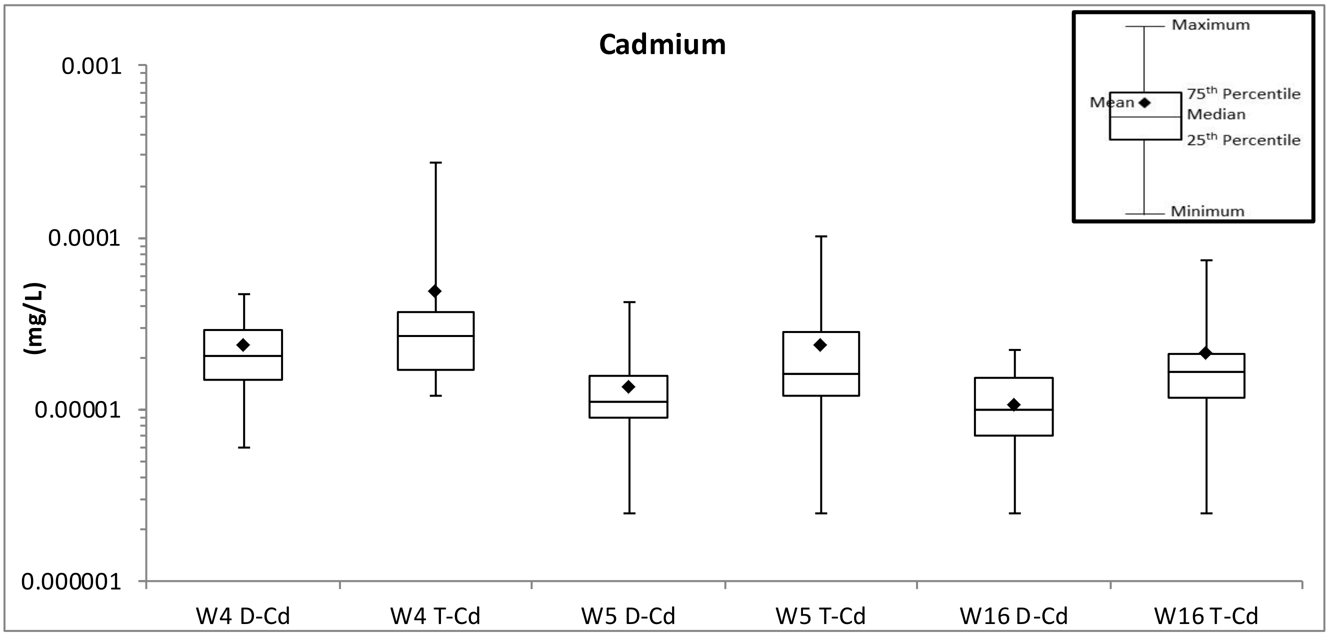


Figure B.7.2-4 Statistical Evaluation of Cadmium for Stations W4, W5 and W16

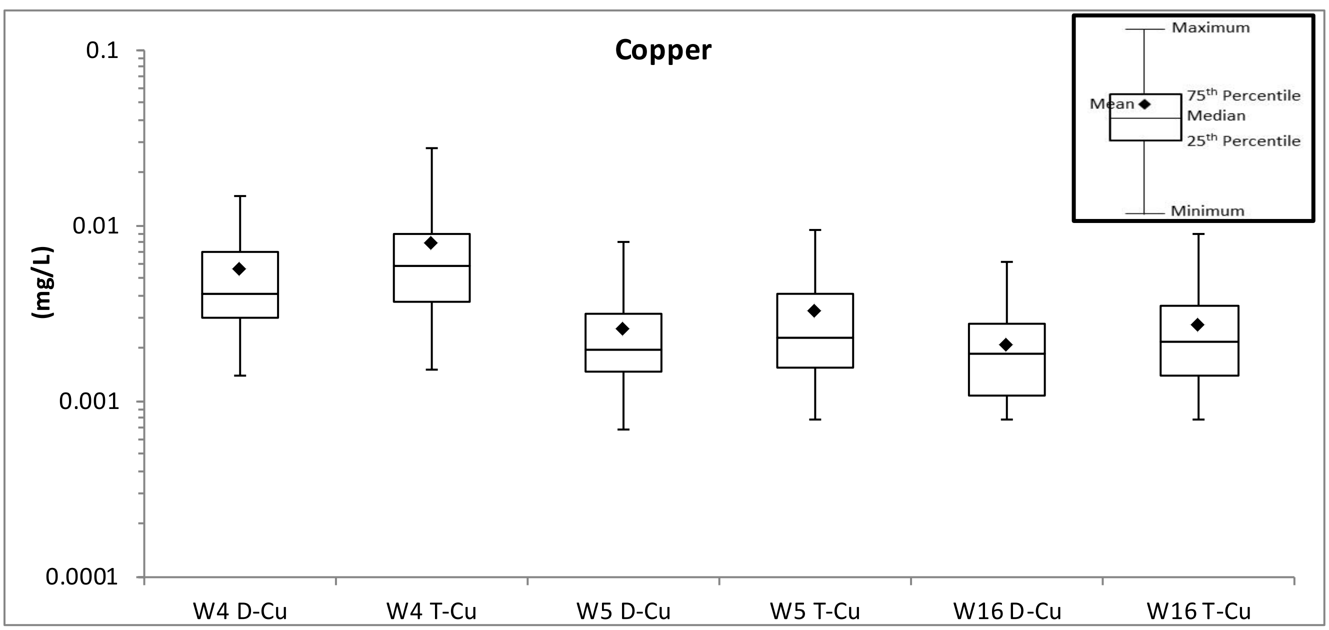


Figure B.7.2-5 Statistical Evaluation of Copper for Stations W4, W5 and W16

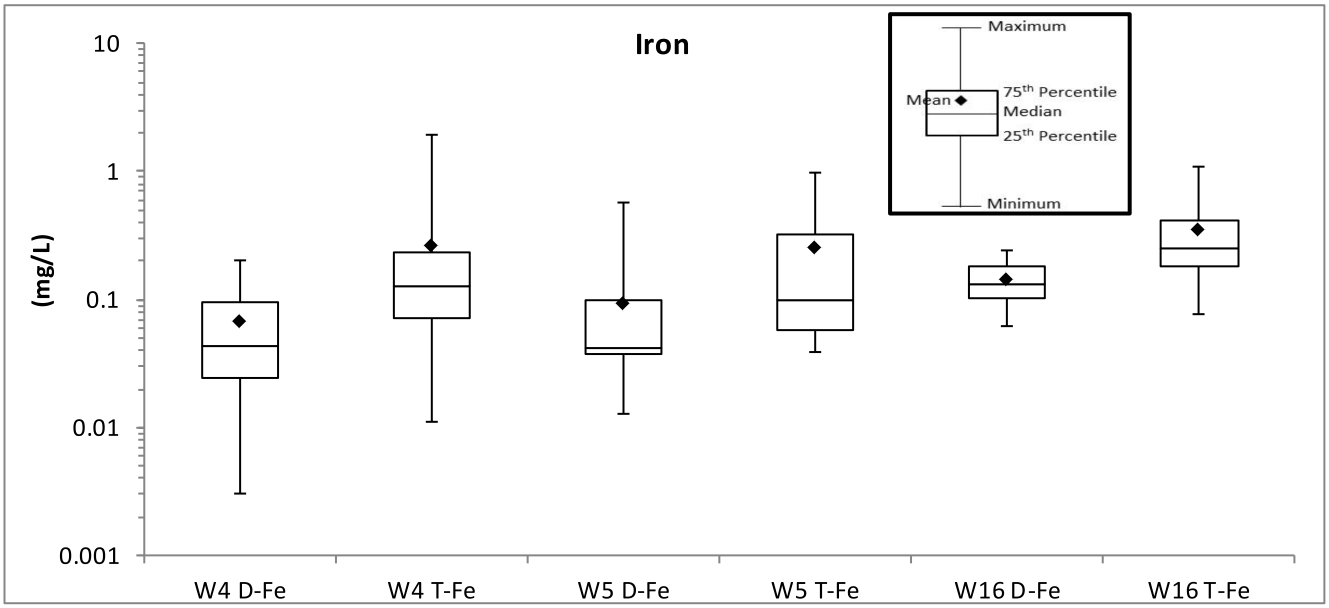


Figure B.7.2-6 Statistical Evaluation of Iron for Stations W4, W5 and W16

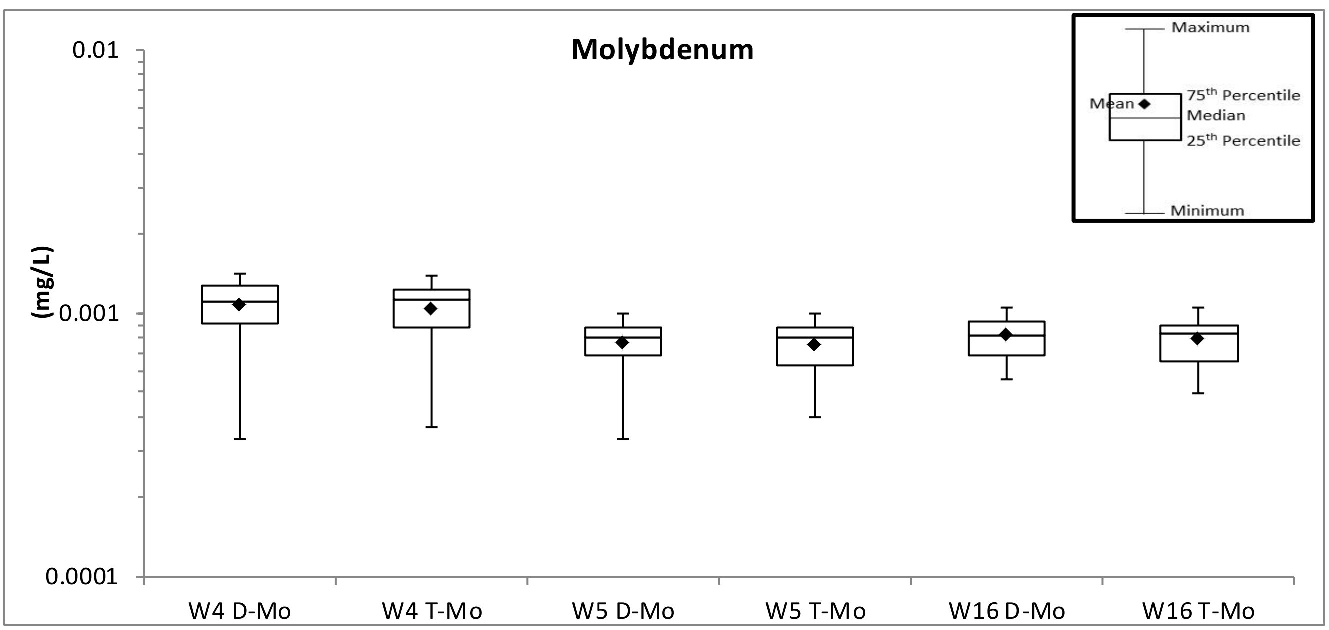


Figure B.7.2-7 Statistical Evaluation of Molybdenum for Stations W4, W5 and W16

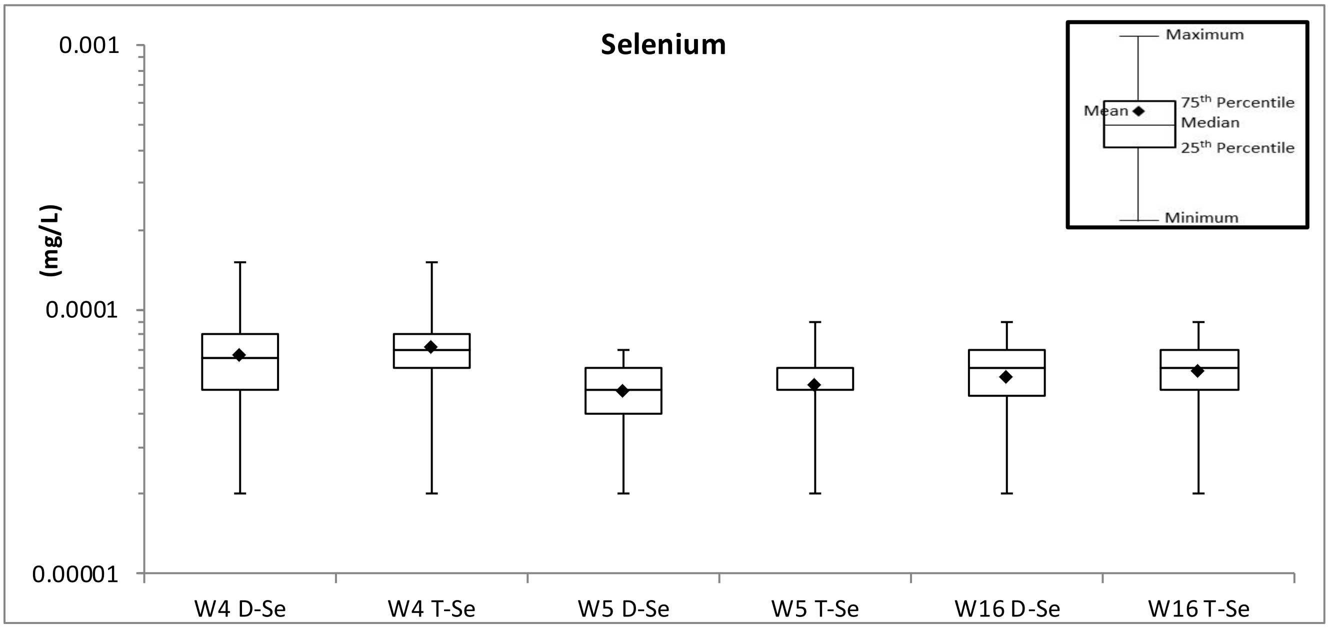


Figure B.7.2-8 Statistical Evaluation of Selenium for Stations W4, W5 and W16

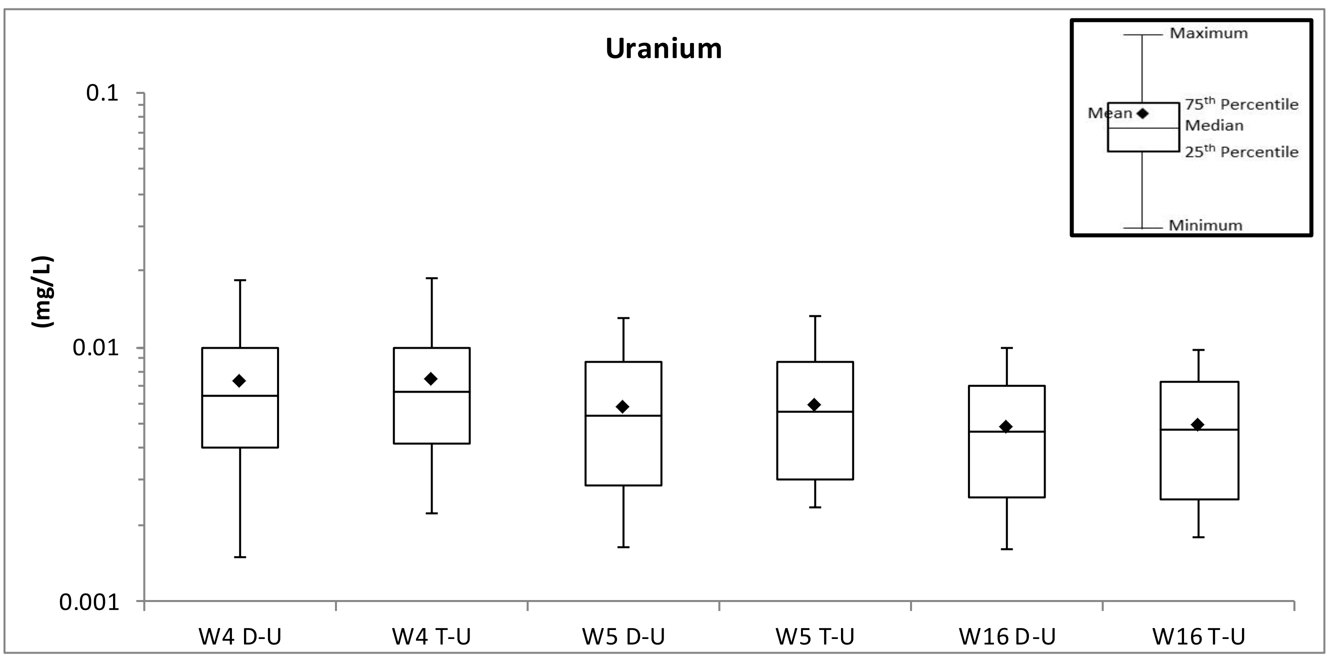


Figure B.7.2-9 Statistical Evaluation of Uranium for Stations W4, W5 and W16

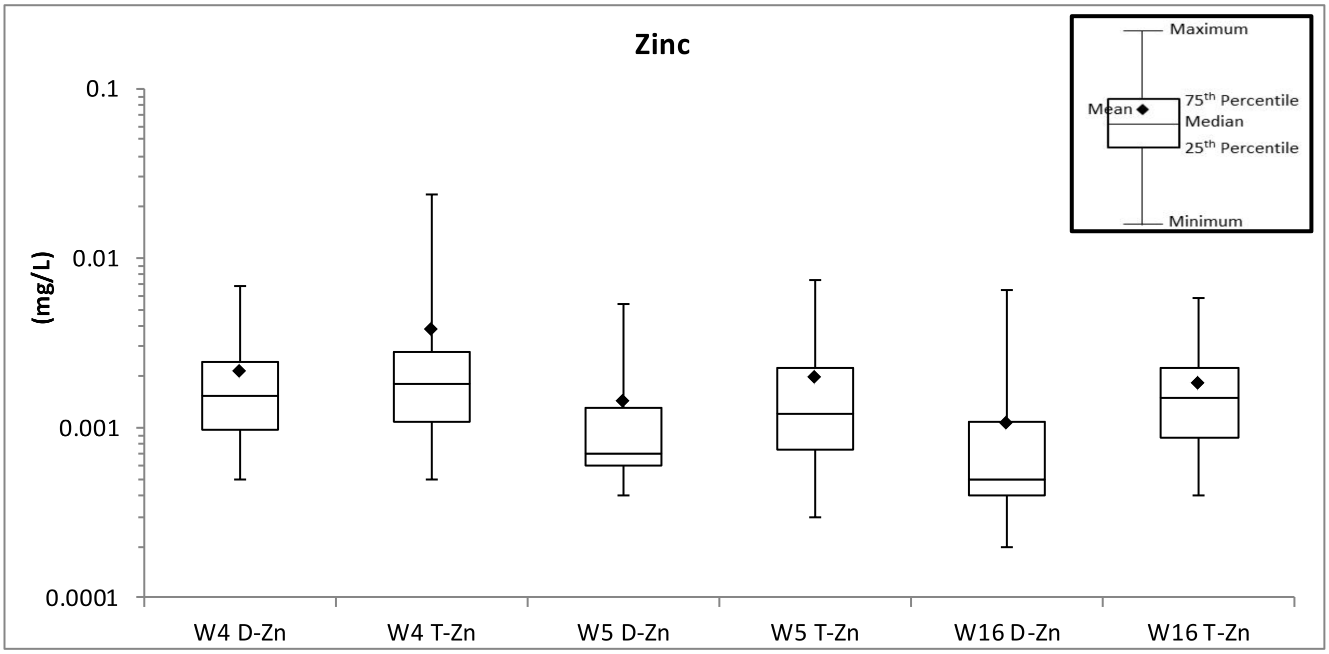


Figure B.7.2-10 Statistical Evaluation of Zinc for Stations W4, W5 and W16

B.7.3 HYDROLOGY BASELINE

B.7.3.1 R2-98

R2-98. Clarification if at any time, the rate of water removal, for the Project, from the Yukon River will cause the water level on the river at the Canada – US border to drop by more than 3 cm.

The *International River Improvements Act* states that no person shall construct, operate or maintain an “international river improvement” unless the person holds a valid licence under the Act. The Yukon River meets the requirements for an “international river”, as it is considered “water flowing from any place in Canada to any place outside Canada”. To be exempted from requiring a licence under the *International River Improvements Act*, the proponent must demonstrate that the effects of the Project on river flows and levels at the Canada-United States border is less than 3 cm, or less than 0.3 m^3/s.

There are two ways in which the Project will affect flow in the Yukon River:

1. Interception of Canadian Creek by the Open Pit, thereby reducing the flows in the headwaters of Britannia Creek and subsequently in the Yukon River; and
2. Radial wells installed adjacent to the Yukon River will pump water to the Project for use as freshwater makeup in the milling processes, which will reduce the groundwater reaching the Yukon River at that point.

If both these flows are taken at their maximum extent (0.14 m^3/s and 0.28 m^3/s), the combined impact at the Canada-US border is an order of magnitude less than 3 cm and 0.3 m^3/s. These flows are discussed further below.

Interception of Canadian Creek

As detailed in the KP memo *Project Effects on Water Quality*, provided in Appendix 7H, changes to water quantity downstream of the Project were calculated as the difference between the baseline and Project mean monthly flows within the water balance model. Water quantity changes were modeled for node W314, located on Britannia Creek immediately downstream of Canadian Creek, which is the closest node to the Yukon River. At node W314, the predicted maximum flow change throughout all phases of the Project is -16%, or -144 L/s in June of the closure phases of the Project. This corresponds to a maximum decrease in flow in Britannia Creek of 0.144 m^3/s.

As detailed in the *Baseline Hydrology* Report, Appendix 7B, the mean annual discharge from Britannia Creek (at station W14) is 0.2 m^3/s, and the mean monthly discharge data is summarized in Table B.7.3-2. From data obtained from the Water Survey of Canada for nearby stations, summarized in Table B.7.3-1 and in Table B.7.3-2, the discharge in the Yukon River is between 756 and 1195 m^3/s, for the stations at Carmacks and above the White River, respectively, which are the two closest sites on either side of the confluence with Britannia Creek. Therefore, even if the entire discharge from Britannia Creek (0.2 m^3/s) was removed from the Yukon River, at a discharge similar to that at the Carmacks station (760 m^3/s), the impact would be less than 0.03% of the total flow at the confluence. Therefore, the impact of the Project on the Yukon River at the border with the United States, which is ~330 km from Britannia Creek, are negligible, and most certainly less than 3 cm and 0.3 m^3/s.

Table B.7.3-1 Water Survey of Canada Data for Yukon River Stations Up and Down Stream from Britannia Creek

Station	Station ID	Years of Record		Latitude	Longitude	Drainage Area	Mean Annual Discharge	Distance from Britannia Creek
		Start Year	End Year			(km^2)	(m^3/s)	(km)
Yukon River at Carmacks	09AH001	1951	1995	62°5’45”	136°16’18”	81,800	760	205
Yukon River above White River	09CD001	1956	2012	63°4’58”	139°29’54”	149,000	1,190	55
Yukon River at Stewart River	09EB002	1956	1965	63°18’42”	139°25’43”	251,000	2,380	85

Table B.7.3-2 Mean Monthly Discharges for Britannia Creek and WSC Stations on the Yukon River

Station	Mean Monthly Discharge (m^3/s)												
	Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Britannia Creek (W14)	0.01	0.01	0.00	0.05	0.71	0.43	0.43	0.27	0.31	0.12	0.04	0.02	0.20
Yukon River at Carmacks	310	284	262	268	592	1557	1617	1287	1118	923	551	364	756
Yukon River above White River	410	357	322	351	1422	2922	2397	1807	1592	1265	706	493	1195
Yukon River at Stewart River	561	474	429	426	2878	6364	5016	3886	2760	1827	936	625	2382

Freshwater Pumping from Yukon River

The maximum water requirement for makeup water is in year 2, and totals 8,659,000 m^3/year or 0.28 m^3/s (Appendix A.7C – Table 3).

Using cross section data of the Yukon River at Eagle, Alaska (USGS, 2000), the width of the Yukon River at the border is estimated to be 150 m at a flow of 500 m^3/s (Figure B.7.3-1). If a total flow reduction at the confluence of Britannia Creek and the Yukon River of 1 m^3/s is conservatively assumed, the resulting change in flow at the border (i.e., Eagle, Alaska) is 0.3 cm, 10% of the 3 cm criteria outlined in the *International River Improvements Act*.

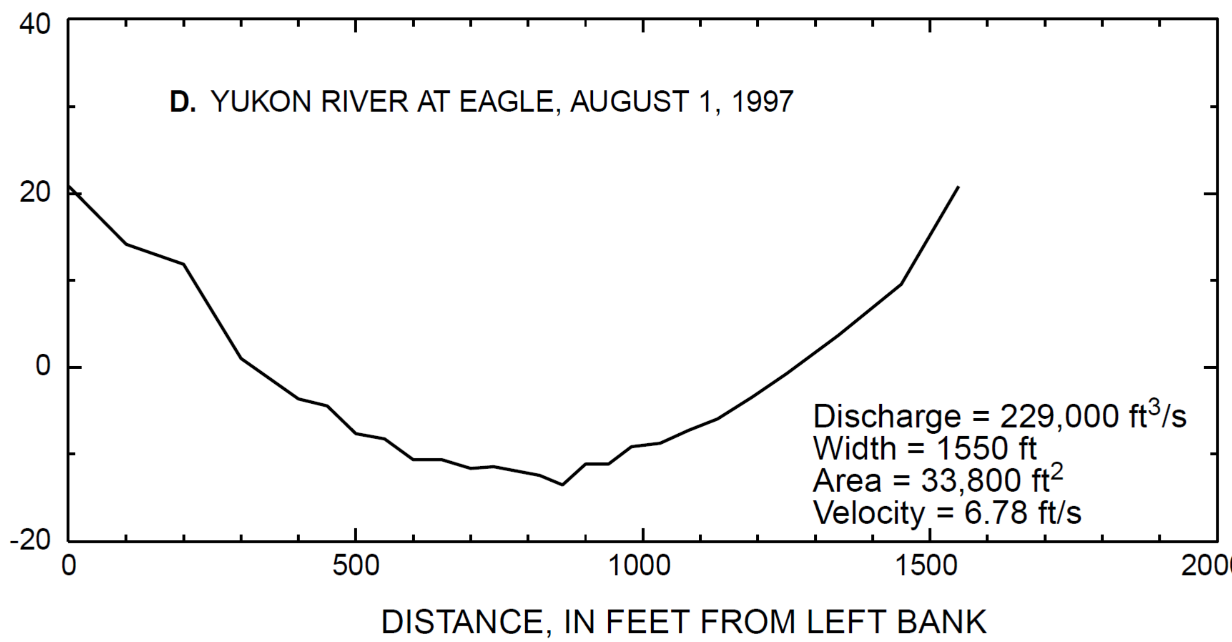


Figure B.7.3-1 Cross Sections of the Yukon River at Eagle, Alaska

B.7.4 GEOCHEMISTRY AND SOURCE TERM PREDICTIONS

B.7.4.1 R2-99

R2-99. Update Tables A.7.6-2 and A.7.6-3 to include samples broken down by alteration type. Details should include an accounting or discussion at minimum for each of the lithology types making up the lithologic unit, not only the dominant lithology within each unit. Data in Table A.7.6-3 should include NAG rock.

The percentage of ABA samples collected according to lithologic unit and proportion of each lithologic unit within the Casino pit limits was provided in Table A.7.6.1 of the SIR-A. This table is updated to include the percentage of ABA samples and proportion of the pit broken down by mineralization, lithology and alteration in Table B.7.4-1 below. The median NP, 90th percentile NPR and median in-situ pH of the CAP mineralization zone, the SUP/SOX mineralization zones and the HYP mineralization zone was provided in Table A.7.6-3 of SIR-A. In this table the HYP mineralization zone was the only mineralization zone broken down by lithology in the table. Note that the statistics from this table did include all samples of the respective rock type groupings and were not segregated by acid generating potential. Statistics on ABA results (including NP, NPR and in-situ pH) broken down by mineralization zone, alteration type, and lithology are presented in the response to R2-100 below. The complete schedule is provided in Table B.7.4-2 and Table B.7.4-3. A detailed description of the lithologic units is provided below.

Table B.7.4-1 Distribution of rock types in pit shell and the distribution of static test samples collected from each rock unit broken down by mineralization zone, alteration type, and lithology.

Distribution of Rock Types in Pit					**Distribution of Samples**				
CAP (397 MT)					CAP (n = 492)				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	9.1%	2.6%	1.2%	0.1%	WR	21.2%	1.5%	0.4%	0.0%
PP	1.9%	0.5%	0.2%	0.0%	PP	5.6%	0.9%	0.0%	0.0%
IX	1.4%	0.1%	1.0%	0.0%	IX	2.7%	0.0%	0.1%	0.0%
MX	1.0%	0.1%	0.0%	0.0%	MX	2.6%	0.2%	0.0%	0.0%
SOX (112 MT)					**SOX (n = 58)**				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	1.0%	1.7%	1.3%	0.0%	WR	1.6%	1.0%	0.4%	0.0%
PP	0.1%	0.5%	0.3%	0.0%	PP	0.1%	0.4%	0.0%	0.0%
IX	0.3%	0.1%	0.9%	0.0%	IX	0.4%	0.0%	0.0%	0.0%
MX	0.1%	0.1%	0.0%	0.0%	MX	0.1%	0.1%	0.0%	0.0%
SUS (395 MT)					**SUS (n = 177)**				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	1.0%	10.3%	2.8%	0.1%	WR	1.6%	5.6%	1.9%	0.0%
PP	0.2%	2.9%	0.9%	0.0%	PP	0.3%	1.6%	0.5%	0.0%
IX	0.2%	1.1%	1.5%	0.0%	IX	0.3%	0.1%	0.3%	0.0%
MX	0.1%	0.5%	0.0%	0.0%	MX	0.0%	0.4%	0.0%	0.0%
HYP (937 MT)					**HYP (n = 673)**				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	0.1%	19.2%	13.6%	0.5%	WR	0.6%	15.3%	17.8%	0.6%
PP	0.0%	4.9%	3.4%	0.0%	PP	0.0%	4.1%	2.4%	0.1%
IX	0.0%	5.2%	4.8%	0.0%	IX	0.0%	1.1%	2.3%	0.0%
MX	0.0%	1.1%	0.0%	0.0%	MX	0.3%	2.7%	0.7%	0.0%

Table B.7.4-2 Casino Mine Schedule by Ore Type, Rock and Alteration Type

Plant Production by Ore Type, Rock Type, and Alteration (kt)																											
Ore Type/Rock Type	-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	TOTAL
Leach Cap (Gold Leach Ore)	**5,030**	**12,676**	**18,517**	**16,601**	**14,877**	**11,824**	**2,087**	**96**	**8**	**3,201**	**7,777**	**9,407**	**5,209**	**11,141**	**387**	**591**	**425**	**79**									**119,933**
PP - Patton Porphyry	83	758	2,458	241	784	1,446	98			117	435	1,459	728	929	28	38											9,602
Potassic Alteration	19	190	344	168	53	175	26					14	4	52													1,045
Phyllic Alteration	5	52	10	2	56	351	0			6	11	215	264	279	0	30	0										1,281
Argillic Alteration	59	516	2,104	71	675	920	72		0	111	424	1,230	460	598	28	8											7,276
IX - Intrusive Breccia	930	6,969	11,352	7,040	669	1,663	228			42	545	470	525	1,536	1	1											31,971
Potassic Alteration	526	3,301	5,068	2,731	115	440	68						149	904													13,302
Phyllic Alteration	97	113	94	78	24	176	30			4	33	131	107	82	1	1											971
Argillic Alteration	307	3,555	6,190	4,231	530	1,047	130			38	512	339	269	550													17,698
WR - Dawson Granodiorite	4,017	4,933	3,778	6,313	13,377	8,715	1,761	86	8	3,042	6,770	7,475	3,956	8,676	358	552	425	79									74,321
Potassic Alteration	458	575	713	1,498	298	87	331	49					134	1,638	4	84	222	8									6,099
Phyllic Alteration	133	85	76	244	1,124	4,114	440	20	8	70	602	2,208	1,733	784	28	39	28	47									11,783
Argillic Alteration	3,426	4,273	2,989	4,571	11,955	4,514	990	17	0	2,972	6,168	5,267	2,089	6,254	326	429	175	24									56,439
MX - Post Mineral Breccia		0	912	2,905	22			10		0	27	3	0	0	0	0	0										3,879
Argillic Alteration		0	912	2,905	22			10		0	27	3	0	0	0	0	0										3,879
Overburden		16	17	102	25	0				0	0																160
Supergene Oxide					**2**	**696**	**7,097**	**6,950**	**3,609**	**3,600**	**3,682**	**4,691**	**5,118**	**4,438**	**3,730**	**4,127**	**1,162**	**223**	**18**				**577**	**1,118**	**3,238**	**4,730**	**58,806**
PP - Patton Porphyry						36	1,669	2,302	448	441	441	546	1,175	1,049	870	352	262	158	18				91	415	874	2,029	13,176
Potassic Alteration						2	151	456	415	415	415	415	479	608	538	214	0	0	0	0	0	0	0	75	0	239	4,423
Phyllic Alteration						13	1,097	1,784	14	9	9	47	606	260	152	90	258	160	18	0	0	0	92	320	882	1,043	6,857
Argillic Alteration						22	416	64	16	16	16	84	92	179	179	48	0	0	0	0	0	0	0	15	10	736	1,895
IX - Intrusive Breccia						60	1,097	2,144	2,035	2,033	2,078	2,516	2,346	2,466	2,401	2,153	39							144	69	887	22,468
Potassic Alteration						16	277	1,498	1,453	1,453	1,453	1,470	1,682	2,035	1,989	1,959	0	0	0	0	0	0	0	9	0	421	15,716
Phyllic Alteration						18	86	147	92	90	90	330	240	102	81	108	39	0	0	0	0	0	0	94	68	254	1,837
Argillic Alteration						27	735	500	490	490	535	716	423	333	333	85	0	0	0	0	0	0	0	38	0	211	4,916
WR - Dawson Granodiorite					2	599	4,332	2,505	1,126	1,126	1,163	1,629	1,596	924	459	1,621	862	65					486	542	2,295	1,814	23,146
Potassic Alteration					0	0	768	1,173	720	720	720	720	453	461	96	631	43	0	0	0	0	0	0	15	738	246	15,008
Phyllic Alteration					2	569	1,856	476	75	75	87	543	856	230	137	570	814	48	0	0	0	0	502	431	1,448	586	9,304
Argillic Alteration					0	31	1,684	821	322	322	347	356	281	233	226	428	14	16	0	0	0	0	0	78	134	959	6,253
Propylitic Alteration					0	0	12	32	9	9	9	9	5	0	0	0	0	0	0	0	0	0	0	0	0	0	85
MX - Post Mineral Breccia																								15			15
Phyllic Alteration																								15			15
Supergene Sulfide				**29,726**	**29,261**	**10,081**	**14,924**	**18,821**	**1,748**			**890**	**16,303**	**37,946**	**24,535**	**832**	**5,300**	**20,868**	**7,197**	**566**			**2,105**	**11,086**	**8,652**	**13,842**	**254,683**
PP - Patton Porphyry				6,056	2,955	616	2,974	2,538	92			97	5,747	10,723	6,583	53	649	4,429	3,635	140			998	6,729	3,471	5,713	64,198
Potassic Alteration				4,679	2,526	172	612	860	83	0	0	17	74	1,557	404	50	382	638	233	0	0	0	19	74	895	1,327	14,602
Phyllic Alteration				459	382	429	2,129	1,663	9	0	0	0	5,663	8,934	6,183	3	269	3,800	3,407	140	0	0	973	6,621	2,290	2,748	46,102
Argillic Alteration				916	48	15	234	16	0	0	0	81	18	219	0	0	0	0	0	0	0	0	0	31	272	1,646	3,496
IX - Intrusive Breccia				12,718	12,792	3,092	3,199	3,373	101			402	2,392	4,661	2,983	73	324	1,036	245				23	444	1,059	843	49,760
Potassic Alteration				9,156	5,616	591	1,350	1,844	97	0	0	207	958	3,037	1,974	16	67	749	221	0	0	0	0	202	294	477	26,856
Phyllic Alteration				2,077	5,051	2,400	1,684	1,517	0	0	0	146	1,428	1,517	1,005	57	254	290	24	0	0	0	22	240	771	216	18,699
Argillic Alteration				1,484	2,127	105	164	10	0	0	0	48	6	110	0	0	0	0	0	0	0	0	0	0	0	154	4,208
WR - Dawson Granodiorite				10,529	13,092	6,296	8,751	12,843	1,503			391	8,165	22,549	14,968	705	4,327	15,403	3,317	426			1,084	3,799	3,584	5,746	137,478
Potassic Alteration				6,020	4,878	1,810	2,046	3,970	257	0	0	0	0	5,473	3,120	90	1,525	5,544	622	129	0	0	103	133	1,554	1,510	38,784
Phyllic Alteration				2,586	4,110	4,306	6,266	7,655	1,151	0	0	392	8,171	16,340	11,843	449	2,697	9,840	2,698	297	0	0	976	3,515	1,740	3,313	88,346
Argillic Alteration				1,915	4,105	181	444	1,163	98	0	0	0	0	735	13	173	103	0	0	0	0	0	0	156	294	923	10,303
Propylitic Alteration					16	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47

Plant Production by Ore Type, Rock Type, and Alteration (kt)

Ore Type/Rock Type	-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	TOTAL
MX - Post Mineral Breccia				421	414	77		67	53					12										114	538	1,540	3,236
Phyllic Alteration				283	346	77	0	65	53	0	0	0	0	12	0	0	0	0	0	0	0	0	0	114	508	1,527	2,985
Argillic Alteration				138	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	13	250
Hypogene				**3,124**	**14,537**	**33,024**	**21,779**	**18,028**	**38,443**	**40,200**	**40,118**	**38,219**	**22,378**	**1,416**	**15,535**	**38,841**	**37,338**	**22,709**	**36,585**	**43,234**	**43,800**	**43,800**	**41,118**	**31,596**	**31,910**	**4,567**	**662,299**
PP - Patton Porphyry				195	2,460	5,610	1,800	1,998	4,897	5,007	5,913	6,537	5,823	9	1,343	5,330	1,063	3,393	5,253	12,547	11,054	3,427	4,057	10,542	12,432	1,034	111,724
Potassic Alteration				194	2,300	4,565	1,245	465	3,164	3,993	4,646	5,467	4,608	8	10	32	53	1,895	1,246	2,092	1,094	1,108	2,207	5,794	3,301	229	49,717
Phyllic Alteration					163	1,041	560	1,538	1,738	1,009	1,265	1,068	1,210	0	1,332	5,305	1,017	1,499	4,024	10,463	9,943	2,327	1,838	4,750	9,118	806	62,015
IX - Intrusive Breccia				649	3,667	13,245	10,488	4,329	9,050	8,043	11,918	14,619	9,488	91	2,580	9,498	12,924	5,049	4,396	5,269	7,927	5,024	10,513	5,339	4,761	280	159,147
Potassic Alteration				519	2,419	5,932	4,024	1,552	5,410	5,439	5,972	6,207	5,005	59	1,497	3,789	4,572	1,695	3,133	2,718	5,284	3,236	3,604	2,541	1,769	1	76,378
Phyllic Alteration				134	1,139	7,065	6,468	2,777	3,641	2,588	5,954	8,412	4,472	32	1,077	5,706	8,337	3,371	1,269	2,547	2,661	1,782	6,908	2,806	2,990	282	82,418
Argillic Alteration					114	252	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	366
WR - Dawson Granodiorite				2,280	8,349	13,887	9,453	11,702	24,315	26,666	21,747	16,596	6,956	1,256	11,450	23,978	22,593	13,765	26,937	25,418	24,819	35,271	26,453	14,982	14,263	2,903	386,039
Potassic Alteration				897	4,532	5,080	3,710	5,708	14,816	15,078	9,523	5,535	3,680	63	1,056	900	3,379	6,825	12,214	14,579	17,762	26,687	13,215	2,915	9,177	1,440	178,771
Phyllic Alteration				1,327	3,079	8,554	5,701	5,842	9,352	11,627	12,225	11,069	3,287	1,193	10,402	23,083	19,205	6,917	14,718	10,845	7,053	8,593	13,218	12,074	4,785	1,442	205,592
Argillic Alteration				28	611	302	7	9	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16	1,049
Propylitic Alteration				23	125	0	0	148	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	291	5	635
MX - Post Mineral Breccia					61	283	40	0	181	482	540	466	112	60	165	35	757	501	0	0	0	75	96	738	453	351	5,396
Phyllic Alteration					61	283	40	0	181	482	540	466	112	60	165	35	757	501	0	0	0	75	96	738	453	351	5,396
ALL MILL ORE				32,850	43,800	43,801	43,800	43,799	43,800	43,800	43,800	43,800	43,799	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	43,800	23,139	975,788

Table B.7.4-3 Casino Mine Waste Production Schedule by Mineral, Rock and Alteration Type

Waste by Mineral Type, Rock Type, and Alteration (kt)																								
Mineral Type/Rock Type	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
All Waste	**2,151**	**3,644**	**6,127**	**23,522**	**27,592**	**32,239**	**43,368**	**38,249**	**32,749**	**42,736**	**46,722**	**51,153**	**48,062**	**52,200**	**47,913**	**48,345**	**48,399**	**46,962**	**34,214**	**30,457**	**20,758**	**19,143**	**14,186**	**760,891**
Overburden	**187**	**542**	**959**	**4,087**	**2,230**	**646**	**882**	**1,188**	**53**	**408**	**306**	**372**	**180**	**1,537**	**373**	**947**	**593**	**56**						**15,546**
Leach Cap (Gold Leach Ore)	**1,964**	**3,094**	**5,130**	**18,513**	**22,538**	**26,641**	**31,971**	**6,493**	**3,293**	**19,612**	**23,097**	**27,118**	**18,242**	**33,742**	**17,519**	**11,273**	**4,998**	**1,700**	**17**	**0**	**0**	**0**	**0**	**276,955**
PP - Patton Porphyry	4	209	1,037	152	167	7,444	2,982	0	7	197	3,023	11,316	5,230	2,192	128	208	12	0	0	0	0	0	0	34,308
Potassic Alteration	4	32	229	131	120	529	139	0	0	0	0	39	456	247	0	0	0	0	0	0	0	0	0	1,926
Phyllic Alteration	0	52	33	0	4	274	891	0	0	12	344	2,209	2,321	815	56	194	12	0	0	0	0	0	0	7,217
Argillic Alteration	0	125	775	21	43	6,641	1,952	0	7	185	2,679	9,068	2,453	1,130	72	14	0	0	0	0	0	0	0	25,165
IX - Intrusive Breccia	87	950	1,174	2,154	271	667	379	0	0	58	811	933	1,645	2,287	20	12	0	0	0	0	0	0	0	11,448
Potassic Alteration	58	649	436	565	29	136	0	0	0	0	0	0	547	1,330	0	0	0	0	0	0	0	0	0	3,750
Phyllic Alteration	14	33	73	95	26	104	41	0	0	4	48	201	366	169	20	12	0	0	0	0	0	0	0	1,206
Argillic Alteration	15	268	665	1,494	216	427	338	0	0	54	763	732	732	788	0	0	0	0	0	0	0	0	0	6,492
WR - Dawson Granodiorite	1,830	1,806	2,502	9,109	16,505	14,335	16,001	5,930	1,254	9,808	10,377	9,801	8,631	21,386	11,919	6,798	4,393	1,425	7	0	0	0	0	153,817
Potassic Alteration	32	133	80	774	637	801	4,396	1,163	0	0	0	0	341	3,540	1,823	789	763	163	0	0	0	0	0	15,435
Phyllic Alteration	203	62	55	825	2,004	2,867	2,652	1,690	462	705	1,534	3,677	3,612	3,806	3,895	2,948	2,007	1,238	7	0	0	0	0	34,249
Argillic Alteration	1,595	1,611	2,367	7,499	13,860	10,667	8,703	3,050	792	9,103	8,843	6,124	4,678	13,983	5,719	2,964	1,623	24	0	0	0	0	0	103,205
Propylitic Alteration	0	0	0	11	4	0	250	27	0	0	0	0	0	57	482	97	0	0	0	0	0	0	0	928
MX - Post Mineral Breccia	0	10	231	1,116	27	0	0	24	0	2,479	4,622	2,606	746	956	2,570	1,024	15	0	0	0	0	0	0	16,426
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllic Alteration	0	10	6	266	26	0	0	12	0	58	35	647	117	123	715	523	15	0	0	0	0	0	0	2,553
Argillic Alteration	0	0	225	850	1	0	0	12	0	2,421	4,587	1,959	629	833	1,855	501	0	0	0	0	0	0	0	13,873
UNK - Undefined Rock Type	43	101	172	5,905	5,555	4,104	12,609	539	2,032	7,061	4,236	2,462	1,990	6,921	2,882	3,231	578	275	10	0	0	0	0	60,706
Potassic Alteration	0	0	0	62	11	0	80	60	0	0	0	0	0	518	33	95	125	0	0	0	0	0	0	984
Phyllic Alteration	43	94	168	5,648	966	653	5,285	472	262	308	197	174	1,328	4,071	2,508	2,949	431	275	10	0	0	0	0	25,842
Argillic Alteration	0	7	4	195	4,578	3,451	7,244	7	1,770	6,753	4,039	2,288	662	2,332	75	52	22	0	0	0	0	0	0	33,479
Propylitic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	266	135	0	0	0	0	0	0	0	401
Overburden		18	14	77	13	91				9	28													250
Supergene Oxide	**0**	**8**	**36**	**670**	**1,075**	**731**	**6,421**	**7,099**	**6,818**	**411**	**2,324**	**3,004**	**3,065**	**2,726**	**6,155**	**6,935**	**2,536**	**1,917**	**1,339**	**13**	**0**	**0**	**0**	**53,283**
PP - Patton Porphyry	0	1	23	3	0	354	1,265	23	10	0	0	0	192	11	0	15	37	179	0	0	0	0	0	2,113
Potassic Alteration	0	1	7	3	0	159	81	0	0	0	0	0	23	53	0	0	0	0	0	0	0	0	0	327
Phyllic Alteration	0	0	0	0	0	53	1,058	23	10	0	0	0	169	-42	0	15	37	179	0	0	0	0	0	1,502
Argillic Alteration	0	0	16	0	0	142	126	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	284
IX - Intrusive Breccia	0	7	11	9	21	0	0	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	52
Potassic Alteration	0	7	2	8	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	18
Phyllic Alteration	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
Argillic Alteration	0	0	9	1	21	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	32
WR - Dawson Granodiorite	0	0	2	647	1,050	356	4,717	7,074	6,808	45	475	1,027	898	980	5,548	6,109	2,489	1,446	822	13	0	0	0	40,506
Potassic Alteration	0	0	2	323	117	55	626	1,590	96	0	0	0	0	255	1,296	2,646	1,337	115	0	0	0	0	0	8,458
Phyllic Alteration	0	0	0	189	698	155	567	2,632	5,925	0	184	233	72	462	3,126	2,930	1,144	1,314	775	13	0	0	0	20,419
Argillic Alteration	0	0	0	131	234	146	3,466	2,756	787	45	291	794	826	263	1,126	163	8	17	47	0	0	0	0	11,100
Propylitic Alteration	0	0	0	4	1	0	58	96	0	0	0	0	0	0	0	370	0	0	0	0	0	0	0	529
MX - Post Mineral Breccia	0	0	0	11	4	0	0	0	0	77	1,268	913	448	0	31	98	0	0	0	0	0	0	0	2,850
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllic Alteration	0	0	0	11	4	0	0	0	0	0	0	377	441	0	3	81	0	0	0	0	0	0	0	917
Argillic Alteration	0	0	0	0	0	0	0	0	0	77	1,268	536	7	0	28	17	0	0	0	0	0	0	0	1,933
UNK - Undefined Rock Type	0	0	0	0	0	21	439	1	0	289	581	1,062	1,527	1,734	576	713	10	292	517	0	0	0	0	7,762
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Waste by Mineral Type, Rock Type, and Alteration (kt)

Mineral Type/Rock Type	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
All Waste	**2,151**	**3,644**	**6,127**	**23,522**	**27,592**	**32,239**	**43,368**	**38,249**	**32,749**	**42,736**	**46,722**	**51,153**	**48,062**	**52,200**	**47,913**	**48,345**	**48,399**	**46,962**	**34,214**	**30,457**	**20,758**	**19,143**	**14,186**	**760,891**
Overburden	**187**	**542**	**959**	**4,087**	**2,230**	**646**	**882**	**1,188**	**53**	**408**	**306**	**372**	**180**	**1,537**	**373**	**947**	**593**	**56**						**15,546**
Phyllic Alteration	0	0	0	0	0	0	0	0	0	0	89	6	16	288	48	422	10	292	517	0	0	0	0	1,688
Argillic Alteration	0	0	0	0	0	21	439	1	0	289	492	1,056	1,511	1,446	524	0	0	0	0	0	0	0	0	5,779
Propylitic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	291	0	0	0	0	0	0	0	295
Supergene Sulfide	**0**	**0**	**1**	**248**	**1,559**	**3,076**	**3,471**	**13,556**	**7,372**	**11,499**	**10,967**	**11,758**	**17,228**	**8,845**	**12,410**	**13,128**	**10,877**	**12,218**	**1,930**	**110**	**0**	**0**	**0**	**140,253**
PP - Patton Porphyry	0	0	1	0	0	69	465	1,272	334	0	0	0	583	526	561	15	197	1,232	305	1	0	0	0	5,561
Potassic Alteration	0	0	0	0	0	0	12	146	1	0	0	0	0	10	84	0	0	3	28	0	0	0	0	284
Phyllic Alteration	0	0	0	0	0	7	250	985	333	0	0	0	568	515	477	15	197	1,229	277	1	0	0	0	4,854
Argillic Alteration	0	0	1	0	0	62	203	141	0	0	0	0	15	1	0	0	0	0	0	0	0	0	0	423
IX - Intrusive Breccia	0	0	0	2	27	0	1	129	1	0	0	0	0	0	74	0	0	0	0	0	0	0	0	234
Potassic Alteration	0	0	0	1	0	0	1	51	1	0	0	0	0	0	74	0	0	0	0	0	0	0	0	128
Phyllic Alteration	0	0	0	1	6	0	0	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85
Argillic Alteration	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
WR - Dawson Granodiorite	0	0	0	235	1,376	2,948	2,952	12,155	6,923	6,231	7,818	10,675	13,052	6,200	9,451	11,672	8,954	9,785	1,179	101	0	0	0	111,707
Potassic Alteration	0	0	0	104	58	26	511	3,349	122	0	0	0	0	30	56	316	2,492	2,740	31	0	0	0	0	9,835
Phyllic Alteration	0	0	0	33	958	2,790	1,727	6,942	6,123	5,929	7,323	10,078	11,968	5,911	8,927	9,582	5,713	7,026	1,148	101	0	0	0	92,279
Argillic Alteration	0	0	0	98	360	132	623	1,213	678	302	495	597	1,082	259	468	1,310	165	19	0	0	0	0	0	7,801
Propylitic Alteration	0	0	0	0	0	0	91	651	0	0	0	0	2	0	0	464	584	0	0	0	0	0	0	1,792
MX - Post Mineral Breccia	0	0	0	11	36	59	0	0	67	0	789	688	1,161	352	57	1,012	1,578	1,104	22	0	0	0	0	6,936
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllic Alteration	0	0	0	11	36	59	0	0	67	0	206	442	1,158	352	57	1,012	1,578	1,104	22	0	0	0	0	6,104
Argillic Alteration	0	0	0	0	0	0	0	0	0	0	583	246	3	0	0	0	0	0	0	0	0	0	0	832
UNK-Undefined Rock Type	0	0	0	0	120	0	53	0	47	5,268	2,360	395	2,432	1,767	2,267	429	148	97	424	8	0	0	0	15,815
Potassic Alteration	0	0	0	0	23	0	17	0	15	3,986	1,745	168	1,933	1,446	2,025	376	125	97	424	8	0	0	0	12,388
Phyllic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argillic Alteration	0	0	0	0	97	0	36	0	32	1,282	615	227	499	321	242	0	0	0	0	0	0	0	0	3,351
Propylitic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	23	0	0	0	0	0	0	76
Hypogene	**0**	**0**	**1**	**4**	**190**	**1,145**	**623**	**9,913**	**15,213**	**10,806**	**10,028**	**8,901**	**9,347**	**5,350**	**11,456**	**16,062**	**29,395**	**31,071**	**30,928**	**30,334**	**20,758**	**19,143**	**14,186**	**274,854**
PP - Patton Porphyry	0	0	0	0	0	6	422	1,537	3,144	2,331	1,801	498	844	0	394	548	12	1,972	4,884	5,051	2,381	3,500	4,406	33,731
Potassic Alteration	0	0	0	0	0	0	0	29	67	89	334	466	765	0	0	0	3	511	742	1,156	274	1,514	3,597	9,547
Phyllic Alteration	0	0	0	0	0	4	361	1,508	3,077	2,242	1,467	32	79	0	394	548	9	1,461	4,142	3,895	2,107	1,986	809	24,121
Argillic Alteration	0	0	0	0	0	2	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63
IX - Intrusive Breccia	0	0	0	0	0	0	0	407	788	444	86	87	458	0	0	57	1,335	1,423	1,002	633	681	3,341	5,472	16,214
Potassic Alteration	0	0	0	0	0	0	0	104	139	27	0	72	227	0	0	0	231	714	264	335	500	1,423	3,462	7,498
Phyllic Alteration	0	0	0	0	0	0	0	303	649	417	86	15	231	0	0	57	1,104	709	738	298	181	1,918	2,010	8,716
Argillic Alteration																								0
WR - Dawson Granodiorite	0	0	1	4	35	809	189	7,969	10,450	6,481	5,427	4,805	5,935	4,631	9,845	13,503	22,994	21,728	23,363	23,971	17,685	12,173	4,271	196,269
Potassic Alteration	0	0	0	4	35	171	75	4,445	5,522	565	808	148	0	0	0	35	912	7,041	9,115	11,059	10,221	7,564	1,819	59,539
Phyllic Alteration	0	0	1	0	0	622	114	2,556	4,542	5,916	4,619	4,657	5,935	4,631	9,845	13,468	21,431	13,212	12,731	11,230	6,873	4,585	2,452	129,420
Argillic Alteration	0	0	0	0	0	16	0	0	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63
Propylitic Alteration	0	0	0	0	0	0	0	968	339	0	0	0	0	0	0	0	651	1,475	1,517	1,682	591	24	0	7,247
MX - Post Mineral Breccia	0	0	0	0	155	330	12	0	831	1,550	1,896	2,541	1,945	670	546	9	2,357	937	0	0	0	129	37	13,945
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllic Alteration	0	0	0	0	155	330	12	0	831	1,550	1,794	1,981	1,945	670	546	9	2,357	937	0	0	0	129	37	13,283
Argillic Alteration	0	0	0	0	0	0	0	0	0	0	102	560	0	0	0	0	0	0	0	0	0	0	0	662
Propylitic Alteration																								0

Waste by Mineral Type, Rock Type, and Alteration (kt)																							
Mineral Type/Rock Type	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
All Waste	**2,151**	**3,644**	**6,127**	**23,522**	**27,592**	**32,239**	**43,368**	**38,249**	**32,749**	**42,736**	**46,722**	**51,153**	**48,062**	**52,200**	**47,913**	**48,345**	**48,399**	**46,962**	**34,214**	**30,457**	**20,758**	**19,143**	**14,186**	**760,891**
Overburden	**187**	**542**	**959**	**4,087**	**2,230**	**646**	**882**	**1,188**	**53**	**408**	**306**	**372**	**180**	**1,537**	**373**	**947**	**593**	**56**						**15,546**
UNK-Undefined Rock Type	0	0	0	0	0	0	0	0	0	0	818	970	165	49	671	1,945	2,697	5,011	1,679	679	11	0	0	14,695
Potassic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	615	220	19	0	0	0	929
Phyllic Alteration	0	0	0	0	0	0	0	0	0	0	818	970	165	49	671	1,884	2,007	2,535	555	243	4	0	0	9,901
Argillic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Propylitic Alteration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	615	1,861	904	417	7	0	0	3,865

Geologic Description of Lithologic Units

The Casino property geology has been described in detail by Godwin (1975) and Payne *et al.* (1987), and was later summarized by Bower *et al.* (1995). Although groupings have changed, the majority of rock descriptions have not; therefore the following sections borrow significantly from all three reports.

Dawson Range Batholith (WR)

The mid-Cretaceous Dawson Range Batholith is the main country rock of the deposit and is characterized by hornblende-biotite-quartz diorite, hornblende-biotite diorite, and biotite-hornblende granodiorite (Payne *et al.,* 1987). Hornblende-biotite bearing phases are common throughout the deposit, and lesser biotite-hornblende bearing phases are generally north of Patton Hill (Godwin, 1975). Diorite (DR) is concentrated north and northeast of the deposit, particularly east of Casino Fault, and is considered to be the earliest phase of the batholith.

Casino diorites (WRDR) are typically dark gray to brown, locally inequigranular, and texturally similar to the meta-diorite of the Wolverine Metamorphic Suite. Average grain size is less than 1 millimetre, dominated by locally aligned and/or zoned plagioclase; hornblende; and interstitial, anhedral quartz. In places, primary biotite is more abundant than hornblende. Accessory minerals include up to 1 percent apatite and trace titanite. Some intrusions show foliation and increased mafic content near their margins, particularly north of the deposit and in the block east of the Casino Fault (Bower *et al.,* 1995). Locally, mafic diorites are cut by later, more felsic phases of the Dawson Range Batholith (Johnston and Shives, 1995).

Granodiorite (WRGD) units are generally pale gray, medium to coarse grain and equigranular to porphyritic. They can be distinguished by scattered, subhedral hornblende phenocrysts averaging 0.5 to 1.2 centimetres long; poikilitic K-feldspar; zoned plagioclase; and 10 to 20 percent mafic minerals, which may be layered. Plagioclase shows minor myrmekitic rims when in contact with K-feldspar. Anhedral quartz and K-feldspar are interstitial to earlier subhedral plagioclase, hornblende and biotite. Locally, quartz forms interlocking aggregates of slightly, to moderately strained grains. Accessory minerals include honey-coloured titanite and apatite to 1 percent each.

Rocks of the Dawson Range commonly display in-situ/crackle to intensely deformed cataclastic brecciation where in contact with the Patton porphyry intrusive plug. Elsewhere, this unit may be truncated by the late Cretaceous dykes and associated explosive breccias (modified from Bower, 1995).

Patton Porphyry (PP)

The main body of the Patton Porphyry (PPDP) is a small, locally mineralized, stock measuring approximately 300 by 800 metres and is surrounded by a potassically-altered intrusive breccia in contact with rocks of the Dawson Range. Elsewhere, the Patton Porphyry forms discontinuous dikes ranging from less than one to tens of metres wide, cutting both the Patton Porphyry Plug and the Dawson Range Batholith (Bower *et al.,* 1995). Contacts between the Patton Porphyry and breccias are variable and range from sharply intrusive to gradational and brecciated. It has therefore been suggested by Bower *et al.,* (1995) and Selby and Creaser (2001) that this suite consists of two or more episodes of high-level intrusions.

Godwin (1975) determined that the Patton Porphyry has an overall composition of rhyodacite, with phenocrysts falling into a dacite composition and the matrix being of quartz latite composition. It is more commonly made up of distinct phenocrysts of abundant plagioclase and lesser biotite, hornblende, quartz and opaques (Godwin, 1975). Phenocrysts average 4 millimetres in size, and can comprise up to 50 percent of the rock. Lathes of plagioclase are euhedral and zoned, and range in size from 2 to 7 millimetres, with some up to 2.5 centimetres in length (Bower *et al.,* 1995). Biotite lathes range from 2-3 millimetres across, and make up 1-5 percent of the rock. They are kink-banded, subhedral, and locally chloritized. Hornblende phenocrysts are difficult to recognize due to their alteration, but have generally been replaced by chlorite and other opaques, and can be recognized by their diamond cross-section. Quartz phenocrysts are not always present but can be anhedral, embayed, and 3-5 millimetres in size. K-feldspar phenocrysts are rare but the mineral is abundant in the commonly medium to dark green, microcystalline matrix.

Smaller, possibly more evolved, discontinuous plugs of Patton Porphyry (PPDK) exist where K feldspar and/or quartz megacrysts range from 3-20mm in size, displaying ragged boundaries and intergrowths with surrounding grains (Godwin, 1975). Contacts between the main Patton plug and this unit are generally gradational or masked by alteration. Currently, the age-relationship between the PPDK and the main plug is unknown.

Later Patton dykes (PPDB) in the south-central part of the deposit somewhat resemble the main Patton Porphyry body and contain 2 to 5 percent quartz phenocrysts and up to 35 percent plagioclase phenocrysts in an aphanitic latite groundmass (Bower *et al.*, 1995). These sills intruded after the main hydrothermal event and contain only minor base- and precious-metal mineralization, as well as locally abundant disseminated pyrite (Godwin, 1975). These dykes are of latitic to dacitic composition and are generally steeply dipping, striking between 130 and 160 degrees (Bower *et al.,* 1995). On the Casino property, they are generally pale to light green with abundant plagioclase and lesser hornblende phenocrysts in a very fine- to extremely fine-grained matrix of plagioclase and K-feldspar (Payne *et al.,* 1987). Wider versions of the dyke are coarser grained and may contain scattered quartz and/or biotite phenocrysts to 3 millimetres along with plagioclase and hornblende. Narrow versions with or without chilled dyke margins can be dark green with a glassy groundmass, and may show flow banding and/or lenticular structures near contacts (Bower *et al.,* 1995). Outcrop of this unit can be mapped on surface trending northwest along Proctor Gulch.

Intrusive/Contact Breccia (IX)

The intrusive/contact breccia surrounding the main Patton Porphyry body consists of granodiorite, diorite, and metamorphic fragments in a fine-grained Patton Porphyry matrix (IXPP). It may have formed along the margins, in part, by the stoping of blocks of wall rocks (Bower *et al.,* 1995). The unit is rhyodacitic in composition and is inherently related to the Patton Porphyry intrusive (Godwin, 1975 and Payne *et al.,* 1987). Local quartz grains are generally 1 to 2 millimetre unstrained crystals and crystal-fragments, and are texturally similar to quartz phenocrysts of the Patton Porphyry (Bower, 1995). Eroded fragments, ranging in size from less than one centimeter to greater than a few metres, are found proximal to their associated wall rocks, and therefore indicate limited transport and/or mixing (after Bower *et al.,* 1995). For example, an abundance of Dawson Range inclusions (IXWR) are prominent at the southern contact of the main plug, Wolverine Creek metamorphics increase along the northern contact, and bleached diorite increases at the eastern contact of the main plug. Strong potassic alteration locally destroys primary textures (Bower *et al.,* 1995).

Explosive Breccia (MX)

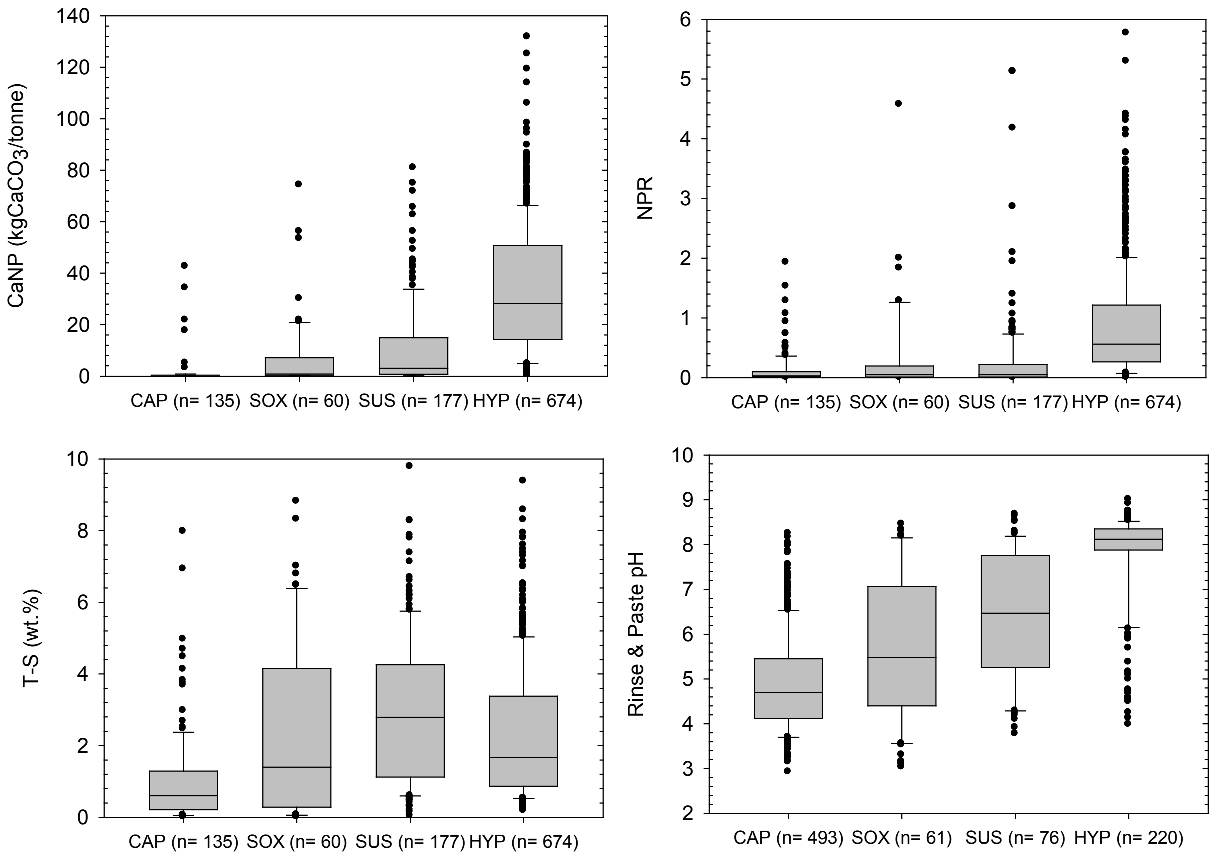
Abundant fragments of the Patton Porphyry and its intrusive breccia are present in a late Cretaceous explosive breccia pipe (MX). Godwin (1975) concluded that this pipe most likely represents a sub volcanic neck, brecciated from explosions caused by the rapid expansion of hot water (hydrothermal solutions) by vessiculation of rhyolitic magmas, and that any extrusive volcanics related to this event may have since been weathered away. This unit indicates multiple episodes of brecciation (Bower, 1995) as it contains 5 to 50 percent ragged fragments of altered intrusive breccia and host rock, with lesser fragments of late often quartz-phyric Patton Porphyry. Locally, the groundmass has a very fine-grained interlocking igneous texture; elsewhere it resembles milled rock flour (Bower, 1995) with up to 10 percent plagioclase and lesser quartz phenocrysts. Godwin also noted large angular cavities being a distinctive quality of this unit measuring up to 10 centimetres in size.

B.7.4.2 R2-100

R2-100. Additional statistics (e.g. demonstrating variability within groupings) should be provided to demonstrate robustness in the geochemical data.

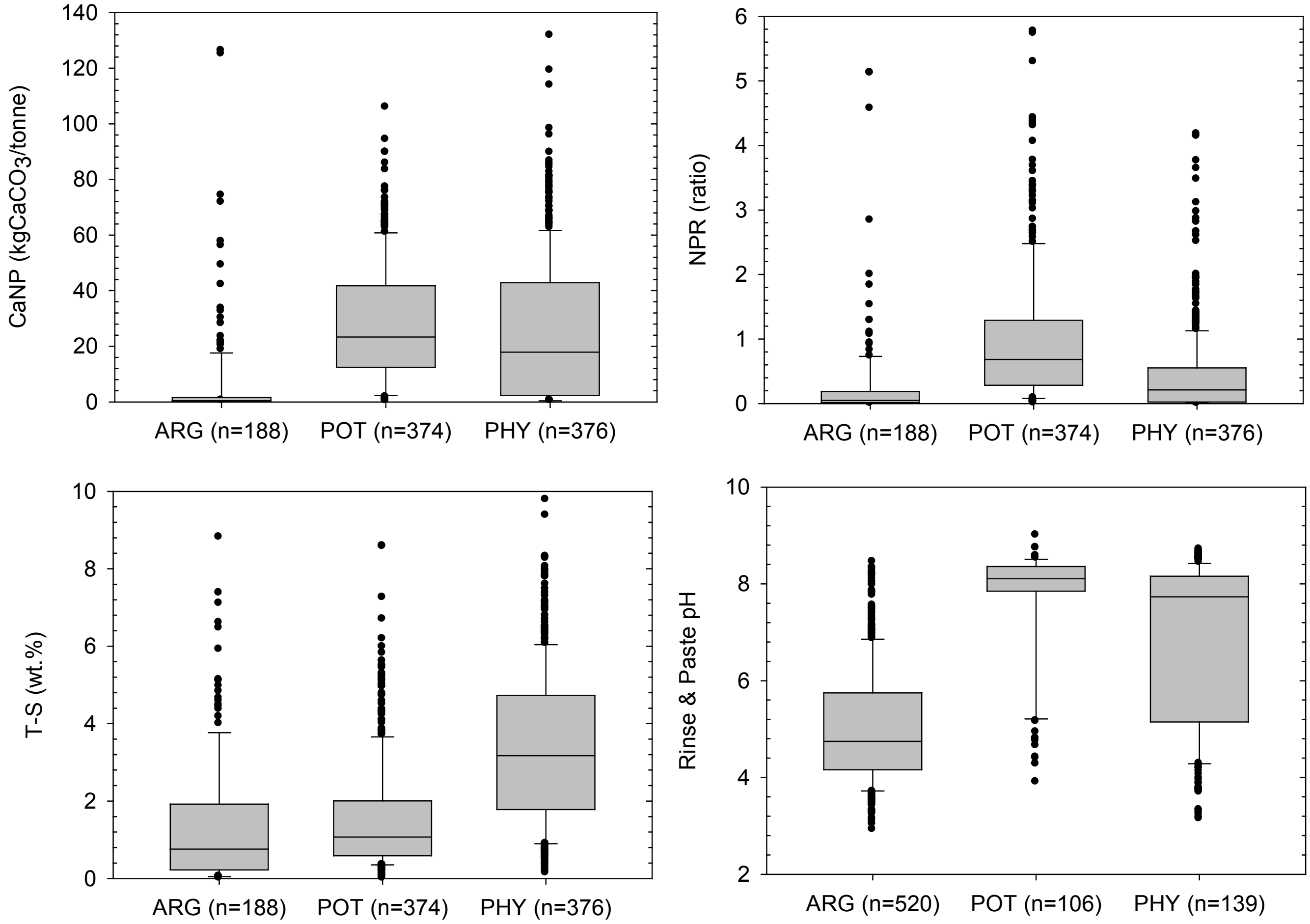
Box and whisker plots of T-S, rinse/paste pH, CaNP and NPR are presented for samples grouped by mineralization zone, alteration type and lithology in Figures B.7.4-1 to B.7.4-11.

Static test results show a relationship between rinse/paste pH and CaNP with the degree of weathering. That is, CAP has the lowest rinse/paste pH and CaNP, SOX and SUS have intermediate rinse/pH and CaNP, and HYP has the highest rinse/paste pH and CaNP (Figure B.7.4-1). Some relationship between ABA parameters and alteration and lithologies can also be observed (Figure B.7.4-2 and Figure B.7.4-3). Particularly, the ARG alteration type tends to have lower rinse/paste pH and T-S then the other alteration types. However, this is likely an artifact of the fact that most ARG alteration samples are sourced from the CAP mineralization zone which has been extensively weathered (Table B.7.4-1). When both mineralization zone and alteration are considered, this relationship disappears. That is, HYP, CAP, SOX and SUS samples with ARG alteration show similar rinse/paste pH and T-S values as other alteration types within the same mineralization zone (Figure B.7.4-7, Figure B.7.4-9 and Figure B.7.4-11).



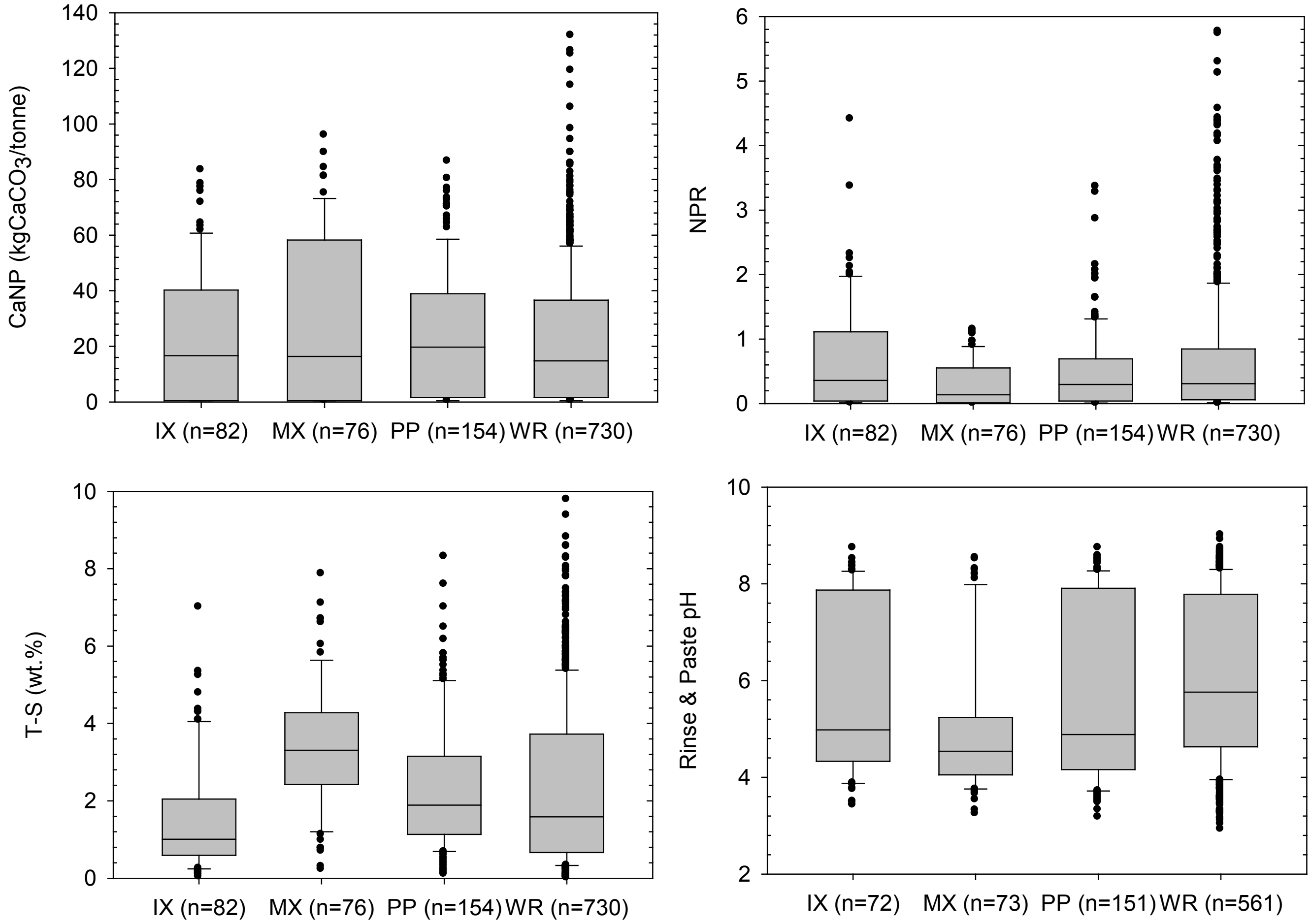
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-1 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH by mineralization zone



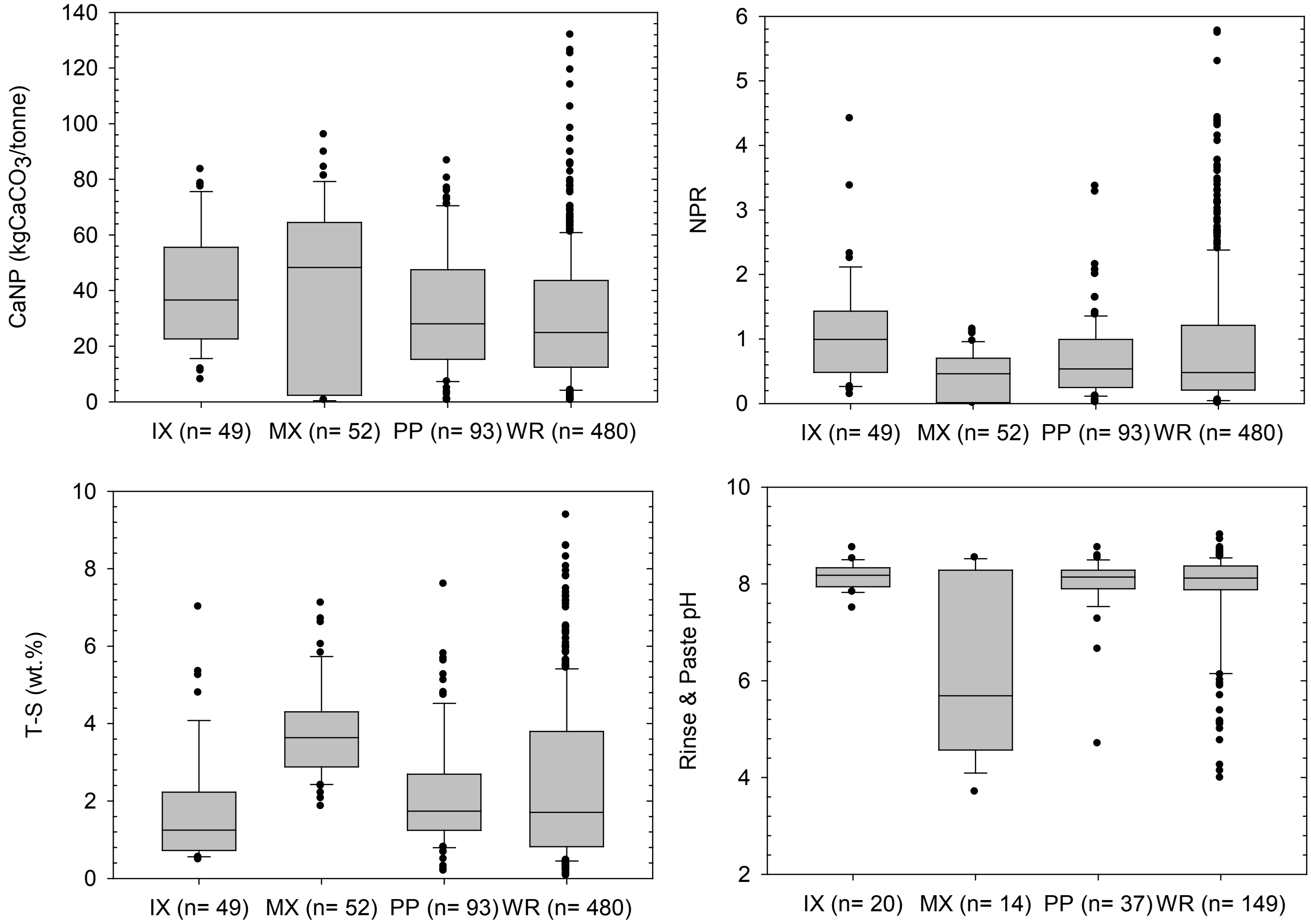
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-2 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH by alteration



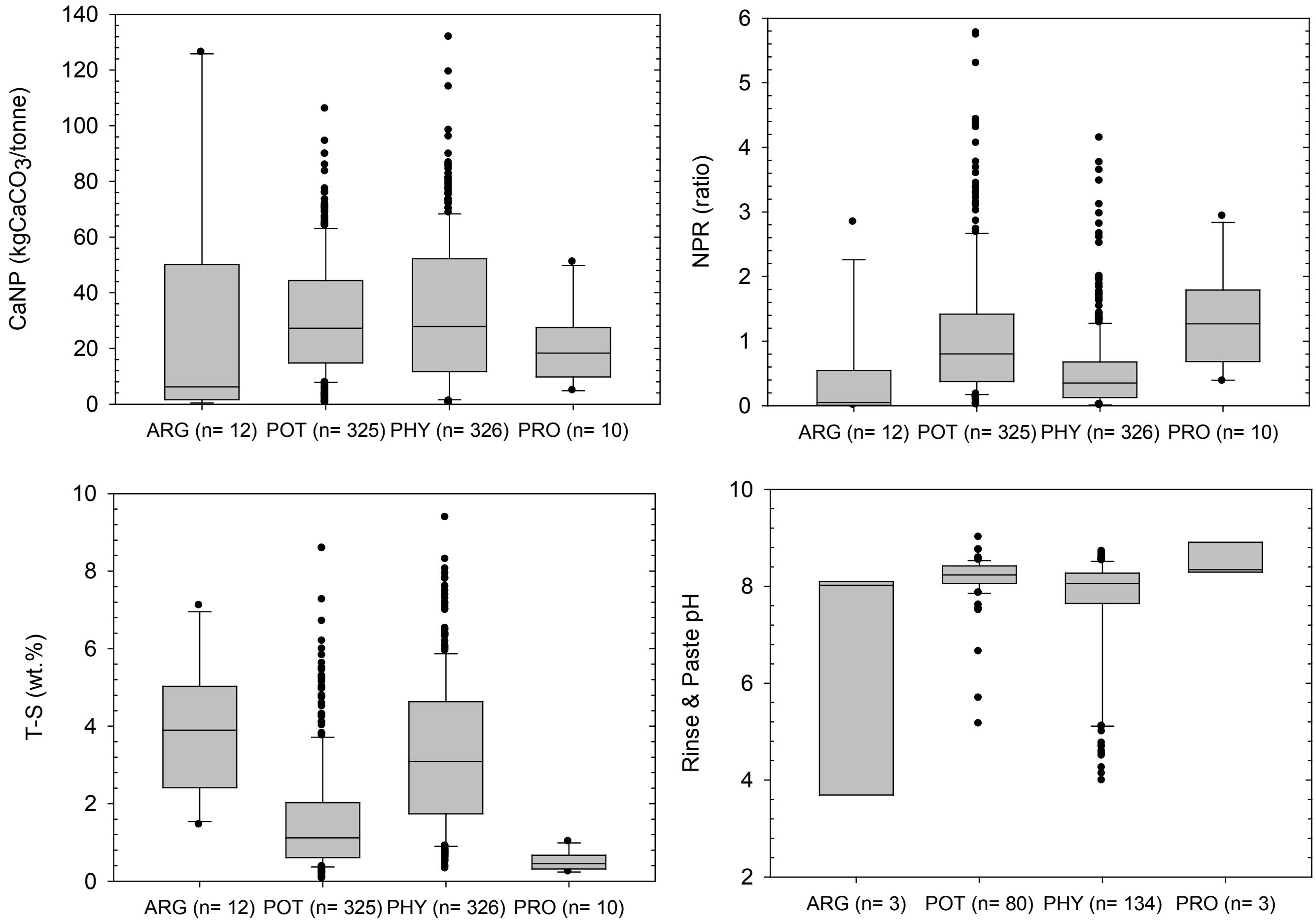
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-3 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH by lithology



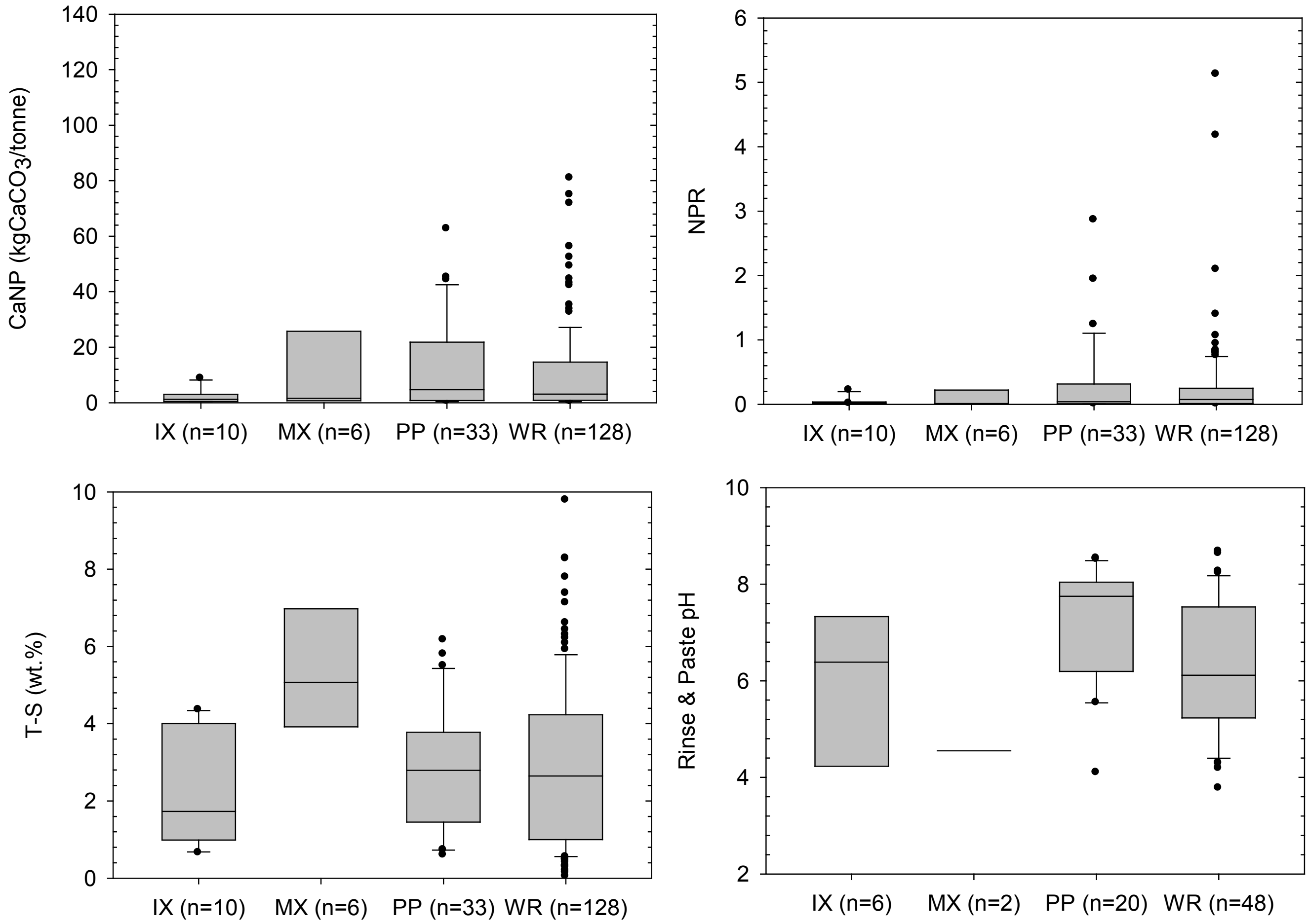
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-4 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of lithologies in the HYP mineralization zone



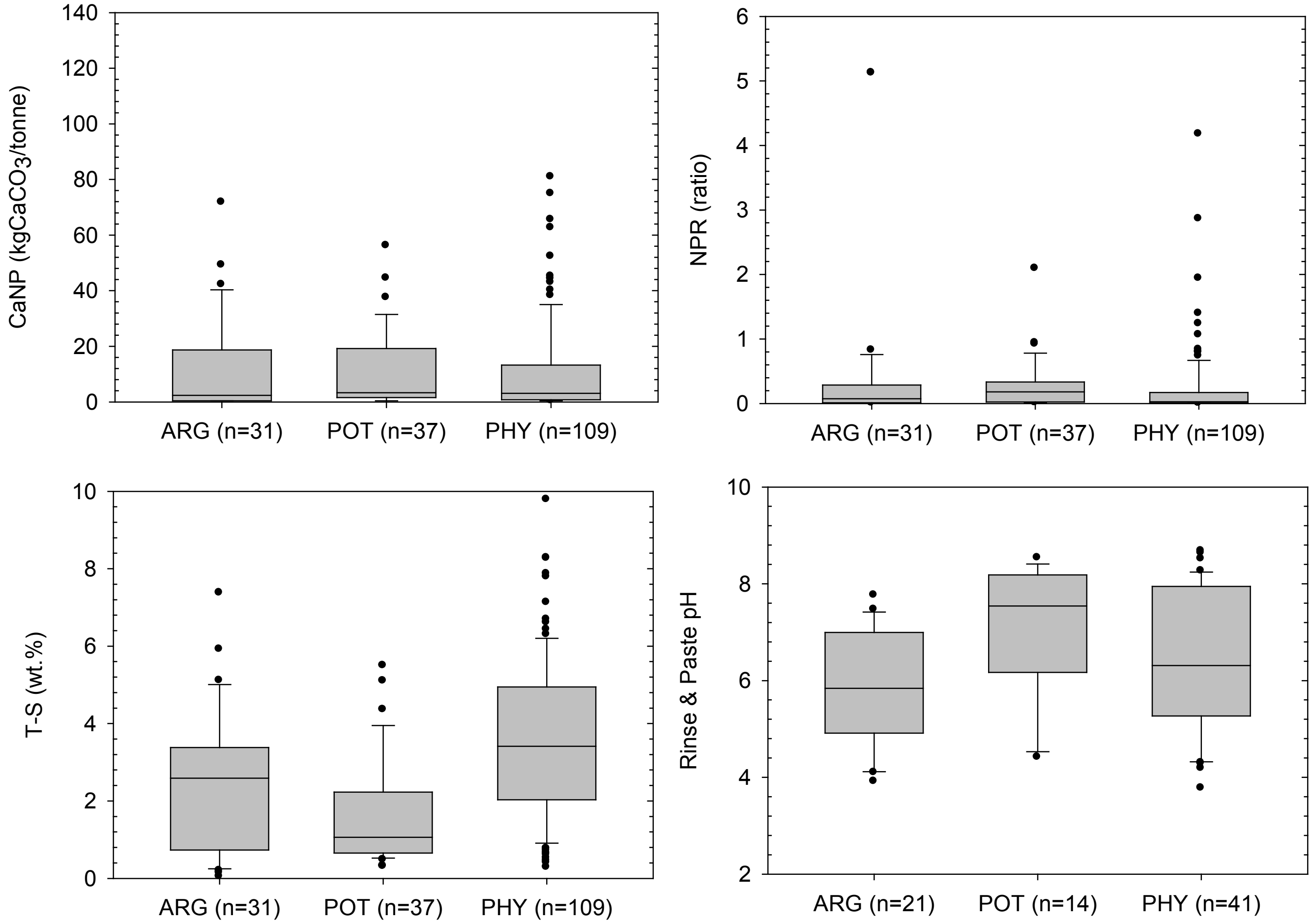
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-5 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of alteration types in the HYP mineralization zone



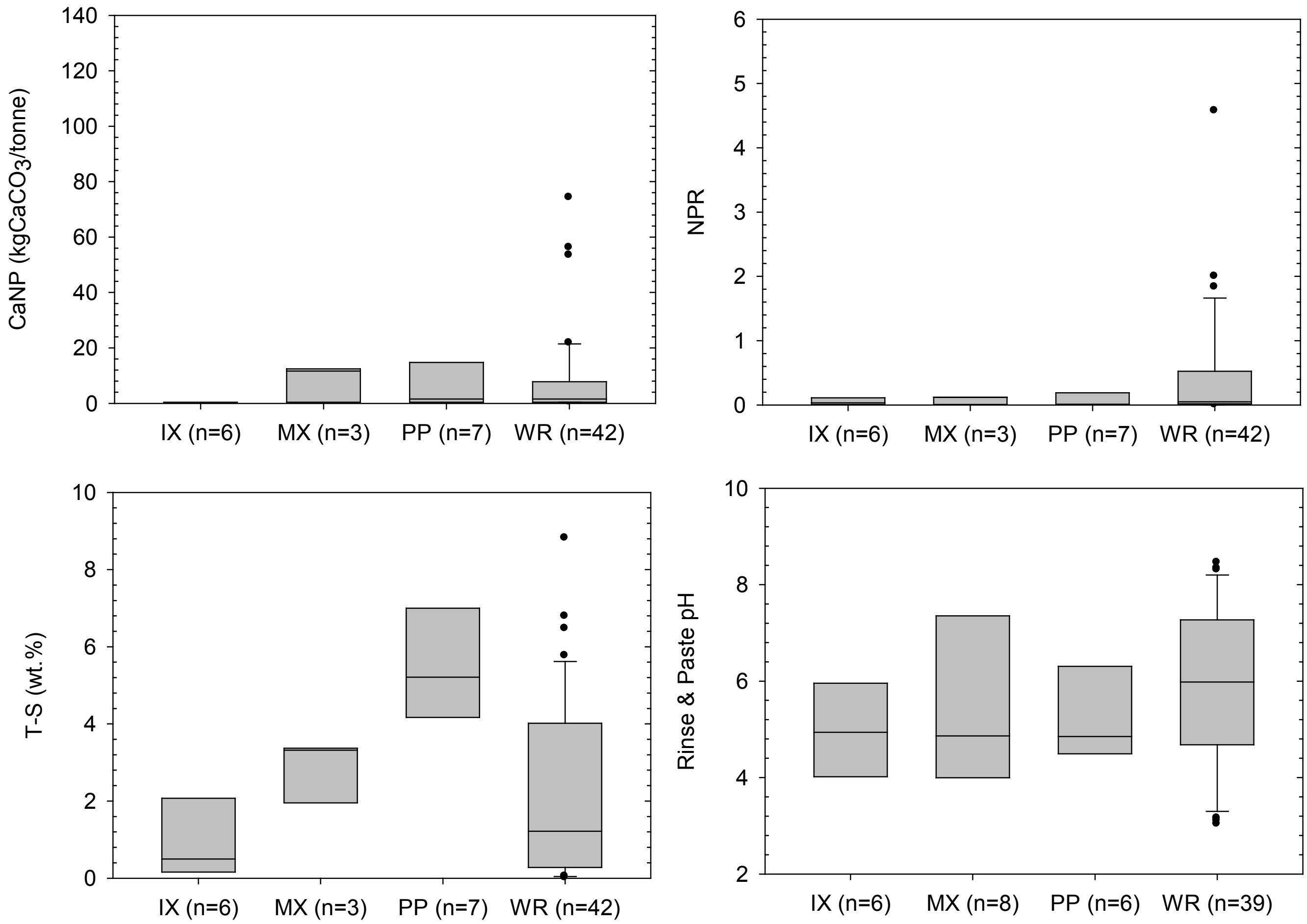
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-6 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of lithologies in the SUS mineralization zone



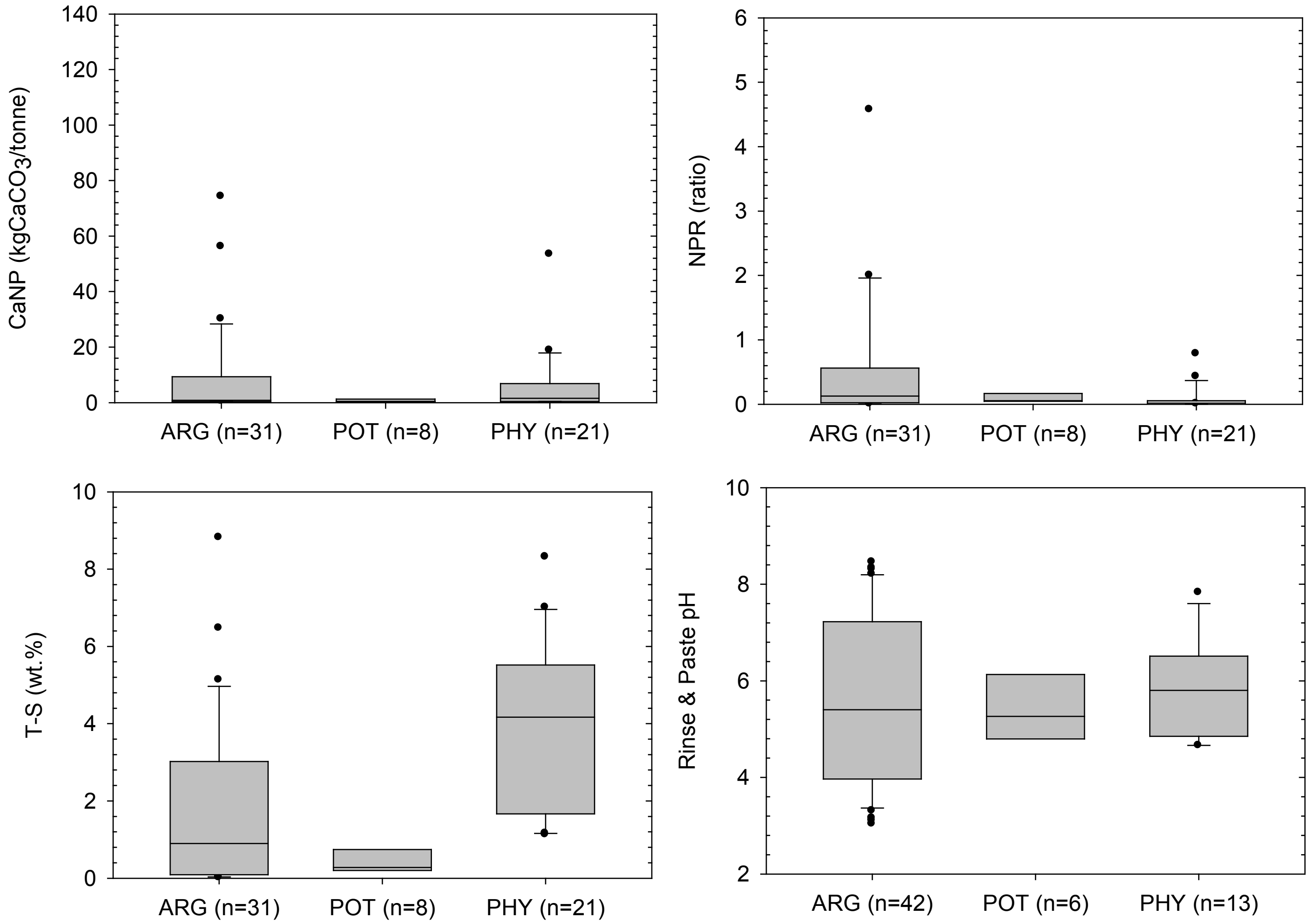
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-7 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of alteration types in the SUS mineralization zone



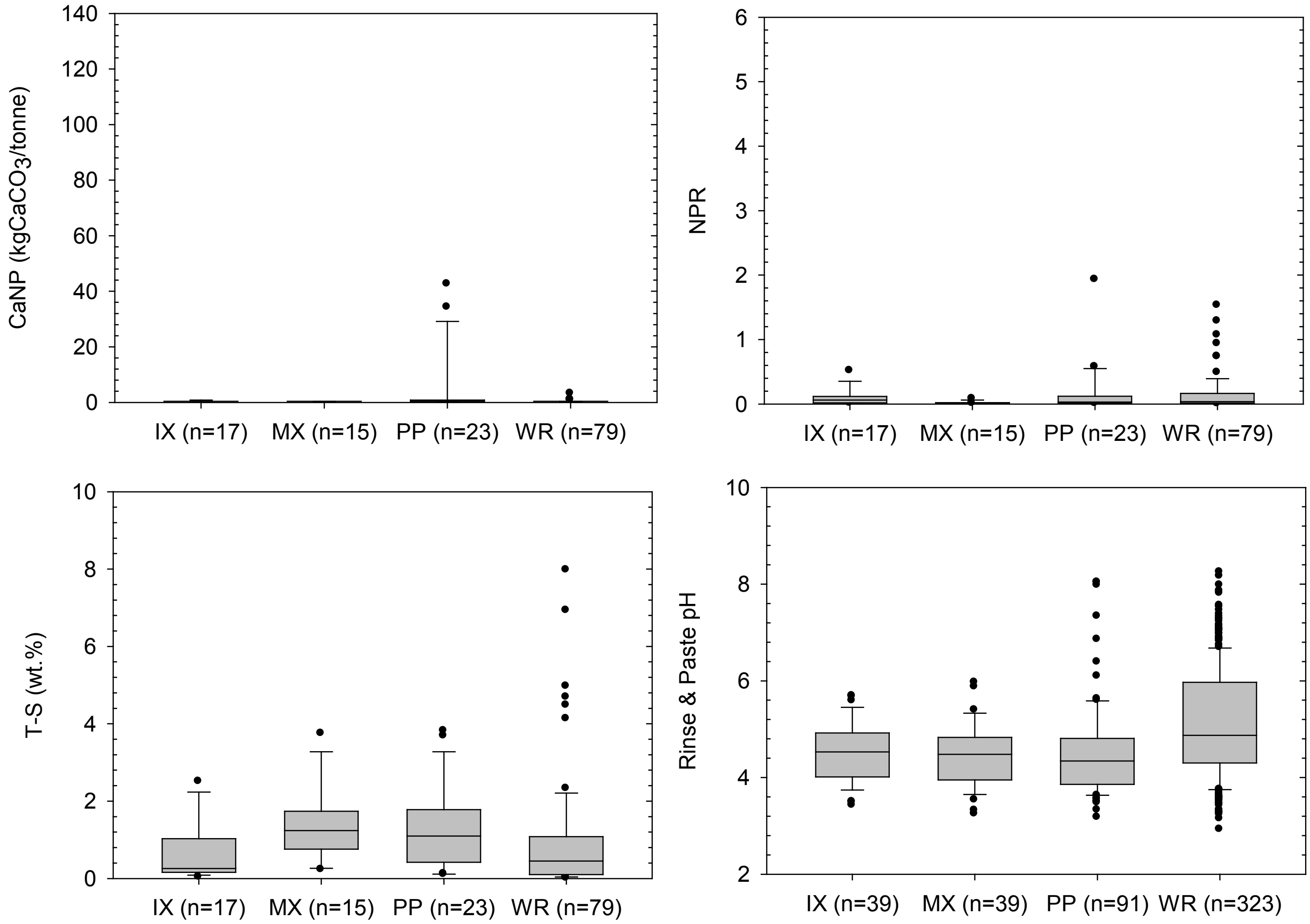
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-8 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of lithologies in the SOX mineralization zone



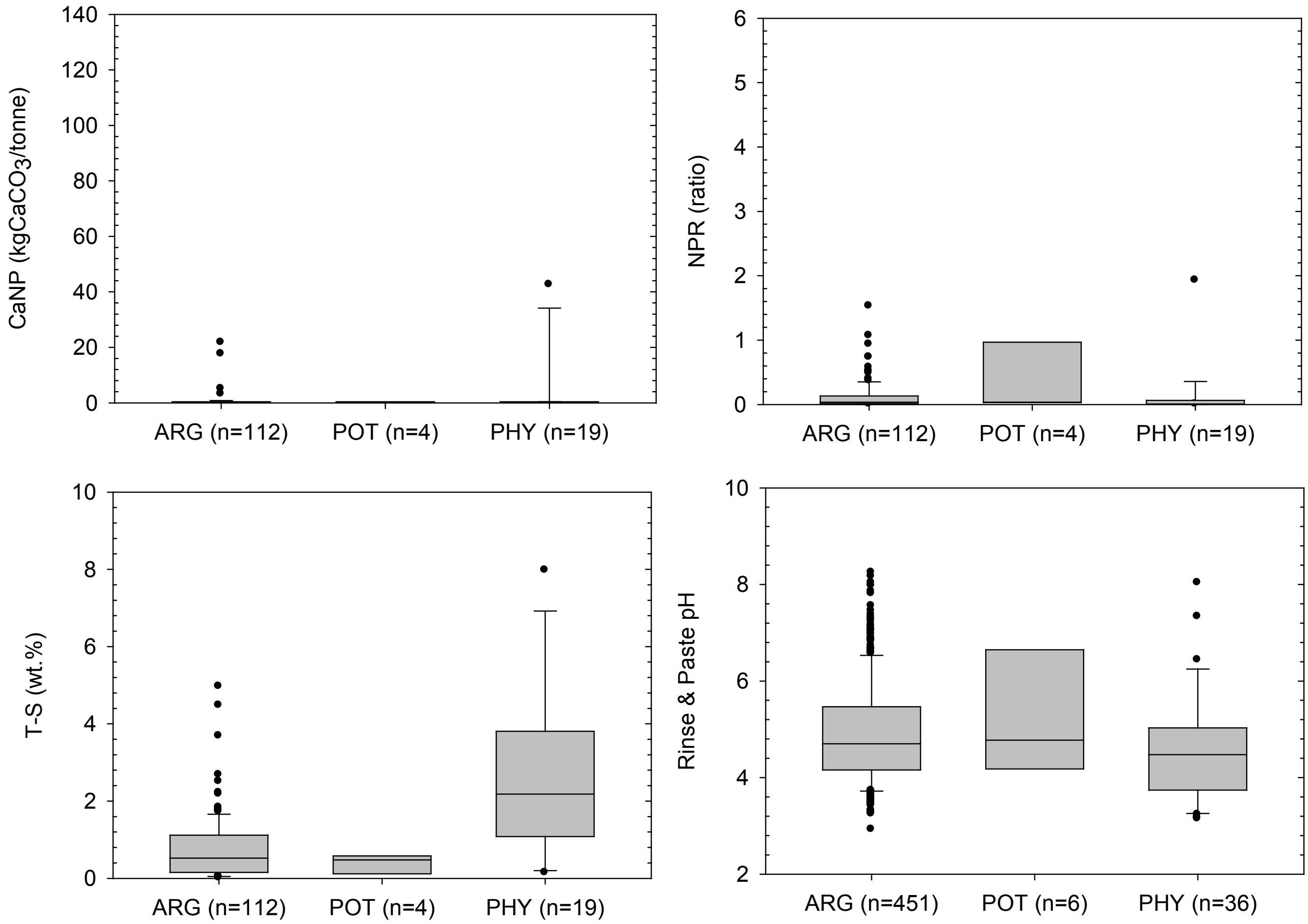
The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-9 Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of alteration types in the SOX mineralization zone



The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-10Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of lithologies in the CAP mineralization zone



The box shows the median, 25th and 75th percentile values. Whiskers denote the 95th and 5th percentile, while data points beyond the 95th and 5th percentile are marked by dots. Note that number of samples is indicated in lower axis headings (n).

Figure B.7.4-11Box and whisker plots for CaNP, NPR (CaNP/T-AP), T-S and rinse & paste pH of alteration types in the CAP mineralization zone

B.7.4.3 R2-101

R2-101. Results of sensitivity analysis and gap analysis of geochemical characterization program.

The geochemical characterization program evolved over time as required to support waste management plans and water quality predictions. At no point was an explicit document addressing data gaps or sensitivities produced.

B.7.4.4 R2-102

R2-102. Additional explanation as to why the Phase I and Phase II Geochemical Assessment Reports are no longer relevant. Details should include what the old geologic interpretations (and rock units) were as related to the new geologic interpretation, and what other lithologies or rock units were and are thought to exist for the project site.

This data was not provided because drill core was re-logged in 2010; hence, the sample classifications in reports pre-dating this re-logging (Phase I and Phase II static tests) are no longer valid. Exploration of the Casino site has been conducted by a number of proponents since the 1970's. CMC identified inconsistencies in some of the geologic interpretations made during these historical exploration programs after acquiring the property. To address these discrepancies, Halle Geologic Services Ltd., under direction of CMC, was contracted to re-log the existing drill core and develop an updated core logging procedure. The re-logging produced new interpretations of the boundaries between alteration types and mineralization zones, while the number of lithologies were reduced. The lithology, alteration and mineralization of Phase I and Phase II static test samples grouped by pre and post 2010 drill core logging are shown in Table B.7.4-4. This re-logging resulted in the re-assignment of lithologies, alteration types and mineralization zone for a large number of static test samples. Since Phase I and Phase II static test reports grouped static test results by the pre-re-logging drill core logs, the statistics and groupings are no longer meaningful. All data presented in the Phase I and Phase II static test reports are presented with up to date alteration, mineralization and lithologic classifications in the Phase III static test report provided as part of the YESAB submission.

Table B.7.4-4 Phase I and Phase II samples grouped by pre and post 2010 drill core logging

Pre 2010 logging		**Post 2010 logging**	
Mineralization	**n**	**Mineralization**	**n**
Overburden (OVB)	6	Overburden (OVB)	2
Hypogene (HYP)	237	Hypogene (HYP)	222
Supergene Sulphide (SUS)	71	Supergene Sulphide (SUS)	67
Supergene Oxide (SOX)	24	Supergene Oxide (SOX)	39
Oxide Cap (CAP)	126	Oxide Cap (CAP)	134
Lithology	n	Lithology	n
Quartz Monzonite (QX, QM)	59	Dawson Range Batholith (WR)	298
Lattite Dykes and Breccias (LT, LP)	52	Patton Porphyry (PP)	81
Dawson Range Batholith (WR)	175	Intrusion breccia (IX)	50
Patton Porphyry (PP, PQ)	73	Explosion breccia (MX)	31
Intrusive Microbreccia (MB)	50	Overburden (OB)	1
Heterolithic Intrusion Breccia (IX)	47	Fault Zone (FZ)	3
Yukon Group Metamorphics (YM)	5		
Overburden (OVB)	1		
Fault Zone (FZ)	2		
Alteration	**n**	**Alteration**	**n**
Argyllic (ARG)	109	Argyllic (ARG)	145
Phyllic (PHY)	133	Phyllic (PHY)	209
Potassic (POT)	194	Potassic (POT)	103
Propyllitic (PRO)	12	Propyllitic (PRO)	3

B.7.4.5 R2-103

R2-103. Provide a quantitative analysis (e.g. using the mine plan waste delivery linked to geochemical data and loading model) to support the approach to waste disposal in the TMF. Consideration should be given to waste type, exposure times prior to inundation, and blending of waste materials.

Quantitative geochemical source terms are developed for saturated and unsaturated waste rock disposed in the TMF in Chapter 3 and Chapter 7 of the Casino Geochemical Source Term Report - Lorax 2013 (Appendix 7D). The source terms calculations are based on the waste production schedule and estimated time to saturation as provided in the production schedule values presented in Table B.7.4-5. These source terms combine geochemical test results from the various waste types that will be disposed in the TMF with the mine schedule, exposure times, and waste placement strategy.

Table B.7.4-5 TMF Waste Materials Staging and Estimated Saturation

Year	Tailings Elevation (masl)	Pond Elevation (masl)	Waste Rock Elevation (masl)	Upstream Waste Rock Elevation (masl)	Waste Storage Area							
					Acidic Supergene	Non-Acidic Supergene	Hypogene	Other	Total	Unsaturated	Saturated	% Saturated
					Tonnes (Cumulative)					Tonnes		
PP	730	791	803	853	0	26,400	0	9,632,000	9,658,400	5,437,865	4,220,535	44
1	800	819	830	868	0	541,200	5,000	31,203,000	31,749,200	11,072,496	20,676,704	65
2	829	841	851	882	0	2,154,350	164,000	57,417,000	59,735,350	15,129,162	44,606,188	75
3	849	858	871	892	0	4,161,300	1,107,000	90,736,000	96,004,300	23,923,386	72,080,914	75
4	861	869	886	912	0	10,800,900	1,680,000	117,454,000	129,934,900	37,488,339	92,446,561	71
5	870	877	900	912	9,767,700	22,739,200	12,370,000	126,397,000	171,273,900	60,925,579	110,348,321	64
6	881	888	911	912	17,021,700	31,605,200	26,466,000	131,270,000	206,362,900	70,211,148	136,151,752	66
7	891	898	921	912	22,725,900	38,577,000	37,045,000	145,694,000	244,041,900	81,140,595	162,901,305	67
8	901	907	930	912	28,213,200	45,283,700	49,446,000	159,068,000	282,010,900	91,758,809	190,252,091	67
9	909	915	937	912	34,151,850	52,542,050	58,398,000	172,777,000	317,868,900	97,689,498	220,179,402	69
10	917	923	944	912	40,482,900	60,280,000	64,767,000	187,354,000	352,883,900	100,529,411	252,354,489	72
11	925	930	953	912	49,114,800	70,830,100	72,698,000	212,939,000	405,581,900	121,290,292	284,291,608	70
12	932	937	961	912	59,661,450	83,720,450	87,971,000	221,892,000	453,244,900	134,376,517	318,868,383	70
13	940	944	967	912	67,831,200	93,705,700	108,312,000	227,193,000	497,041,900	141,859,729	355,182,171	71
14	946	951	973	912	72,444,150	99,343,750	139,684,000	228,355,000	539,826,900	147,575,822	392,251,078	73
15	953	957	979	912	75,151,350	102,652,550	171,063,000	228,789,000	577,655,900	148,201,574	429,454,326	74
16	959	963	983	912	75,404,700	102,962,200	208,433,000	228,790,000	615,589,900	147,026,040	468,563,860	76
17	965	969	986	912	75,404,700	102,962,200	228,675,000	228,790,000	635,831,900	127,235,142	508,596,758	80
18	972	976	987	912	75,404,700	102,962,200	236,941,000	228,790,000	644,097,900	85,725,475	558,372,425	87
19	978	982	988	912	75,404,700	102,962,200	241,873,000	228,790,000	649,029,900	39,126,784	609,903,116	94
20	985	989	988	912	75,404,700	102,962,200	241,873,000	228,790,000	649,029,900	0	649,029,900	100
21	990	992	988	912	75,404,700	102,962,200	241,873,000	228,790,000	649,029,900	0	649,029,900	100
22	991	995	988	912	75,404,700	102,962,200	241,873,000	228,790,000	649,029,900	0	649,029,900	100

Year	Tailings Elevation (masl)	Pond Elevation (masl)	Waste Rock Elevation (masl)	Upstream Waste Rock Elevation (masl)	Marginal Grade Ore							
					Marginal Grade Ore Tonnes (Cumulative)	Unsaturated Tonnes	Saturated Tonnes	% Saturated	Exposure Time Years	Total Tonnes	Saturated Tonnes	% Saturated
PP	730	791	803	853	21,600	21,600	0	0	2.7	9,680,000	4,220,535	44
1	800	819	830	868	442,800	442,800	0	0	2.8	32,192,000	20,676,704	64
2	829	841	851	882	1,762,650	1,762,650	0	0	3.4	61,498,000	44,606,188	73
3	849	858	871	892	3,404,700	3,304,560	100,140	3	3.4	99,409,000	72,181,054	73
4	861	869	886	912	8,837,100	8,301,520	535,580	6	4.6	138,772,000	92,982,141	67
5	870	877	900	912	8,837,100	7,605,575	1,231,525	14	3.6	180,111,000	111,579,846	62
6	881	888	911	912	8,837,100	6,164,023	2,673,077	30	2.6	215,200,000	138,824,829	65
7	891	898	921	912	8,837,100	4,213,983	4,623,117	52	1.6	252,879,000	167,524,422	66
8	901	907	930	912	8,837,100	1,745,432	7,091,668	80	0.6	290,848,000	197,343,759	68
9	909	915	937	912	8,837,100	0	8,837,100	100	submerged	326,706,000	229,016,502	70
10	917	923	944	912	8,837,100	0	8,837,100	100	submerged	361,721,000	261,191,589	72
11	925	930	953	912	8,837,100	0	8,837,100	100	submerged	414,419,000	293,128,708	71
12	932	937	961	912	8,837,100	0	8,837,100	100	submerged	462,082,000	327,705,483	71
13	940	944	967	912	8,837,100	0	8,837,100	100	submerged	505,879,000	364,019,271	72
14	946	951	973	912	8,837,100	0	8,837,100	100	submerged	548,664,000	401,088,178	73
15	953	957	979	912	8,837,100	0	8,837,100	100	submerged	586,493,000	438,291,426	75
16	959	963	983	912	8,837,100	0	8,837,100	100	submerged	624,427,000	477,400,960	76
17	965	969	986	912	8,837,100	0	8,837,100	100	submerged	644,669,000	517,433,858	80
18	972	976	987	912	8,837,100	0	8,837,100	100	submerged	652,935,000	567,209,525	87
19	978	982	988	912	8,837,100	0	8,837,100	100	submerged	657,867,000	618,740,216	94
20	985	989	988	912	8,837,100	0	8,837,100	100	submerged	657,867,000	657,867,000	100
21	990	992	988	912	8,837,100	0	8,837,100	100	submerged	657,867,000	657,867,000	100
22	991	995	988	912	8,837,100	0	8,837,100	100	submerged	657,867,000	657,867,000	100

B.7.4.6 R2-104

R2-104. Provide clear criteria or targets for the "mixing criteria" identified for waste materials.

Starting at year 5 of mine life, supergene (SUP) waste rock will be mixed with hypogene (HYP) waste rock in the TMF. The waste rock placement and TMF flooding schedules limit exposure of PAG waste rock to between 3 and 7 years before being saturated. Both HYP and SUP waste rock are classified as PAG, however, HYP waste rock has sufficient NP to delay acid generation for decades to centuries while 45% of SUP waste rock has relatively little NP and may become acid generating shortly after exposure. The excess NP provided by HYP waste rock will be utilized to prevent ARD from occurring in SUP waste rock during the 3 to 7 years that waste rock will be unsaturated prior to submergence beneath the TMF pond. The minimum mixing criteria is presented below to demonstrate the feasibility and conservative nature of this approach.

The median carbonate NP in 647 HYP waste rock samples collected as part of the geochemical characterization program is 27.3 kg$CaCO_3$/tonne. However, not all of this NP will be available to neutralize acidity generated from SUP waste rock. A portion of the NP contained in HYP waste rock will be consumed by oxidation of sulphide minerals contained within the HYP waste rock, and a portion of the total NP will be unavailable. Unavailable NP represents measured NP that is ineffective at buffering the pH to a neutral value. The NP consumption rate and the unavailable NP in unsaturated HYP waste rock is estimated to be 0.27 kg$CaCO_3$/tonne/yr and 3.7 kg$CaCO_3$/tonne, respectively (Casino Geochemical Source Term Report - Lorax 2013, Appendix 7D). These estimates indicate that typical HYP waste rock with a median NP of 27.3 kg$CaCO_3$/tonne will have an NP of 21.7 kg$CaCO_3$/tonne available after 7 years of exposure.

Acidity may be released from SUP waste rock due to both sulfide oxidation and dissolution of acidic sulphate minerals. The rate of acid generation in acidic SUP was estimated as 0.447 kgCaCO3/tonne/yr from humidity cell tests (Casino Geochemical Source Term Report - Lorax 2013, Appendix 7D). This acid generation rate would result in the release of 3.1 kg$CaCO_3$/tonne if it were sustained for 7 years.

In addition to acidity generated from sulphide oxidation, NP will also be consumed neutralizing water soluble acidity associated with acidic sulphate minerals (*i.e.,* jarosite identified by XRD). Acid base accounting results indicate that SUP waste rock has a median sulphate-S content of 0.03 wt.%. By assuming that this sulphate concentration is present as K-jarosite results in an acidity estimate of 0.7 kg$CaCO_3$/tonne. The sum of acidity generated from soluble acidic sulphate minerals and 7 years of sulfide oxidation is 3.8 kg$CaCO_3$/tonne.

These estimates of available HYP NP and SUP acidity can be used to define the minimum mixing criteria of HYP and SUP waste rock in the TMF. Assuming that acidic SUP waste rock will generate 3.8 kg$CaCO_3$/tonne of acidity over 7 years of exposure, and that HYP waste rock has an available NP of 21.7 kg$CaCO_3$/tonne, a minimum mixing ratio of HYP: SUP of 0.3:1 is required to ensure that twice as much NP is available in HYP waste rock than is required to neutralize the AP generation from acidic SUP.

The mass of acidic SUP and HYP waste rock produced after year 5 of mine life is presented in Table B.7.4-6. Acidic SUP is assumed to be any SUP with little or no NP that has the potential to become acid generating shortly after exposure. The minimum per annum ratio of HYP to acidic SUP is 0.9:1, which is three times greater than the minimum ratio calculated above. The ratio of HYP to total SUP produced during mine life is compared in Table B.7.4-7. This table shows that the minimum per annum HYP to total SUP ratio is 0.4:1. Hence, even if segregation of low NP SUP is not successful there will be sufficient NP to maintain the minimum mixing ratio of 0.3:1.

Table B.7.4-6 Annual waste rock production schedule of HYP and SUP with little or no available NP (A-SUP) and the ratio of HYP to A-SUP

	HYP	A-SUP	HYP:A-SUP
Year	Tonnes Annual	Tonnes Annual	Ratio
5	10,690,000	9,767,700	1.1
6	14,096,000	7,254,000	1.9
7	10,579,000	5,704,200	1.9
8	12,401,000	5,487,300	2.3
9	8,952,000	5,938,650	1.5
10	6,369,000	6,331,050	1.0
11	7,931,000	8,631,900	0.9
12	15,273,000	10,546,650	1.4
13	20,341,000	8,169,750	2.5
14	31,372,000	4,612,950	6.8
15	31,379,000	2,707,200	11.6
16	37,370,000	253,350	147.5
17	20,242,000	0	-
18	8,266,000	0	-
19	4,932,000	0	-

Table B.7.4-7 Annual waste rock production schedule of HYP and total SUP and the ratio of HYP to SUP

	HYP	SUP	HYP:SUP
Year	**Tonnes Annual**	**Tonnes Annual**	**Ratio**
5	10,690,000	21,706,000	0.5
6	14,096,000	16,120,000	0.9
7	10,579,000	12,676,000	0.8
8	12,401,000	12,194,000	1.0
9	8,952,000	13,197,000	0.7
10	6,369,000	14,069,000	0.5
11	7,931,000	19,182,000	0.4
12	15,273,000	23,437,000	0.7
13	20,341,000	18,155,000	1.1
14	31,372,000	10,251,000	3.1
15	31,379,000	6,016,000	5.2
16	37,370,000	563,000	66.4
17	20,242,000	0	-
18	8,266,000	0	-
19	4,932,000	0	-

B.7.4.7 R2-105

R2-105. Indication whether there is any veining or intrusion along fault zones introducing unique or added mineralization or alterations introduced such that the FZ "lithology" was considered as important, initially.

The core logging procedure for identifying the lithology of a fault zone (FZ) is to assign it the same lithology that is on either side of the zone. If the FZ occurs at a contact between two different lithologies the core logger will take adjacent drill hole logs into consideration, generally using completed cross sections. Occasionally fragments of rocks or minerals can be identified in a FZ and a geologist is sometimes able to identify the original lithology based on these components.

The FZ is not a separate unit and should not have been logged as a lithology. This tends to be a practice of some geologists and is misleading. Essentially, a FZ is a secondary structure caused by a primary structure, a fault. This feature is not prevalent in any one particular suite of rocks (waste or ore) since faults and fault zones can cut across all lithologies.

Three samples logged as FZ were collected as part of the geochemical characterization program. These samples included one CAP waste rock sample and two samples of SOX ore. Sulphur concentrations in these samples do not show evidence of enrichment. That is, the CAP waste rock FZ sample has total-S (1.48 wt.%) and the two SOX ore samples logged as FZ had total-S (0.28 wt.% and 0.18 wt.%). The two SOX samples are in the lower 25^{th} percentile of total sulphur values of the SOX mineralization zone, while the CAP sample is between the 75^{th} and 90^{th} percentile of sulphur values in the CAP mineralization zone. These results indicate that there sulphur content in samples logged as FZ is similar to other lithologies within a given mineralization zone.

B.7.4.8 R2-106

R2-106. Shake flask data, number of samples, and other summary statistics for each of the lithologies and alteration types. Ensure all of the tables providing pertinent data are updated.

The number of shake flask extraction (SFE) samples for each weathering zone broken down by alteration and lithology are provided in Table B.7.4-8 below. A majority (n=78) of SFE tests were performed on the CAP mineralization zone with relatively few samples performed on the SOX (n=5), SUS (n=6) and HYP (n=12) mineralization zones. The focus of SFE tests was placed on the CAP material to provide an indication of the water soluble metal load associated with this oxidized rock unit. Shake flask results sorted by mineralization zone and waste/ore type are provided in Table 5-5, Table, 5-8 and Table 5-10 of Casino Waste Rock and Ore Geochemical Static Test Assessment report – Lorax 2013 (Appendix 7D), and complete results were appended to this report. Additional SFE statistics are provided in Table B.7.4-9 through Table B.7.4-18 below. These include SFE results by mineralization zone (Table B.7.4-9, Table B.7.4-10, Table B.7.4-11 and Table B.7.4-12). Furthermore, the CAP mineralization zone is broken down by ARG and PHY alteration types (Table B.7.4-13 and Table B.7.4-14), and by lithology in Table B.7.4-15, Table B.7.4-16, Table B.7.4-17 and Table B.7.4-18.

Table B.7.4-8 Number of SFE samples by mineralization, alteration and lithology.

HYP					**SUS**				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	0	4	4	0	WR	2	2	1	0
PP	0	1	2	0	PP	0	0	0	0
IX	0	0	0	0	IX	1	0	0	0
MX	0	1	0	0	MX	0	0	0	0
CAP					**SOX**				
	ARG	PHY	POT	PRO		ARG	PHY	POT	PRO
WR	44	6	0	0	WR	2	2	0	0
PP	12	1	0	0	PP	0	0	0	0
IX	8	0	0	0	IX	0	0	0	0
MX	7	0	0	0	MX	1	0	0	0

Table B.7.4-9 Shake flask extraction results for the CAP mineralization zone compared to CCME and MMER guidelines

Parameter	Units	CCME (max)[2]	MMER[3]	CAP					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.19	3.81	5.47	7.25	7.85	78
Sulphate	mg/L	100	-	6	13	38.5	535.3	2355	78
Fluoride	mg/L	-	-	0.06	0.06	0.09	0.372	1.04	29
D-Al	mg/L	0.005[a]	-	0.0065	0.02656	0.1975	22.97	397	78
D-Sb	mg/L	0.02[b]	-	0.00002	0.00002	0.000225	0.003642	0.0453	78
D-As	mg/L	0.005	0.5	0.00002	0.000117	0.000445	0.005206	0.0284	78
D-Cd	mg/L	0.000004[c]	-	0.000003	0.0000074	0.000081	0.0008256	0.00479	78
D-Cr	mg/L	0.001[d]	-	0.0001	0.0001	0.001	0.01403	0.152	78
D-Co	mg/L	0.11	-	0.000002	0.0001532	0.001155	0.06296	0.472	78
D-Cu	mg/L	0.002[c]	0.3	0.00747	0.01582	0.07375	3.32	19.3	78
D-Fe	mg/L	0.3	-	0.004	0.0188	0.0975	1.483	6.26	78
D-Pb	mg/L	0.001[c]	0.2	0.000014	0.00005	0.000435	0.003274	0.0231	78
D-Mn	mg/L	0.2[e]	-	0.00081	0.003688	0.037	0.5699	4.48	78
D-Hg	ug/L	0.026	-	0.01	0.01	0.02	0.05	0.18	78
D-Mo	mg/L	0.73	-	0.00005	0.000067	0.002215	0.09197	0.872	78
D-Ni	mg/L	0.25[c]	0.5	0.0002	0.0003	0.00142	0.03151	0.24	78
D-Se	mg/L	0.001	-	0.00022	0.000375	0.001455	0.008768	0.151	78
D-Ag	mg/L	0.0001	-	0.000005	0.000008	0.000021	0.0001969	0.0036	78
D-U	mg/L	0.015	-	0.000012	0.0000903	0.00057	0.009726	0.0686	78
D-Zn	mg/L	0.03	0.5	0.00040	0.0010	0.0070	0.1362	0.988	78

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.

a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-10 Shake flask extraction results for the SOX mineralization zone compared to CCME and MMER guidelines

Parameter	Units	CCME (max)[2]	MMER[3]	SOX					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.27	3.97	7.08	7.72	7.77	5
Sulphate	mg/L	100	-	20	31	37	409	521	5
Fluoride	mg/L	-	-	0.23	0.615	1	1.008	1.01	3
D-Al	mg/L	0.005[a]	-	0.0106	0.146	0.23	45.144	71.4	5
D-Sb	mg/L	0.02[b]	-	0.00009	0.0002	0.0003	0.00772	0.0114	5
D-As	mg/L	0.005	0.5	0.00015	0.0003	0.0013	0.005474	0.00779	5
D-Cd	mg/L	0.000004[c]	-	0.000003	0.000013	0.000281	0.0012892	0.00192	5
D-Cr	mg/L	0.001[d]	-	0.0001	0.0009	0.0018	0.01642	0.0259	5
D-Co	mg/L	0.11	-	0.000398	0.000467	0.00163	0.06208	0.0752	5
D-Cu	mg/L	0.002[c]	0.3	0.00288	0.0871	0.117	52.6	87.1	5
D-Fe	mg/L	0.3	-	0.001	0.09	0.1	4.89	7.55	5
D-Pb	mg/L	0.001[c]	0.2	0.000016	0.00015	0.00018	0.0006052	0.000822	5
D-Mn	mg/L	0.2[e]	-	0.004	0.014	0.0942	0.4958	0.667	5
D-Hg	ug/L	0.026	-	0.01	0.01	0.01	0.044	0.06	5
D-Mo	mg/L	0.73	-	0.00043	0.00078	0.00476	0.3042	0.325	5
D-Ni	mg/L	0.25[c]	0.5	0.00042	0.001	0.003	0.0549	0.0739	5
D-Se	mg/L	0.001	-	0.00027	0.00042	0.00138	0.007844	0.00854	5
D-Ag	mg/L	0.0001	-	0.000005	0.00001	0.00003	0.0000664	0.00009	5
D-U	mg/L	0.015	-	0.000115	0.000433	0.00424	0.01832	0.0234	5
D-Zn	mg/L	0.03	0.5	0.0005	0.0020	0.0040	0.1566	0.211	5

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.
a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-11 Shake flask extraction results for the SUS mineralization zone compared to CCME and MMER guidelines

Parameter	Units	CCME (max)[2]	MMER[3]	SUS					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.90	4.05	6.14	7.62	7.88	6
Sulphate	mg/L	100	-	18	25.5	74.5	1192.5	2248	6
Fluoride	mg/L	-	-	1.92	1.923	1.935	1.947	1.95	2
D-Al	mg/L	0.005[a]	-	0.0109	0.037	0.980	20.6	30.6	6
D-Sb	mg/L	0.02[b]	-	0.0001	0.00041	0.00103	0.0202	0.0325	6
D-As	mg/L	0.005	0.5	0.00006	0.00026	0.0011	0.0024	0.0033	6
D-Cd	mg/L	0.000004[c]	-	0.000078	0.0002885	0.001193	0.015765	0.0235	6
D-Cr	mg/L	0.001[d]	-	0.0001	0.0002	0.00135	0.00275	0.0033	6
D-Co	mg/L	0.11	-	0.000173	0.0003785	0.01302	0.1808	0.33	6
D-Cu	mg/L	0.002[c]	0.3	0.00633	0.019065	1.98	36.4	47.6	6
D-Fe	mg/L	0.3	-	0.002	0.0115	0.17	2.37	3.05	6
D-Pb	mg/L	0.001[c]	0.2	0.000018	0.000104	0.0002515	0.000545	0.00056	6
D-Mn	mg/L	0.2[e]	-	0.001	0.0233	0.1115	3.966	7.68	6
D-Hg	ug/L	0.026	-	0.01	0.01	0.045	0.1	0.11	6
D-Mo	mg/L	0.73	-	0.0003	0.0005	0.01555	0.5269	0.969	6
D-Ni	mg/L	0.25[c]	0.5	0.00058	0.00059	0.000855	0.09915	0.186	6
D-Se	mg/L	0.001	-	0.00108	0.00147	0.002315	0.00362	0.0044	6
D-Ag	mg/L	0.0001	-	0.000005	0.000008	0.00008	0.00014	0.00014	6
D-U	mg/L	0.015	-	0.000069	0.000424	0.007541	0.0546	0.0683	6
D-Zn	mg/L	0.03	0.5	0.001	0.00165	0.0118	0.645	0.831	6

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.

a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-12 Shake flask extraction results for the HYP mineralization zone compared to CCME and MMER guidelines

Parameter	Units	CCME (max)[2]	MMER[3]	HYP					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	4.47	6.08	7.79	8.08	8.19	12
Sulphate	mg/L	100	-	13	21.4	43.5	205	1760	12
Fluoride	mg/L	-	-	-	-	-	-	-	0
D-Al	mg/L	0.005[a]	-	0.0144	0.01963	0.04	0.197	2.78	12
D-Sb	mg/L	0.02[b]	-	0.00047	0.000473	0.000985	0.00966	0.0141	12
D-As	mg/L	0.005	0.5	0.00024	0.00072	0.00141	0.008376	0.02	12
D-Cd	mg/L	0.000004[c]	-	0.000005	0.0000082	0.00004	0.000256	0.00041	12
D-Cr	mg/L	0.001[d]	-	0.0001	0.0001	0.0003	0.00068	0.0009	12
D-Co	mg/L	0.11	-	0.000013	0.0000317	0.0004875	0.001907	0.0123	12
D-Cu	mg/L	0.002[c]	0.3	0.00217	0.002506	0.0109	1.36	12.6	12
D-Fe	mg/L	0.3	-	0.001	0.0031	0.0085	0.1152	0.745	12
D-Pb	mg/L	0.001[c]	0.2	0.000024	0.0000308	0.000153	0.0004073	0.00071	12
D-Mn	mg/L	0.2[e]	-	0.00191	0.005024	0.0244	0.09111	0.1	12
D-Hg	ug/L	0.026	-	0.01	0.01	0.01	0.047	0.05	12
D-Mo	mg/L	0.73	-	0.0012	0.003012	0.006815	0.03378	0.0937	12
D-Ni	mg/L	0.25[c]	0.5	0.0002	0.000235	0.00173	0.009769	0.0298	12
D-Se	mg/L	0.001	-	0.00054	0.000665	0.001125	0.002579	0.00417	12
D-Ag	mg/L	0.0001	-	0.000005	0.000005	0.000009	0.0000394	0.000107	12
D-U	mg/L	0.015	-	0.000358	0.000553	0.0073	0.0645	0.0875	12
D-Zn	mg/L	0.03	0.5	0.0002	0.00041	0.00115	0.00828	0.0844	12

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.
a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-13 Shake flask extraction results for the CAP mineralization zone with ARG alteration compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-ARG					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.39	4.08	5.55	7.26	7.85	71
Sulphate	mg/L	100	-	6	13	29	210	1704	71
Fluoride	mg/L	-	-	0.06	0.06	0.08	0.383	1.04	28
D-Al	mg/L	0.005[a]	-	0.0065	0.0246	0.171	3.71	250	71
D-Sb	mg/L	0.02[b]	-	0.00002	0.00002	0.0002	0.0021	0.0453	71
D-As	mg/L	0.005	0.5	0.00002	0.00011	0.0004	0.00349	0.0284	71
D-Cd	mg/L	0.000004[c]	-	0.000003	0.000008	0.000073	0.00073	0.00479	71
D-Cr	mg/L	0.001[d]	-	0.0001	0.0001	0.0009	0.0086	0.152	71
D-Co	mg/L	0.11	-	0.000002	0.000128	0.000967	0.0475	0.209	71
D-Cu	mg/L	0.002[c]	0.3	0.00747	0.0147	0.062	0.682	16.2	71
D-Fe	mg/L	0.3	-	0.004	0.016	0.085	0.974	5.15	71
D-Pb	mg/L	0.001[c]	0.2	0.000014	0.00005	0.000368	0.00213	0.0231	71
D-Mn	mg/L	0.2[e]	-	0.00081	0.00296	0.0276	0.271	4.48	71
D-Hg	ug/L	0.026	-	0.01	0.01	0.02	0.05	0.18	71
D-Mo	mg/L	0.73	-	0.00005	0.00007	0.00266	0.108	0.872	71
D-Ni	mg/L	0.25[c]	0.5	0.0002	0.0003	0.001	0.0169	0.129	71
D-Se	mg/L	0.001	-	0.00022	0.00034	0.00123	0.0069	0.0957	71
D-Ag	mg/L	0.0001	-	0.000005	0.000008	0.00002	0.000213	0.0036	71
D-U	mg/L	0.015	-	0.000012	0.000084	0.000445	0.00354	0.0686	71
D-Zn	mg/L	0.03	0.5	0.0004	0.001	0.006	0.086	0.988	71

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.

a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-14 Shake flask extraction results for the CAP mineralization zone with PHY alteration compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-PHY					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.19	3.30	3.97	4.52	4.62	7
Sulphate	mg/L	100	-	47	56	89	1600.2	2355	7
Fluoride	mg/L	-	-	0.12	0.12	0.12	0.12	0.12	1
D-Al	mg/L	0.005[a]	-	0.759	0.7914	3.51	214.54	397	7
D-Sb	mg/L	0.02[b]	-	0.00005	0.00008	0.0019	0.00676	0.01	7
D-As	mg/L	0.005	0.5	0.00095	0.00098	0.00151	0.0096	0.0102	7
D-Cd	mg/L	0.000004[c]	-	0.000003	0.0000888	0.00075	0.001826	0.00185	7
D-Cr	mg/L	0.001[d]	-	0.0012	0.00132	0.0022	0.04526	0.092	7
D-Co	mg/L	0.11	-	0.00305	0.00722	0.0319	0.4462	0.472	7
D-Cu	mg/L	0.002[c]	0.3	0.117	0.5052	9.84	15.76	19.3	7
D-Fe	mg/L	0.3	-	0.27	0.3678	1.8	5.936	6.26	7
D-Pb	mg/L	0.001[c]	0.2	0.000371	0.0005624	0.00096	0.01408	0.0145	7
D-Mn	mg/L	0.2[e]	-	0.189	0.1908	0.388	1.87	2.32	7
D-Hg	ug/L	0.026	-	0.02	0.026	0.05	0.07	0.1	7
D-Mo	mg/L	0.73	-	0.00005	0.000062	0.0011	0.05488	0.0682	7
D-Ni	mg/L	0.25[c]	0.5	0.00238	0.002752	0.0206	0.1686	0.24	7
D-Se	mg/L	0.001	-	0.0038	0.0044	0.00916	0.10426	0.151	7
D-Ag	mg/L	0.0001	-	0.000008	0.0000092	0.00003	0.000184	0.00019	7
D-U	mg/L	0.015	-	0.00057	0.004866	0.00918	0.04228	0.0514	7
D-Zn	mg/L	0.03	0.5	0.0282	0.03768	0.132	0.607	0.82	7

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.

a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-15 Shake flask extraction results for the CAP mineralization zone of WR lithology compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-WR					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.38	3.86	5.49	7.34	7.85	50
Sulphate	mg/L	100	-	6	14.9	38.5	222.9	2355	50
Fluoride	mg/L	-	-	0.06	0.06	0.13	0.361	1	20
D-Al	mg/L	0.005[a]	-	0.0069	0.03054	0.257	19.59	397	50
D-Sb	mg/L	0.02[b]	-	0.00002	0.00002	0.0003	0.00433	0.0453	50
D-As	mg/L	0.005	0.5	0.00002	0.000156	0.00061	0.00862	0.0284	50
D-Cd	mg/L	0.000004[c]	-	0.000003	0.0000158	0.0001055	0.0008132	0.00192	50
D-Cr	mg/L	0.001[d]	-	0.0001	0.0002	0.00115	0.00438	0.152	50
D-Co	mg/L	0.11	-	0.000002	0.0001604	0.00126	0.06252	0.472	50
D-Cu	mg/L	0.002[c]	0.3	0.0124	0.01819	0.0743	7.581	19.3	50
D-Fe	mg/L	0.3	-	0.007	0.0296	0.13	1.0346	6.26	50
D-Pb	mg/L	0.001[c]	0.2	0.000014	0.00005	0.000623	0.006228	0.0231	50
D-Mn	mg/L	0.2[e]	-	0.001	0.0058	0.0395	0.5633	4.48	50
D-Hg	ug/L	0.026	-	0.01	0.01	0.02	0.051	0.18	50
D-Mo	mg/L	0.73	-	0.00005	0.000059	0.00189	0.1092	0.872	50
D-Ni	mg/L	0.25[c]	0.5	0.0002	0.0003	0.00147	0.0228	0.121	50
D-Se	mg/L	0.001	-	0.00024	0.000385	0.001825	0.0107	0.151	50
D-Ag	mg/L	0.0001	-	0.000005	0.000008	0.000029	0.0003381	0.0036	50
D-U	mg/L	0.015	-	0.000012	0.0000731	0.000613	0.01142	0.0686	50
D-Zn	mg/L	0.03	0.5	0.0004	0.001	0.00775	0.1334	0.82	50

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.
a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-16 Shake flask extraction results for the CAP mineralization zone of PP lithology compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-PP					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.19	3.54	5.48	6.75	7.35	13
Sulphate	mg/L	100	-	17	26	52	1513	1704	13
Fluoride	mg/L	-	-	0.06	0.06	0.165	0.809	1.04	4
D-Al	mg/L	0.005[a]	-	0.0065	0.02618	0.0934	76.03	250	13
D-Sb	mg/L	0.02[b]	-	0.00002	0.000024	0.0002	0.000304	0.001	13
D-As	mg/L	0.005	0.5	0.00003	0.00006	0.0004	0.00134	0.0092	13
D-Cd	mg/L	0.000004[c]	-	0.000003	0.0000084	0.000057	0.00321	0.00479	13
D-Cr	mg/L	0.001[d]	-	0.0001	0.0001	0.0006	0.03298	0.0836	13
D-Co	mg/L	0.11	-	0.000033	0.000582	0.00231	0.17938	0.429	13
D-Cu	mg/L	0.002[c]	0.3	0.0079	0.01494	0.136	4.65	7.84	13
D-Fe	mg/L	0.3	-	0.004	0.0104	0.06	2.144	5.15	13
D-Pb	mg/L	0.001[c]	0.2	0.000025	0.0000484	0.00022	0.0009536	0.0025	13
D-Mn	mg/L	0.2[e]	-	0.00148	0.01	0.0455	2.1	2.46	13
D-Hg	ug/L	0.026	-	0.01	0.01	0.03	0.05	0.05	13
D-Mo	mg/L	0.73	-	0.00005	0.000102	0.00191	0.05204	0.0758	13
D-Ni	mg/L	0.25[c]	0.5	0.00021	0.0007	0.0023	0.1088	0.24	13
D-Se	mg/L	0.001	-	0.00026	0.00059	0.00104	0.0052	0.0095	13
D-Ag	mg/L	0.0001	-	0.000005	0.0000068	0.000011	0.0001416	0.00018	13
D-U	mg/L	0.015	-	0.000095	0.000165	0.000691	0.032228	0.0514	13
D-Zn	mg/L	0.03	0.5	0.001	0.00108	0.007	0.4026	0.988	13

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.

a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-17 Shake flask extraction results for the CAP mineralization zone of IX lithology compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-IX					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	3.53	4.34	5.53	6.49	6.85	8
Sulphate	mg/L	100	-	10	10	21.5	136.4	394	8
Fluoride	mg/L	-	-	0.06	0.06	0.06	0.204	0.24	3
D-Al	mg/L	0.005[a]	-	0.0157	0.02389	0.06365	18.7869	61.3	8
D-Sb	mg/L	0.02[b]	-	0.00002	0.000076	0.000175	0.00075	0.0011	8
D-As	mg/L	0.005	0.5	0.0001	0.000107	0.00026	0.00146	0.0016	8
D-Cd	mg/L	0.000004[c]	-	0.000003	0.0000037	0.000101	0.0005977	0.00073	8
D-Cr	mg/L	0.001[d]	-	0.0001	0.0001	0.0006	0.01352	0.025	8
D-Co	mg/L	0.11	-	0.000237	0.0002685	0.000507	0.06322	0.207	8
D-Cu	mg/L	0.002[c]	0.3	0.0147	0.02093	0.07045	0.7357	0.861	8
D-Fe	mg/L	0.3	-	0.006	0.0088	0.0435	1.203	1.49	8
D-Pb	mg/L	0.001[c]	0.2	0.000027	0.0000473	0.0002465	0.001192	0.00283	8
D-Mn	mg/L	0.2[e]	-	0.00158	0.003764	0.0145	0.12506	0.268	8
D-Hg	ug/L	0.026	-	0.01	0.01	0.01	0.043	0.05	8
D-Mo	mg/L	0.73	-	0.00005	0.000071	0.00344	0.08447	0.132	8
D-Ni	mg/L	0.25[c]	0.5	0.0003	0.00037	0.000775	0.012848	0.0397	8
D-Se	mg/L	0.001	-	0.00022	0.000283	0.00064	0.007116	0.00762	8
D-Ag	mg/L	0.0001	-	0.000005	0.0000071	0.0000195	0.0001771	0.00042	8
D-U	mg/L	0.015	-	0.000156	0.000205	0.0003735	0.002053	0.00458	8
D-Zn	mg/L	0.03	0.5	0.001	0.001	0.00275	0.04863	0.111	8

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.
a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

Table B.7.4-18 Shake flask extraction results for the CAP mineralization zone of MX lithology compared to CCME and MMER guidelines

Parameter	Units	CCME (max)	MMER	CAP-MX					
				Minimum	10th percentile	Median	90th percentile	Maximum	n
Rinse pH	s.u.	-	-	4.29	4.45	5.23	6.70	6.93	7
Sulphate	mg/L	100	-	11	11.6	18	47.2	49	7
Fluoride	mg/L	-	-	0.06	0.061	0.065	0.069	0.07	2
D-Al	mg/L	0.005[a]	-	0.0356	0.068	0.132	1.5886	3.16	7
D-Sb	mg/L	0.02[b]	-	0.00045	0.00048	0.0007	0.013412	0.0275	7
D-As	mg/L	0.005	0.5	0.00018	0.00018	0.00035	0.004462	0.00592	7
D-Cd	mg/L	0.000004[c]	-	0.000006	0.0000138	0.000073	0.0002142	0.000351	7
D-Cr	mg/L	0.001[d]	-	0.0002	0.00026	0.0018	0.00802	0.0166	7
D-Co	mg/L	0.11	-	0.000038	0.0000644	0.000675	0.004204	0.00595	7
D-Cu	mg/L	0.002[c]	0.3	0.00747	0.016788	0.0661	0.09622	0.121	7
D-Fe	mg/L	0.3	-	0.031	0.0478	0.08	0.689	1.04	7
D-Pb	mg/L	0.001[c]	0.2	0.00005	0.0000728	0.000365	0.0006856	0.000889	7
D-Mn	mg/L	0.2[e]	-	0.00081	0.001914	0.0182	0.0984	0.174	7
D-Hg	ug/L	0.026	-	0.01	0.01	0.01	0.02	0.02	7
D-Mo	mg/L	0.73	-	0.00025	0.000586	0.00362	0.13698	0.285	7
D-Ni	mg/L	0.25[c]	0.5	0.0004	0.0004	0.0006	0.003232	0.00493	7
D-Se	mg/L	0.001	-	0.00061	0.000904	0.00199	0.004106	0.00422	7
D-Ag	mg/L	0.0001	-	0.00001	0.00001	0.000012	0.000071	0.000116	7
D-U	mg/L	0.015	-	0.000057	0.0001458	0.000451	0.00129	0.00171	7
D-Zn	mg/L	0.03	0.5	0.0016	0.00172	0.005	0.03032	0.0383	7

Notes: Values which exceed CCME guidelines are shaded blue while values which exceed MMER guidelines for maximum authorized monthly mean concentrations are shaded grey.
a) criteria based on pH of <6.5; b) criteria based on proposed Ontario guideline for the protection of freshwater aquatic life; c) criteria based on hardness of 7.5 mg $CaCO_3$/L for hardness dependent metals; d) criteria is for Cr (VI); e) irrigation guideline

B.7.4.9 R2-107

R2-107. Identification when results of additional metallurgical test work on heap leach facility ore and residue will be available. Provide a discussion on uncertainties in the absence of this information.

Additional heap leach columns were initiated to better understand the geochemical evolution of heap leach drainage at the end of operations through drain down. This testwork consisted of three composite CAP ore samples used to construct 6 x 89 kg columns. After the initial CN leach, the columns were rinsed with either barren solution or tap water for 7 to 12 weeks. After this rinsing phase, the column solids were subsampled and two smaller scale kinetic tests were initiated with the residue. This data expands upon the geochemical dataset that was incorporated into the Project Proposal and is part of the continuing baseline environmental testwork. The additional data provides information regarding the long term geochemical behaviour of the heap leach facility that will be used to inform management decisions in the detailed design phase. Uncertainties in the geochemical behaviour of the heap leach facility were dealt with by conservative assumptions as discussed in Casino Geochemical Source Term Report-Lorax 2013 (Appendix 7D of Project Proposal). Testwork results are relevant to the determinations made in the effects assessment, and are not provided.

B.7.4.10 R2-108

R2-108. For the Freegold Road upgrade and extension provide additional details and information on:

a. **all geological materials, including estimates of volumes, that will be excavated, exposed or otherwise disturbed;**

b. **geochemical characterization, analysis, and interpretation on representative samples for those geological materials; and,**

c. **consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.**

a. Information on soil cuts and rock cuts were provided in 20 m increments and incorporated into the Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage (Appendix A.7J in SIR-A). Some additional material may be required for fill beyond what is made available by road cuts. The sources and volumes of this material have not yet been identified, however, static testwork generally showed that the all material encountered along the road alignment had little or no ML/ARD potential. This shows that it is feasible to obtain enough quarry material that is acceptable from a geochemical standpoint for road construction.

b. Sixty seven samples were collected from the road alignment for acid base accounting and total metals analysis. In general, these results show that material is non-potentially acid generating with total sulphur values being generally less than 0.02 wt.%. Furthermore, little evidence of metal enrichment was found, with metal concentrations generally being less than three times average continental abundance.

c. The ML/ARD assessment of the Freegold Road upgrade and extension assigned risk ratings to 81 road sections defined by surface water catchments and the road alignment. These ratings were based on: catchment size; volume of road cuts; ML/ARD static testwork; and, information regarding aquatic receptors. A majority of the road length (71%) was determined to be at low risk for ML/ARD while sixteen sections of road representing 29% of the total road length were assigned a moderate-low risk or greater.

   Additional ML/ARD testwork will be conducted as specific borrow sites are defined. These results will be used to develop site specific mitigation plans as needed. This information will also be used in the development of an ML/ARD monitoring and management plan that will be put adopted for road construction. This level of detail will be determined during the detailed design process for the road.

B.7.4.11 R2-109

R2-109. For airstrip borrow sources provide additional details and information on:

a. **why airstrip borrow samples and barge landing borrow samples were grouped together in the summary description of geochemical results given their location at opposite ends of the project footprint;**

b. **provide justification on how representative these samples are of the borrow material specifically intended for airstrip construction and expansion (i.e. does the geochemical analysis of the airstrip borrow site account for areas which will be disturbed in the construction of the airstrip?);**

c. **details on the short-term metal leaching potential for the material proposed for use at the airstrip; and**

d. **details on mitigation is being proposed to prevent release of metals and sediments to local receiving water.**

a. Four samples were collected from the airstrip borrow area, located south of the project area and 5 samples were collected from two locations along the proposed barge landing access road, to the north of the project area. Complete static test results for airstrip borrow samples and barge landing borrow samples were provided in Appendix 7D. The borrow material in these areas have a neutral rinse pH, are non-acid generating and have a total sulphur concentration of 0.01 wt.% or lower.

b. The airstrip borrow samples were collected from the southwestern section of the borrow source identified for airstrip construction. Although the sample area is limited, the generally positive results (*e.g.*, sulphur content <0.01 wt.% and neutral rinse pH) shows that borrow material acceptable from a geochemical standpoint should not be difficult to find. A borrow monitoring program will be implemented during borrow site excavation and airstrip construction.

c. Airstrip borrow samples were subjected to acid base accounting and total metals analysis to identify intrinsic ML/ARD potential. This testwork shows that the samples are non-acid generating, have low sulphur content (0.01 wt.% or lower), and do not exhibit metal enrichment relative to continental values. Additional metal leaching testwork is not planned until the detailed design phase.

d. Details regarding the management of sedimentation will be described in the Surface Erosion Prevention and Sediment Control Plan (Appendix A.22C). This level of detailed design and planning will not be provided until after the YESAB process, during permitting. Mitigation plans for metal leaching from the airstrip will be developed if significant metal leaching potential is identified from the airstrip borrow material during subsequent characterization of this material, in conjunction with the ML/ARD Management Plan (Appendix A.22H).

B.7.4.12 R2-110

R2-110. Clarify whether waste rock from previous mining operations will be used in construction of the Freegold Road. If yes, outline a plan to characterize the ARD/ML potential with results provided during the assessment process.

Waste rock from previous mining operations will not be used in construction of the Freegold Road.

B.7.5 NUMERICAL GROUNDWATER MODEL

B.7.5.1 R2-111

R2-111. An analysis or model of how groundwater movement and hydraulic conductivity results from the groundwater model may be influenced by permafrost at the model's scale.

As described in the Numerical Groundwater Modelling report (Appendix 7E), the objective of the numerical modelling was to provide a representation of baseline groundwater conditions and to evaluate potential effects of the Project on hydrogeological conditions. To achieve this objective, a 3-D steady-state, regional-scale numerical groundwater model was developed using MODFLOW-SURFACT to simulate baseline hydrogeological conditions at the Project site. The baseline model was then modified to include proposed mine facilities in order to assess hydrogeological conditions during five phases of mine operations.

At the local scale, geologic structures (faults and fractures) are expected to influence groundwater flow pathways and hydraulic gradients. Within the unweathered hydrostratigraphic unit groundwater is inferred to flow primarily within structural discontinuities and joints. However, considering the highly fractured, faulted, and weathered nature of the bedrock, groundwater flow is assumed to be homogeneous and isotropic at the regional scale for the purpose of regional and project-site scale assessment of groundwater flow.

Groundwater discharge from the deep (regional) groundwater flow system contributes to streamflow in Casino, Canadian and Britannia Creeks year-round and sustains baseflow (low flows) in Casino Creek and the lower reaches of Canadian Creek during the winter and early spring months. Groundwater discharge in the natural system is expected to be focused within “windows” of the subsurface that are permafrost-free. At the regional-scale, however, the net volume of groundwater discharge to the creek valleys is expected to be independent of permafrost distribution, particularly considering the relatively steep valley slopes that drive groundwater flow at the Project site. It is considered sufficient for the purpose of this regional hydrogeology assessment to consider the subsurface as a homogeneous unit that is permafrost-free. Any future hydrogeologic studies that are focused at a smaller-scale should consider the spatial distribution of permafrost.

The Modflow model was constructed with the level of detail required to represent the primary groundwater flow pathways. Refining the model to include spatially distributed permafrost by assigning subsurface layers as no flow would restrict groundwater flow within select regions. However, groundwater flow would still be forced to follow a similar flow path due to the steep topography at the site. At the small-scale (i.e., 10’s of meters) the predicted groundwater flow paths would differ if permafrost was included in the model. However, at the large-scale (i.e., 100’s of meters) that is represented by the Modflow model, the predicted flow paths would be similar.

By definition, the hydraulic conductivity of frozen permafrost is zero; therefore, the hydraulic conductivity of frozen hydrostratigraphic units will also be zero and no groundwater flow will occur through the frozen unit. Thermal changes within the permafrost (frozen unit) are not expected to influence groundwater flow since it will still remain a (frozen) barrier to flow. Based on the relatively steep topography at the site, groundwater flow is expected to follow local flow paths and discharge to valleys and local topographic lows. Under the influence of this steep topography, flow paths are expected to be short, with groundwater discharging to adjacent streams.

Representation of permafrost in the numerical groundwater model as a barrier to groundwater flow was considered during initial development of the numerical model. However, the decision was made not to represent permafrost zones with a lower hydraulic conductivity within the subsurface of the baseline numerical model since the distribution of permafrost is not expected to have a significant effect on the regional-scale seepage pathways from facilities to downstream receptors or impact seepage rates. The relatively steep topography at the site is expected to drive groundwater flow and define groundwater recharge and discharge zones at topographic highs and lows, respectively.

B.7.5.2 R2-112

R2-112. An analysis of the effects of permafrost degradation to groundwater movement and hydraulic conductivity, building off of R2-111 above.

As stated above, in the response to R2-111, the numerical groundwater model was conducted at a regional scale, and groundwater flow is assumed to be homogeneous and isotropic at the regional scale for the purpose of regional and project-site scale assessment of groundwater flow. At the regional-scale, the net volume of groundwater discharge to the creek valleys is expected to be independent of permafrost distribution, particularly considering the relatively steep valley slopes that drive groundwater flow at the Project site. It is considered sufficient for the purpose of this regional hydrogeology assessment to consider the subsurface as a homogeneous unit that is permafrost-free.

Additionally, while representation of permafrost in the numerical groundwater model as a barrier to groundwater flow was considered during initial development of the numerical model, permafrost zones with a lower hydraulic conductivity were not represented within the subsurface of the baseline numerical model since the distribution of permafrost is not expected to have a significant effect on the regional-scale seepage pathways from facilities to downstream receptors or impact seepage rates. The relatively steep topography at the site is expected to drive groundwater flow and define groundwater recharge and discharge zones at topographic highs and lows, respectively.

The purpose of the groundwater model is to assess the effects of the Project on the environment, not the effects of permafrost degradation on groundwater flow. The Mine Life Modflow models assumed that permafrost below all facilities degrades or is removed during mine operations. This allows groundwater to flow unobstructed to the downgradient discharge location.

B.7.5.3 R2-113

R2-113. Clarification on the most recent inferred permafrost spatial distribution (figure 2.3 of appendix 7C or figure 3.4 of appendix 7E).

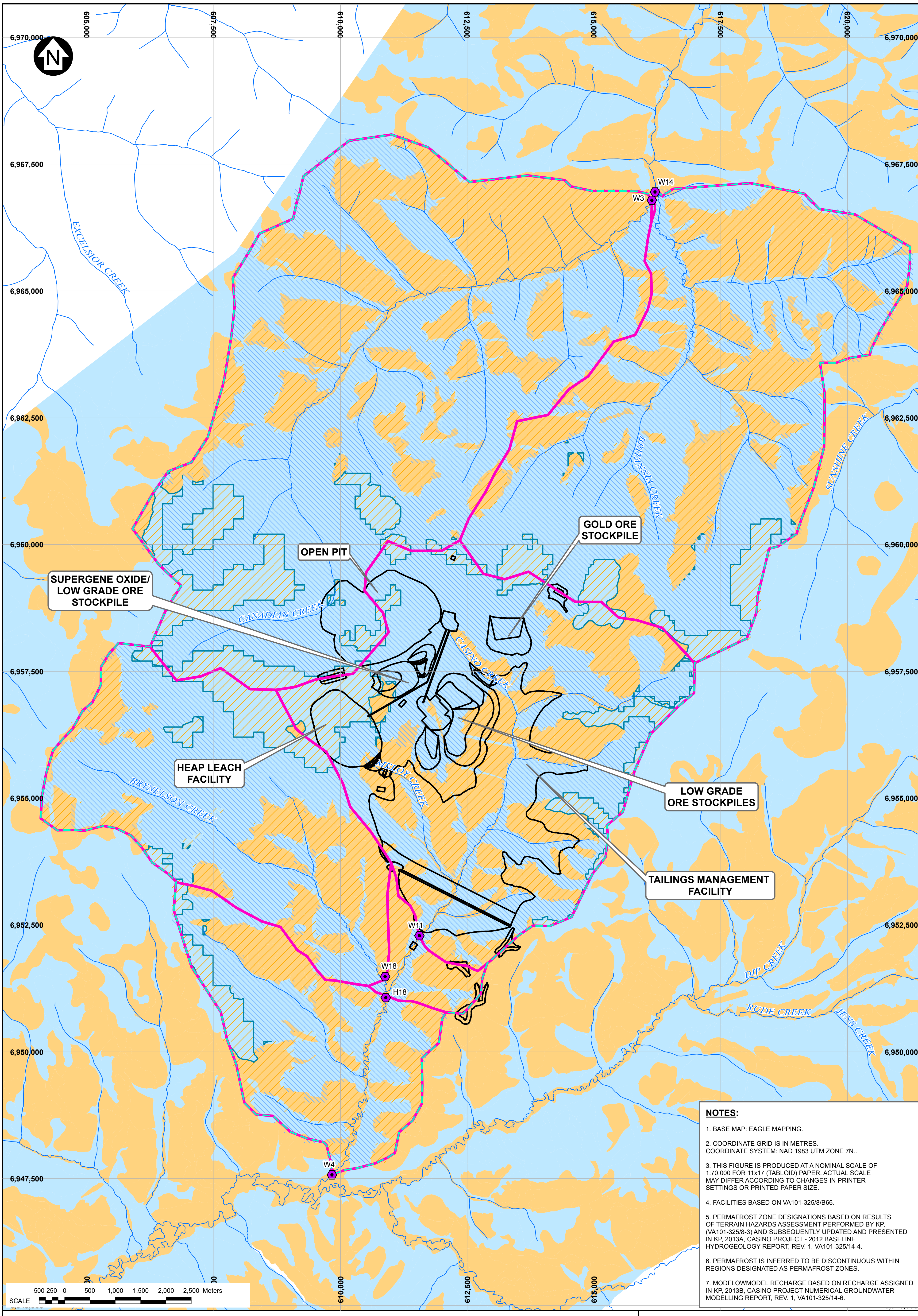
The most recent interpretation of permafrost distribution at the project site is presented in Figure 2.3 of the Hydrogeology Baseline Report (Appendix 7C).

B.7.5.4 R2-114

R2-114. Discussion and display of how the recharge and permafrost areas differ between the data used in the groundwater model and the most recent data.

The recharge distribution assigned to the numerical groundwater model was not *modified*; rather, an earlier interpretation of the permafrost distribution was used as model input. A larger area of the model was assigned recharge than what would have been assigned based on the updated interpretation of permafrost distribution. This additional model area assigned recharge is primarily located upslope of the Heap Leach Facility and within the southwestern headwaters of the Canadian Creek catchment, with smaller areas located in other portions of sub-catchment headwaters. Differences between areas of the Modflow model assigned recharge and the updated interpretation of permafrost distribution are shown on Figure B.7.5-1.

As outlined in the response to R219, and for the reasons presented therein, the present results are considered to be conservative, and the permafrost distribution used to assign model recharge will not updated.



NOTES:

1. BASE MAP: EAGLE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 7N..
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:70,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. FACILITIES BASED ON VA101-325/8/B66.
5. PERMAFROST ZONE DESIGNATIONS BASED ON RESULTS OF TERRAIN HAZARDS ASSESSMENT PERFORMED BY KP, (VA101-325/8-3) AND SUBSEQUENTLY UPDATED AND PRESENTED IN KP, 2013A, CASINO PROJECT - 2012 BASELINE HYDROGEOLOGY REPORT, REV. 1, VA101-325/14-4.
6. PERMAFROST IS INFERRED TO BE DISCONTINUOUS WITHIN REGIONS DESIGNATED AS PERMAFROST ZONES.
7. MODFLOWMODEL RECHARGE BASED ON RECHARGE ASSIGNED IN KP, 2013B, CASINO PROJECT NUMERICAL GROUNDWATER MODELLING REPORT, REV. 1, VA101-325/14-6.

LEGEND:

- STREAMFLOW GAUGING STATION
- RIVER
- BASELINE MODEL EXTENTS
- WATERSHED DIVIDE
- CASINO PROPOSED FACILITIES

PERMAFROST INTERPRETATION (KP, 2013A)

- PERMAFROST
- NO PERMAFROST

MODFLOW MODEL (KP, 2013B)

- PERMAFROST (NO RECHARGE ASSIGNED)
- NO PERMAFROST (ASSIGNED RECHARGE)
- MODFLOW MODEL AND UPDATED PERMAFROST DISTRIBUTION DIFFER

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	25NOV'14	ISSUED WITH REPORT	KTD	AMD	CAS	KJB

CASINO MINING CORPORATION

CASINO PROJECT

INFERRED SPATIAL DISTRIBUTION OF PERMAFROST AND MODFLOW MODEL RECHARGE

Knight Piésold CONSULTING

P/A NO. VA101-325/17

REF NO. 2

FIGURE B.7.5-1

REV 0

SAVED: M:\1\01\00325\17\A\GIS\Figs\InferredSpatialDistribOfPermafrost.mxd; Nov 25, 2014 9:33 AM; adinca

B.7.5.5 R2-115

R2-115. Analysis of potential effects due to the loss of upgradient areas due to the creation of the open pit.

Potential effects on groundwater from the creation of the Open Pit are anticipated to include effects to groundwater elevations and to baseflows discharging to adjacent streams.

As detailed in Section 4.6 of the Numerical Groundwater Modelling Report (Appendix 7E), the Open Pit is expected to have a localized effect on groundwater elevations. Local groundwater drawdown associated with operational dewatering of the Open Pit is predicted to be up to 150 m at the perimeter of the Open Pit (Figure B.7.5-2, inset). Groundwater drawdowns decrease with distance from the perimeter of the Open Pit, and are predicted to be negligible at a distance of two to three kilometers from the perimeter of the Open Pit. Upon closure, the Open Pit will be flooded to maintain a Pit Lake and groundwater elevations immediately surrounding the Open Pit are expected to recover to the water surface elevation of the Pit Lake (1,100 masl; Figure B.6 of Appendix 7E).

MODPATH particle tracking was used to delineate the capture zone of the proposed Open Pit at the predicted maximum extent of de-watering (Year 19) as shown on Figure B.7.5-2. This assessment indicates that the groundwater capture zone of the Open Pit extends into Casino and Canadian Creek watersheds. The groundwater that originates in this capture zone will flow toward the Open Pit during operations. Impacts to baseflows in Canadian Creek were assessed using the Modflow model. Impacts to baseflows in Canadian Creek were assessed at hydrology station W3 located on Canadian Creek at the confluence with Britannia Creek and approximately 12 km downstream of the ultimate northern extent of the Open Pit rim. Average annual baseflow (groundwater discharge to surface) at hydrology station W3 was estimated to be approximately 100 L/s in baseline conditions. Baseflow reductions at hydrology station W3 when the Open Pit is at its maximum extent are estimated to be approximately 6 L/s, equivalent to a 6% decrease in flows. Baseflow reductions at hydrology station W3 are expected to be less than 6 L/s during other phases of the mine life. Changes in baseflows to upper Casino Creek were not explicitly assessed since this stream segment flows into the TMF.

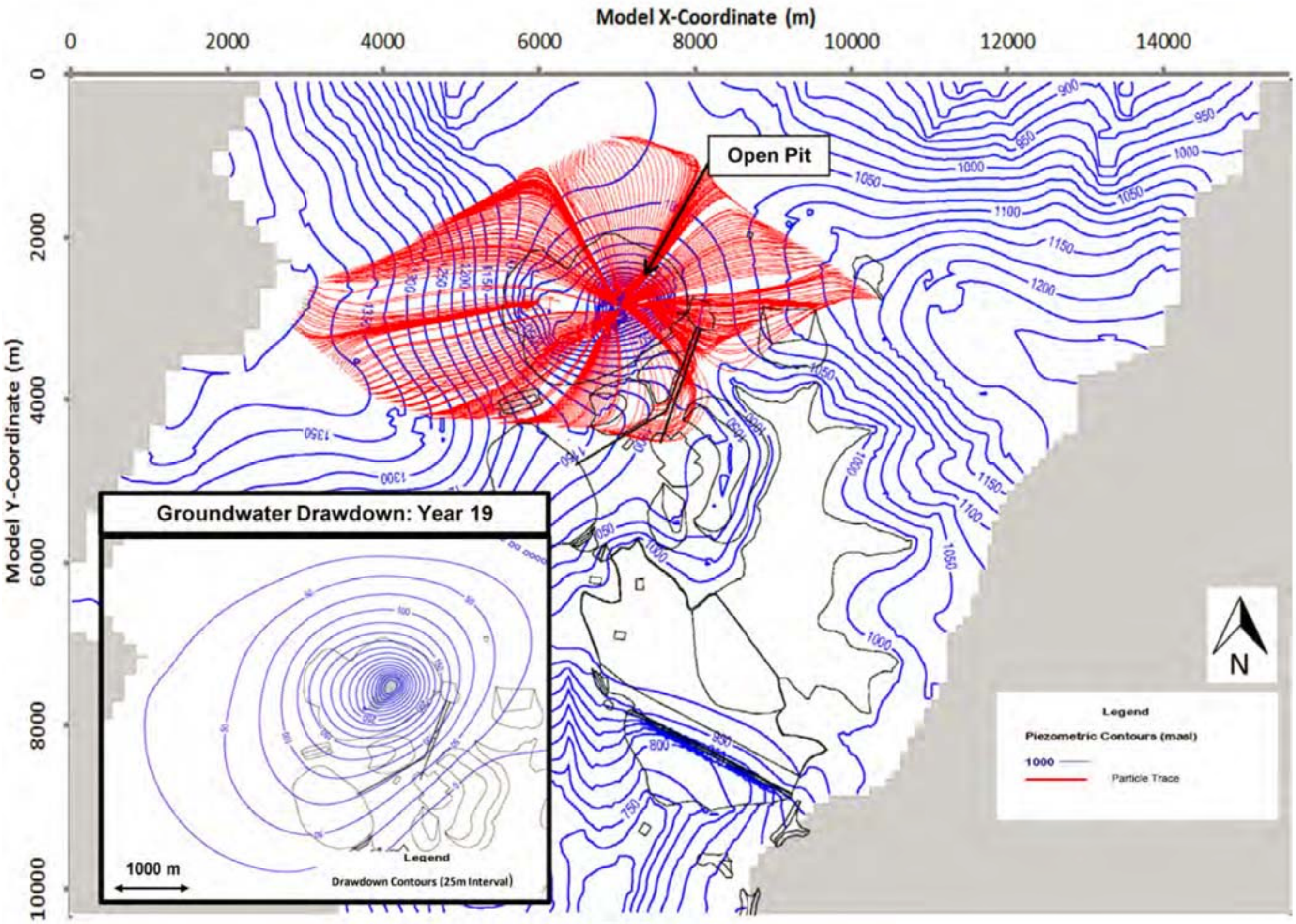


Figure B.7.5-2 MODPATH Delineation of Open Pit Capture Zone

B.7.5.6 R2-116

R2-116. An analysis to justify modelling the hydrogeologic system at the Casino Mine using a porous media approach rather than a discrete fracture system approach.

The equivalent porous media (EPM) approach is commonly used to describe groundwater flow in fractured rock, based on the assumption that at a sufficiently large scale (i.e., at a Representative Elementary Volume (REV)) the bedrock mass will behave like a porous medium. Other model types, i.e., a Discrete Fracture Network (DFN) or Dual Porosity Model (DPM), should be used when the modelling objectives, data set, and/or conceptual hydrogeologic model warrant the use of one of these approaches.

A groundwater modelling guideline was recently published by the province of British Columbia: Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural resource Development Activities (British Columbia Ministry of Environment, 2012). As stated in these guidelines:

- These guidelines generally recommend the use of the EPM approach for groundwater modelling in support of natural resource projects in fractured bedrock settings but the application must be reasonably justified (e.g., supporting site data, simple objectives, etc.).

- DFN or DPM approaches should be considered in projects where the modelling objectives justify these approaches (e.g. contaminant transport in fractured bedrock with high risk/consequence) and the supporting site characterization data is available.

No large-scale structures with elevated permeability have been identified in the footprint of the TMF that warrant the use of a discrete fracture modelling approach. CMC does not believe further analysis to justify the modelling approach is warranted.

B.7.5.7 R2-117

R2-117. Clarification on if, and how much, groundwater will flow into Brynelson Creek and its tributaries from the TMF and an analysis of any potential effects.

As detailed in the Numerical Groundwater Modelling report (Appendix 7E), a seepage assessment using MODPATH particle tracking was conducted to assess the rate of foundation seepage beneath the TMF West Embankment and through the topographic knob between embankments ("West Embankment foundation seepage"). The West Embankment foundation seepage assessment was conducted using the Post-Closure model (using 'Model 2') since the mine plan indicates that the elevation of the supernatant pond is expected to approach the West Embankment only slightly before Year 19 (Appendix A).

Simulation results indicate that foundation and embankment seepage originating from the West Embankment is estimated to be approximately 5 to 6% of the total Post-Closure seepage from the TMF. The total seepage is estimated to be comprised of approximately 1.4 L/s foundation seepage (6% of the total Post-Closure TMF foundation seepage) and approximately 0.8 L/s embankment seepage (5% of the total Post-Closure embankment seepage). Simulation results indicate that West Embankment foundation seepage originates from the Non-PAG tailings unit and that it discharges to the tributary southwest and downslope of the West Embankment and into Brynelson Creek.

B.7.6 TRANSPARENCY OF WATER QUALITY PREDICTIONS

B.7.6.1 R2-118

R2-118. Discussion and comparison of 2013 and 2014 water quality baseline data collected with water quality baseline data used in the water quality model. Discuss variations in the data and where necessary, implications to the predictions from the water quality model.

The range of baseline water quality and sediment quality values, collected throughout 2008 - 2012, as well as a discussion of the seasonal variability of the baseline data, is provided in the Water and Sediment Quality Baseline Report (Appendix 7A). To evaluate the water quality results of samples collected in 2013/2014, the 2013/2014 median concentrations were compared to the 25th percentile, median and 75th percentile values of the 2008-2012 baseline data. The 2013/2014 data is considered comparable to the 2008-2012 data if the data falls within the 25th to 75th percentile range. The data is presented in Figure B.7.6-1 through Figure B.7.6-17 in descending order downgradient from the Open Pit location. Values for W43 and W13 in the Casino watershed, W22 in the Dip Creek watershed, W3, W14, W2, and W1 in the Britannia Creek watershed and all sites in the Klotassin and Yukon River watersheds are not shown in the figures below, as no samples were collected at these sites in 2013/2014.

General chemistry parameters, including pH, alkalinity, hardness, conductivity and total suspended solids are shown in Figure B.7.6-1 through Figure B.7.6-5. Nutrients (nitrogen and phosphorus compounds) and organic matter parameters are shown in Figure B.7.6-6 and Figure B.7.6-7. Select anions (fluoride and sulphate) are shown in Figure B.7.6-8 and Figure B.7.6-9. Total metal parameters are shown in Figure B.7.6-10 through Figure B.7.6-17.

As shown in the figures below, the 2013/2014 data falls within the 2008-2012 dataset for the majority of parameters, at the majority of sample sites, and hence the 2008-2012 dataset continues to be representative of the baseline water quality. Note that water quality sampling site W7 was moved in 2013; hence water quality results vary slightly from the results of the 2008-2012 water quality sampling. The water quality model does not require to be updated, as the 2013/2014 data fits well within the baseline dataset used in the model.

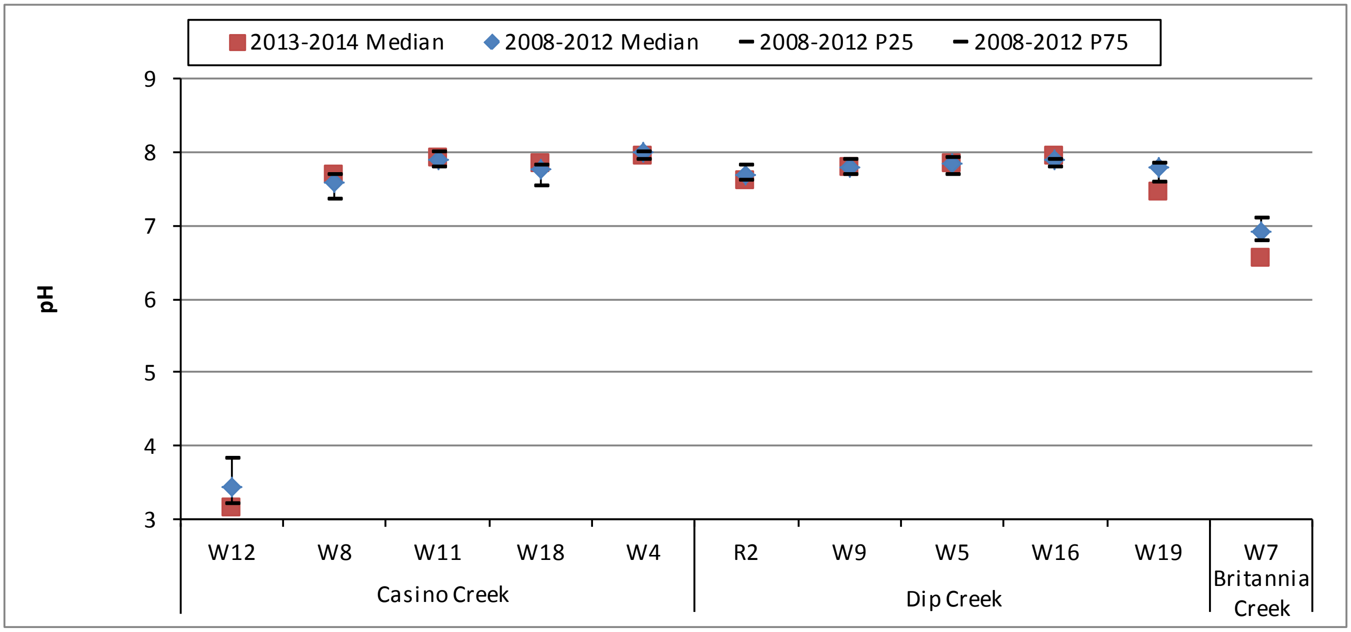


Figure B.7.6-1 Comparison of 2013-2014 Median pH to the 2008-2012 Baseline Dataset

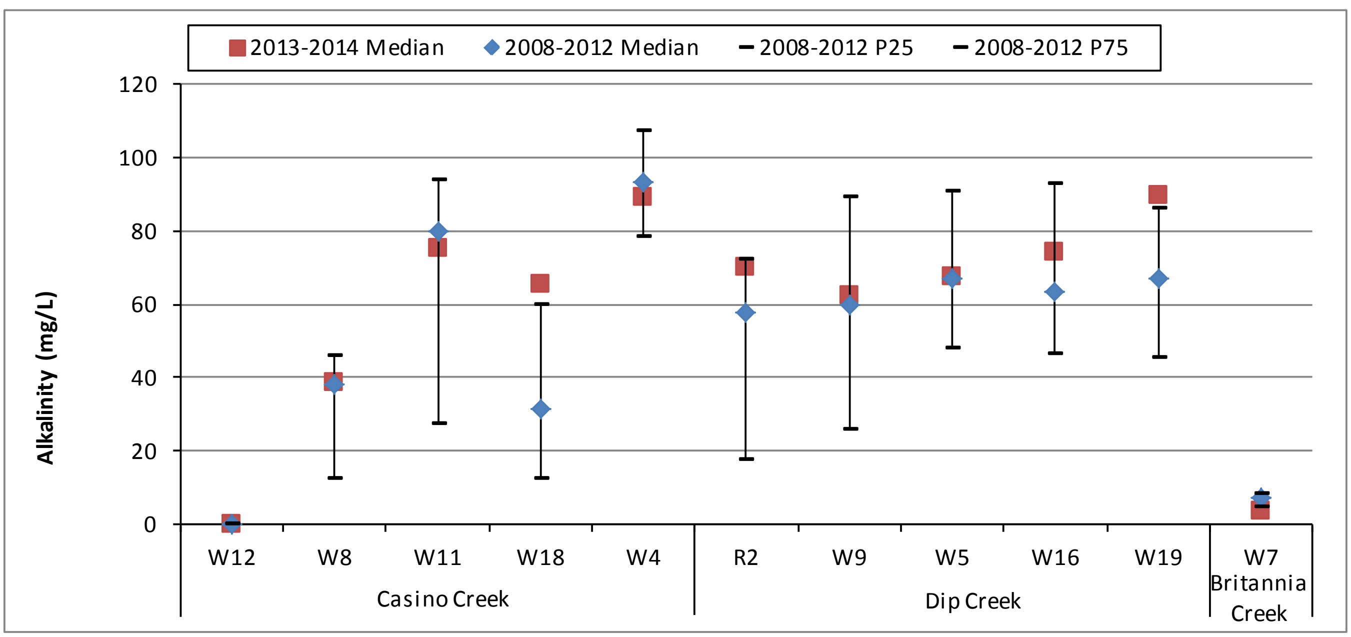


Figure B.7.6-2 Comparison of 2013-2014 Median Alkalinity to the 2008-2012 Baseline Dataset

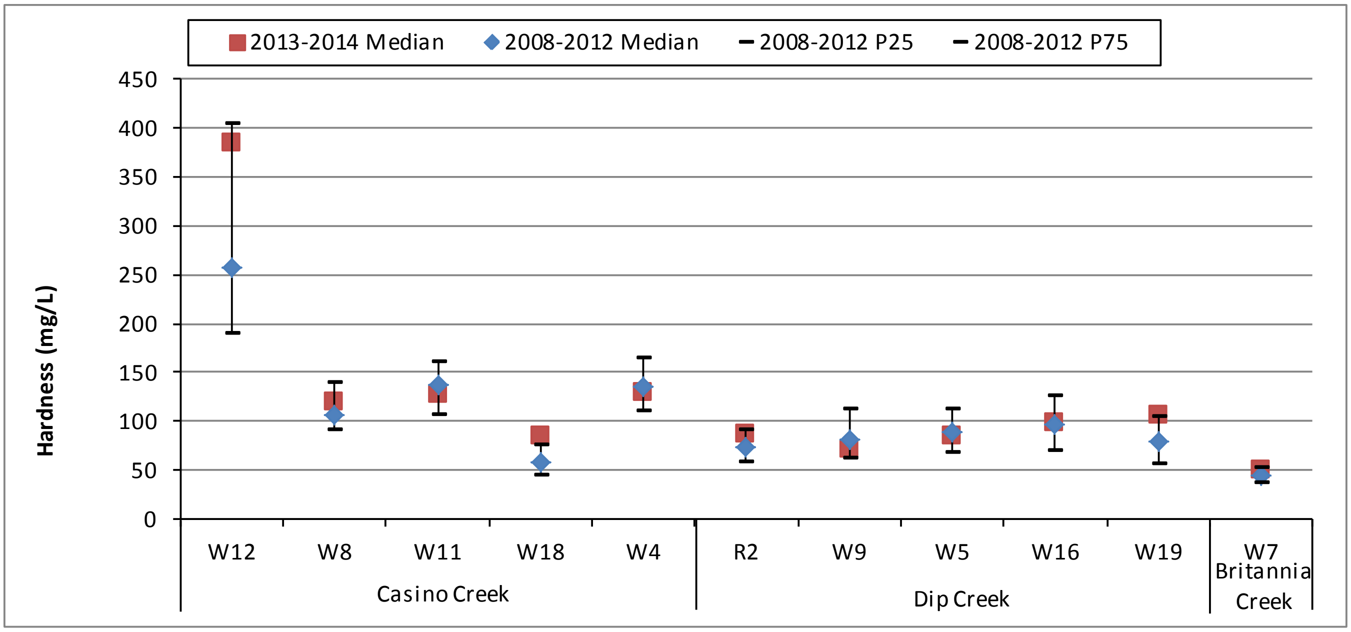


Figure B.7.6-3 Comparison of 2013-2014 Median Hardness to the 2008-2012 Baseline Dataset

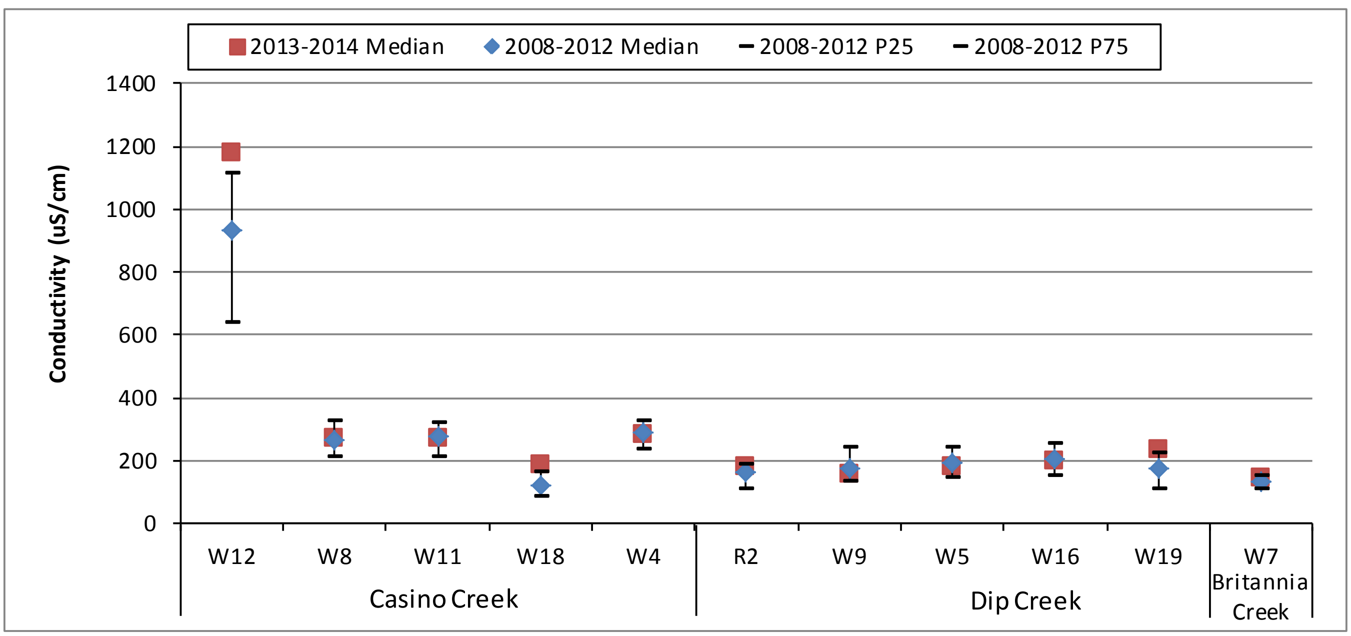


Figure B.7.6-4 Comparison of 2013-2014 Median Conductivity to the 2008-2012 Baseline Dataset

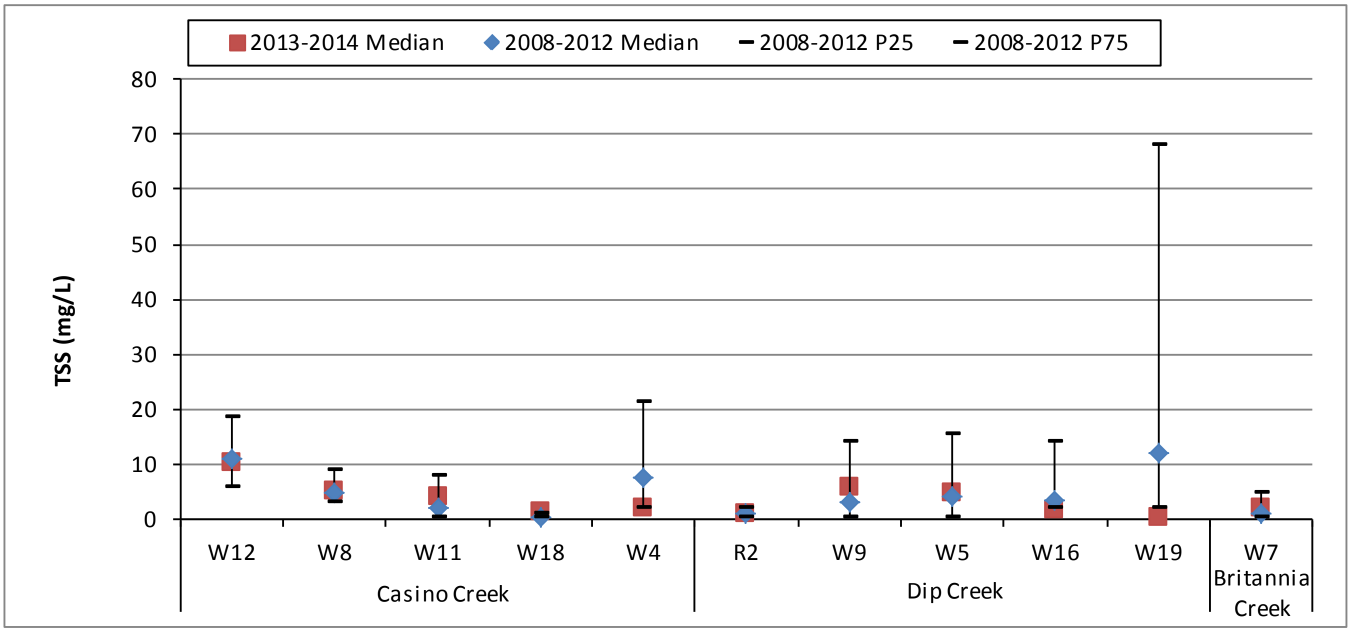


Figure B.7.6-5 Comparison of 2013-2014 Median TSS to the 2008-2012 Baseline Dataset

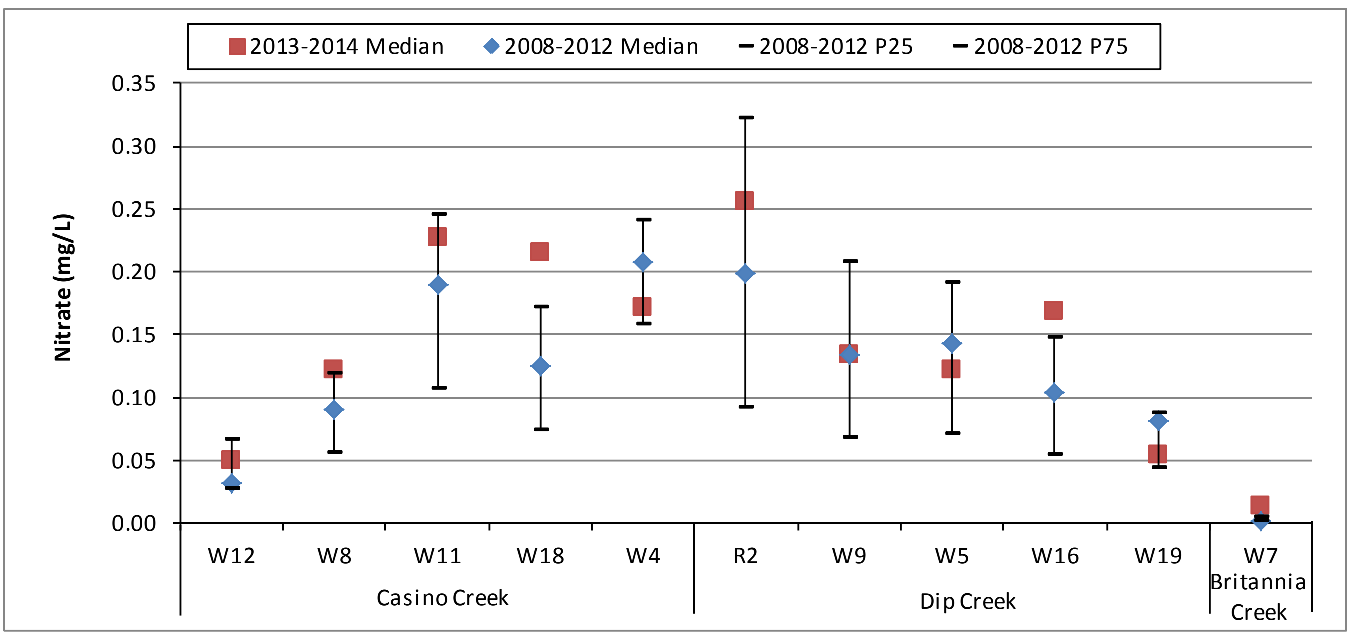


Figure B.7.6-6 Comparison of 2013-2014 Median Nitrate to the 2008-2012 Baseline Dataset

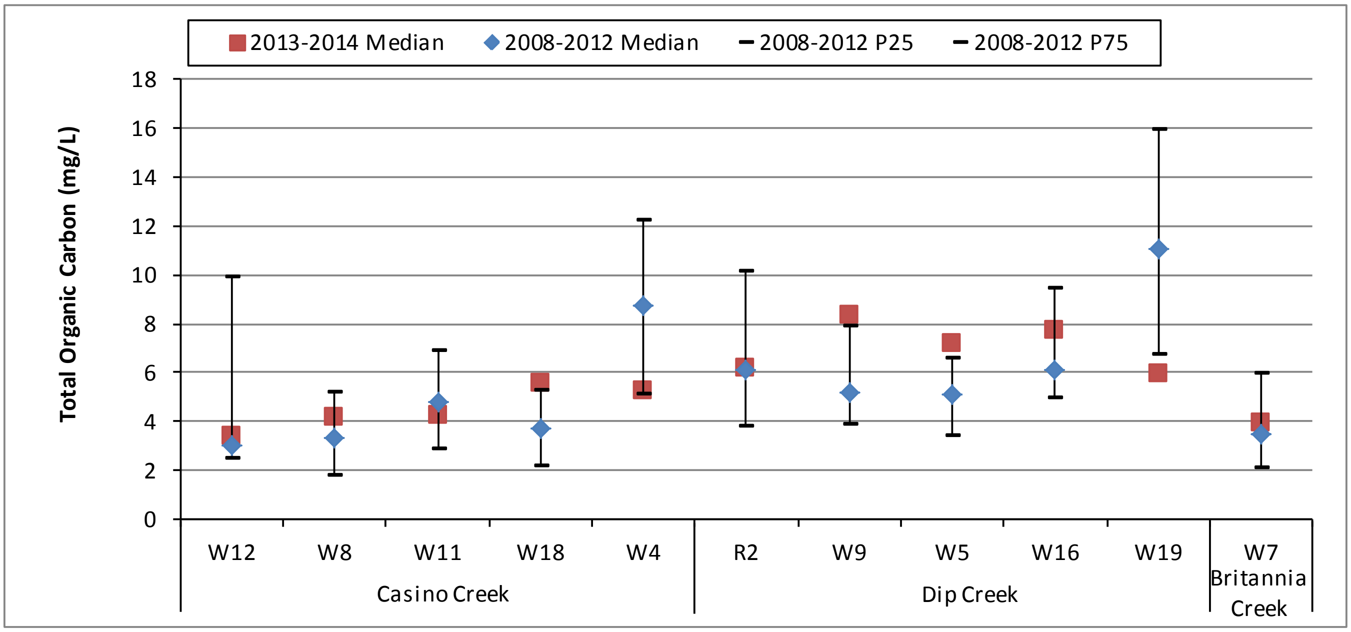


Figure B.7.6-7 Comparison of 2013-2014 Median TOC to the 2008-2012 Baseline Dataset

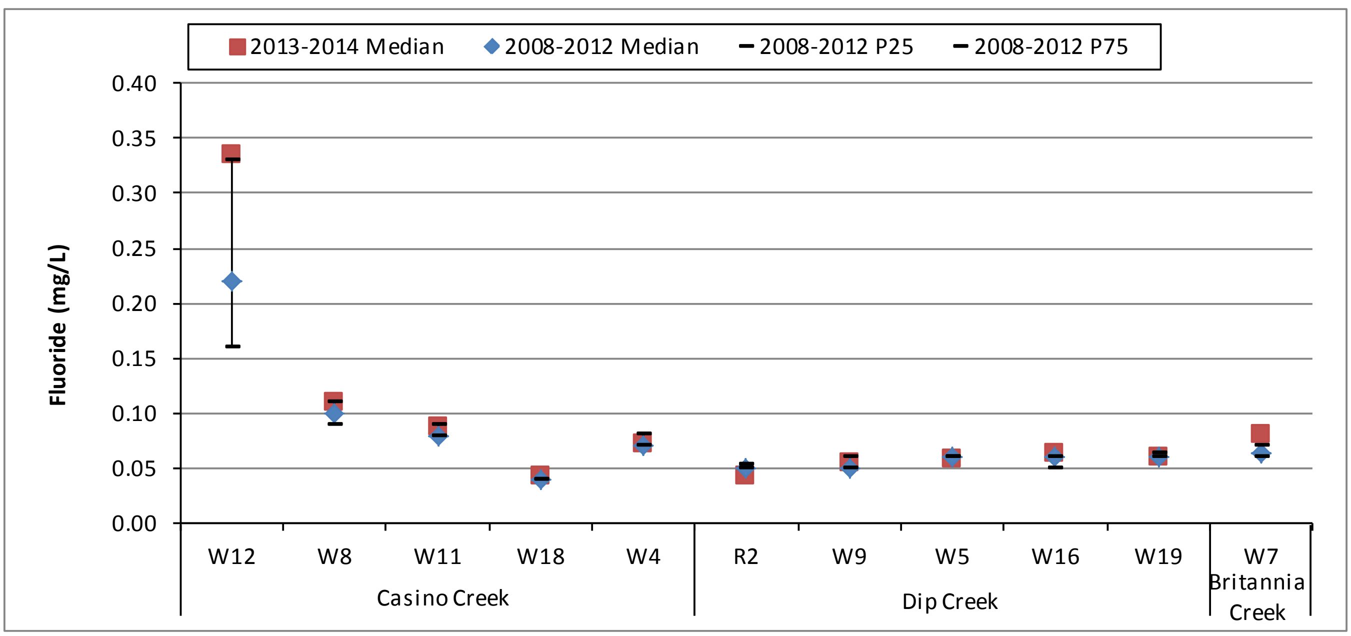


Figure B.7.6-8 Comparison of 2013-2014 Median Fluoride to the 2008-2012 Baseline Dataset

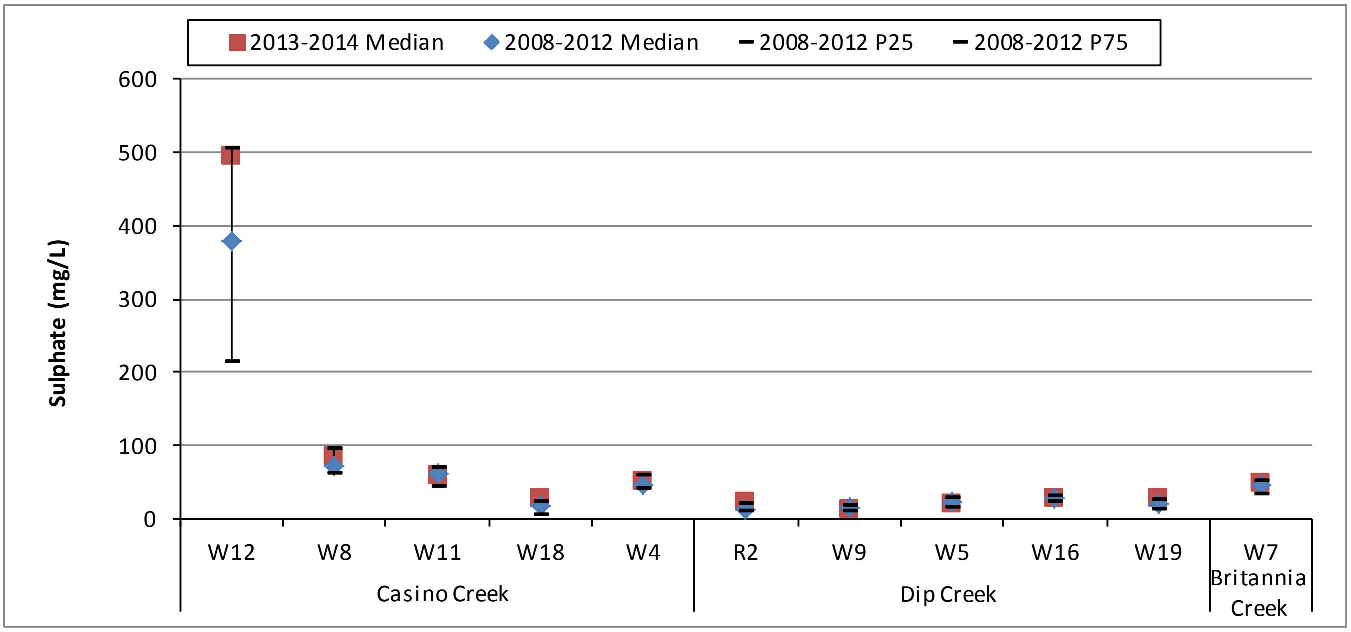


Figure B.7.6-9 Comparison of 2013-2014 Median Sulphate to 2008-2012 the Baseline Dataset

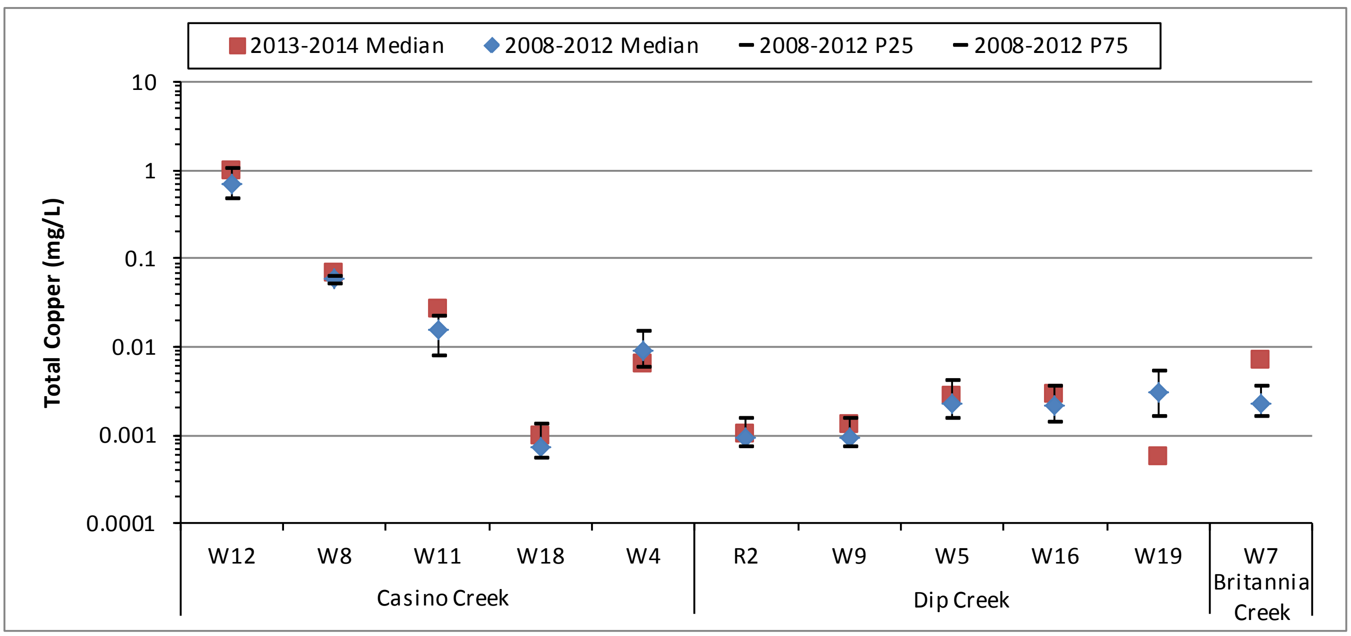


Figure B.7.6-10Comparison of 2013-2014 Median Total Copper to the 2008-2012 Baseline Dataset

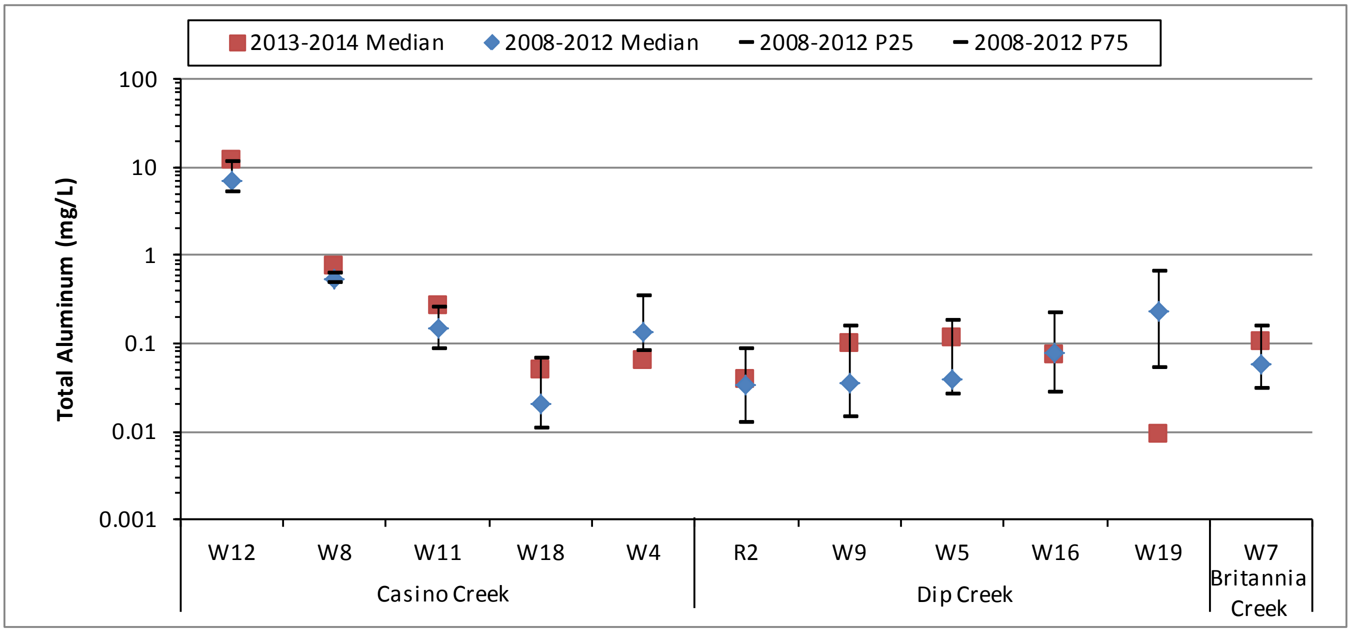


Figure B.7.6-11Comparison of 2013-2014 Median Total Aluminum to the 2008-2012 Baseline Dataset

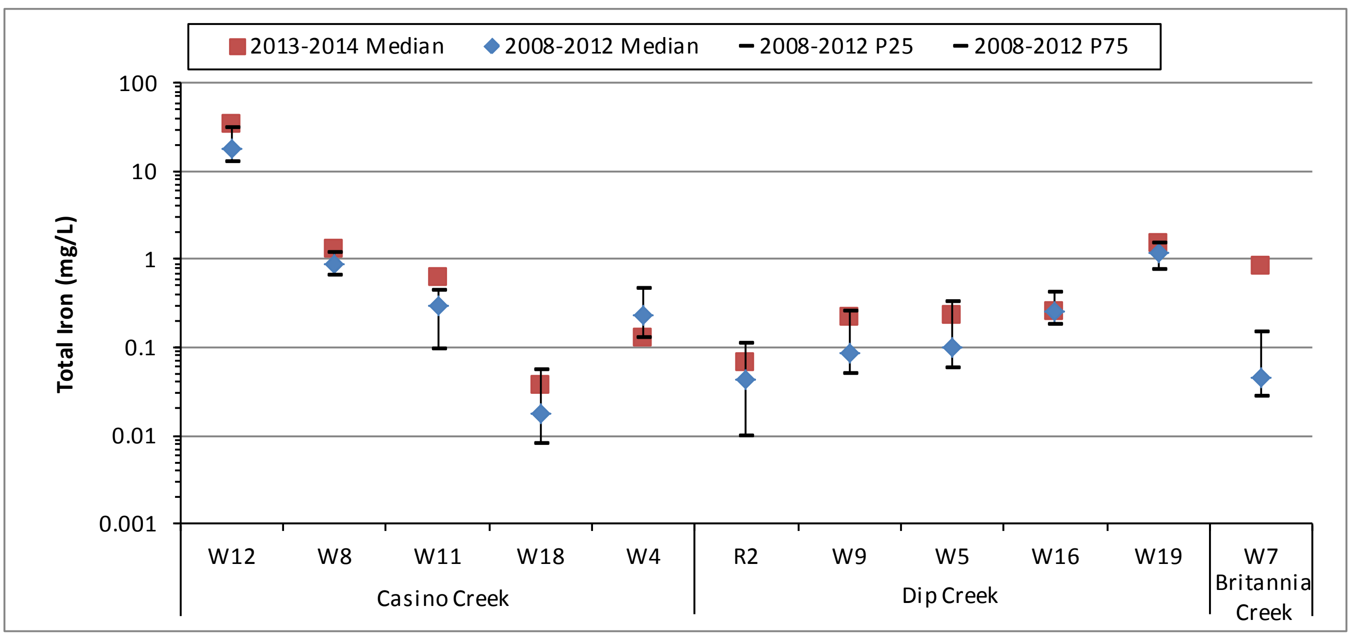


Figure B.7.6-12Comparison of 2013-2014 Median Total Iron to the 2008-2012 Baseline Dataset

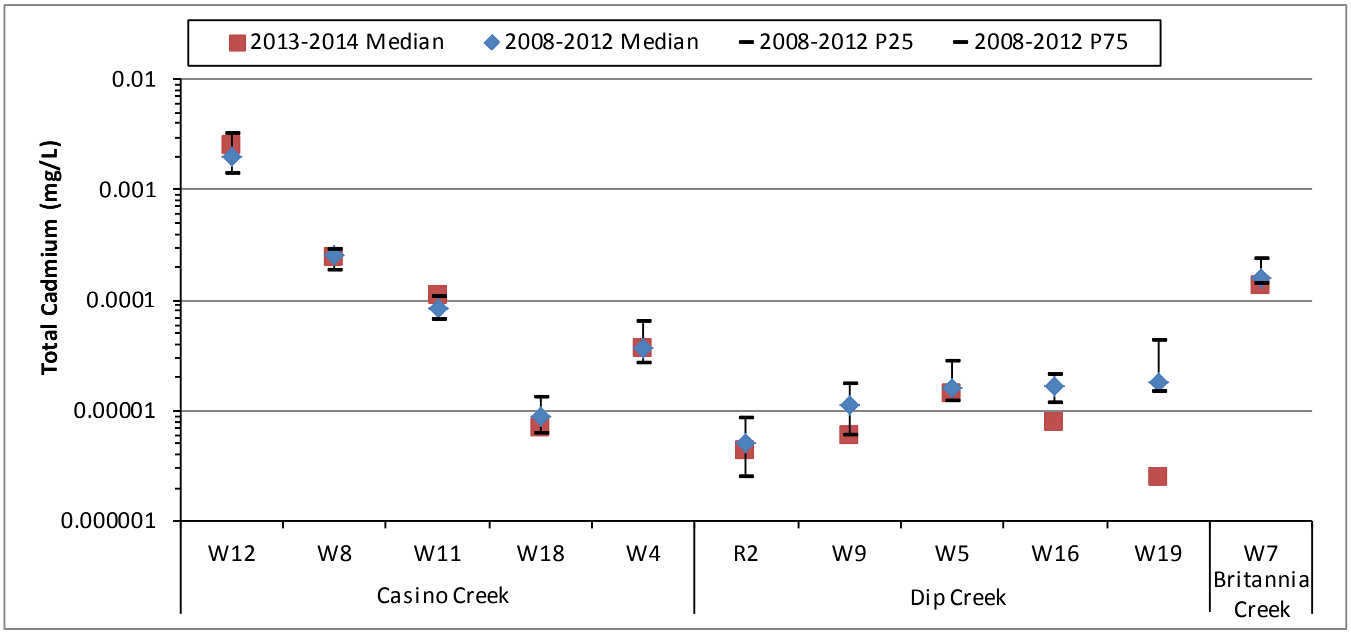


Figure B.7.6-13Comparison of 2013-2014 Median Total Cadmium to the 2008-2012 Baseline Dataset

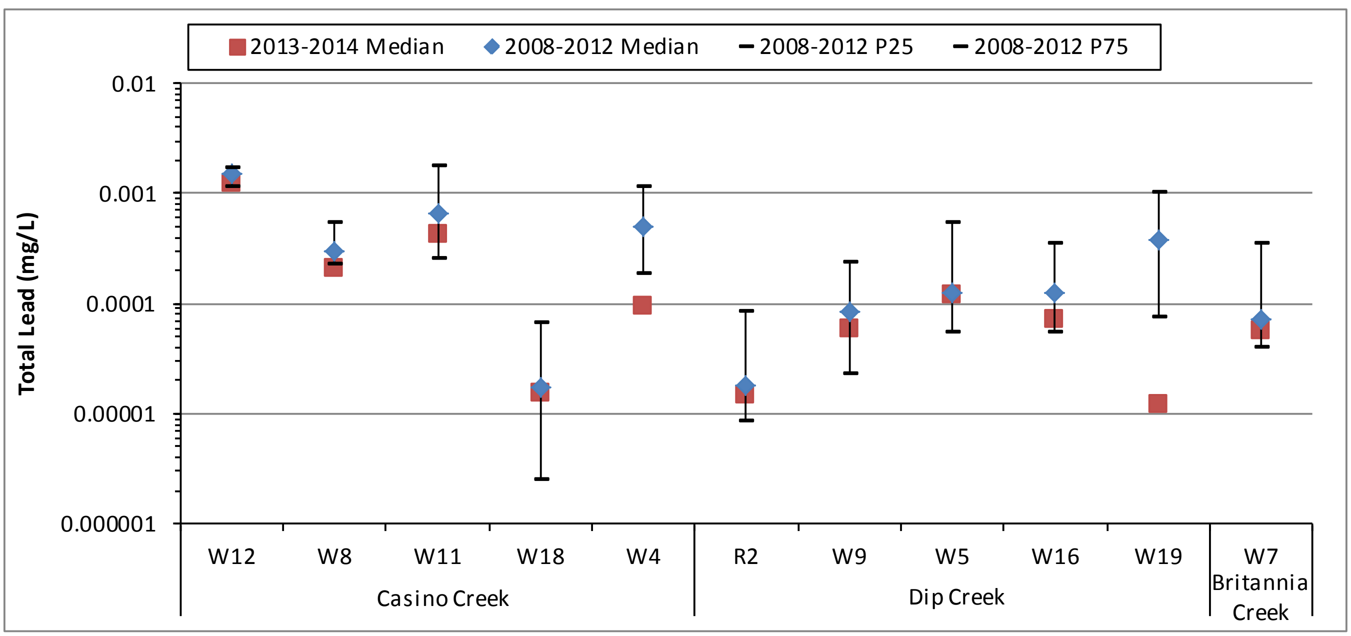


Figure B.7.6-14Comparison of 2013-2014 Median Total Lead to the 2008-2012 Baseline Dataset

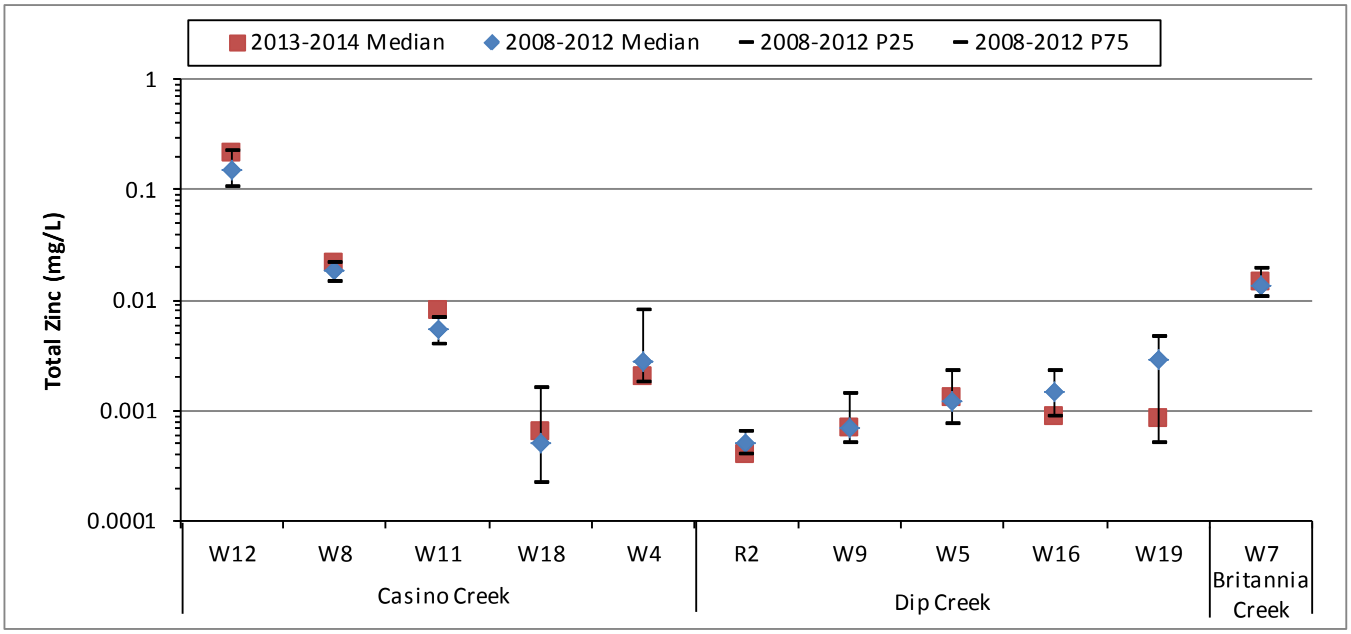


Figure B.7.6-15Comparison of 2013-2014 Median Total Zinc to the 2008-2012 Baseline Dataset

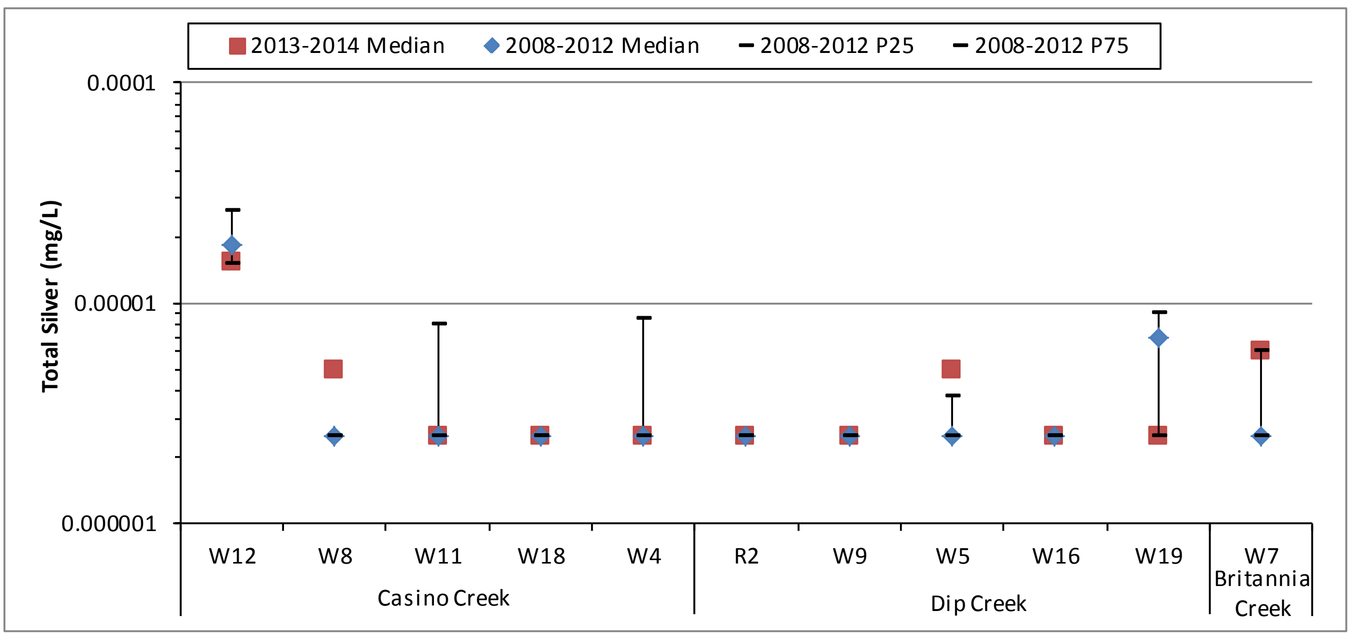


Figure B.7.6-16Comparison of 2013-2014 Median Total Silver to the 2008-2012 Baseline Dataset

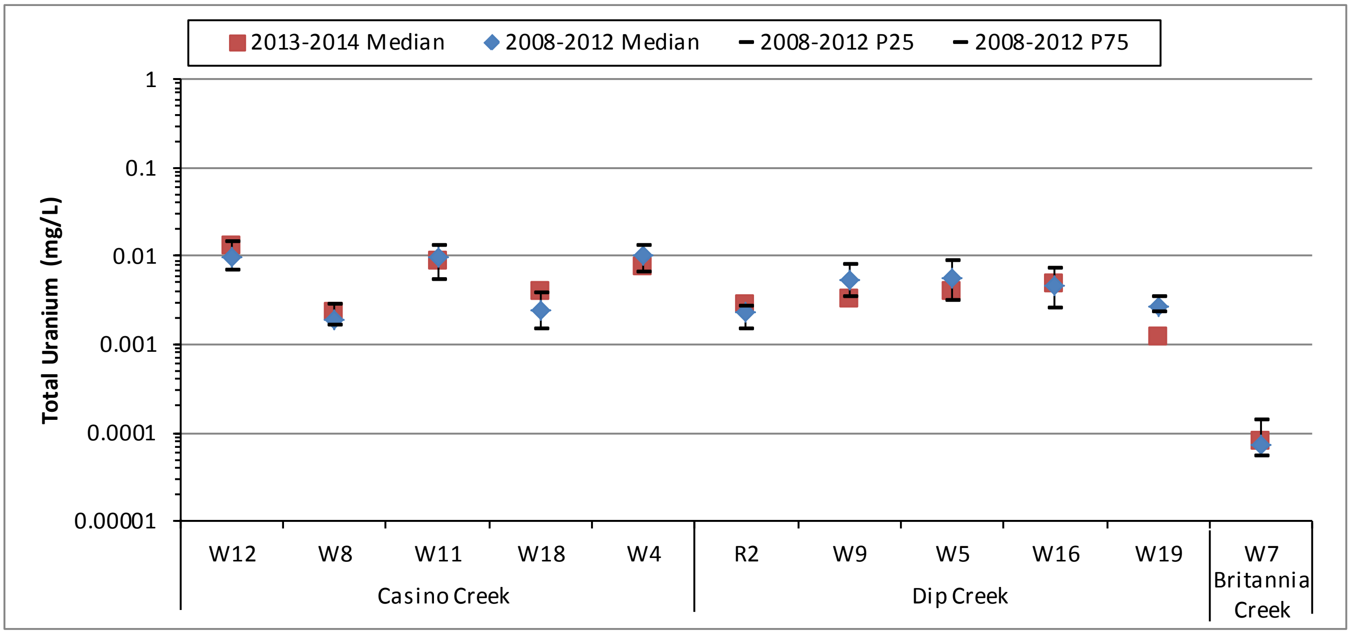


Figure B.7.6-17 Comparison of 2013-2014 Median Total Uranium to the 2008-2012 Baseline Dataset

B.7.7 METAL MINING EFFLUENT REGULATIONS

B.7.7.1 R2-119

R2-119. Provide a discussion on how water quality predictions in the tailings management facility pond and water management pond will address the requirements under the Metal Mining Effluent Regulations with regards to radium-226.

Schedule 4 of the Metal Mining Effluent Regulations (MMER) specifies the deleterious substances and the maximum prescribed limits under which these substances may be discharged in mine effluent. The maximum allowable monthly mean concentration of Ra-226 in mine site discharge is 0.37 Bq/L (MMER Schedule 4, 2002).

A complete dataset of baseline water quality and source terms was not available for inclusion of Ra-226 in the water quality model. In place of Ra-226 model output, modelled uranium (U) concentrations were used as a proxy for Ra-226, under the assumption that the presence of Ra-226 would occur proportionally to U levels at the site. Source terms are derived from upscaling kinetic loading rates and applying thermodynamic solubility controls (Appendix 7D). Kinetic data is calibrated to observed drainage at other minesites and Casino on-site field bins, which are large drums filled with representative samples of hypogene, supergene and leach cap waste rock, exposed to atmospheric conditions.

To evaluate the proportion of U to Ra-226 concurrent water quality data from the baseline dataset was calculated. Surface water quality samples were collected on September 7, 2011 and field bin samples were collected on August 13, and September 24, 2015, and each sample was analyzed for total U and Ra-226 (Table B.7.7-1 and Table B.7.7-2). The Ra-226 results from all surface water samples and most field bin samples were below the analytical detection limit (ADL) of 0.01 Bq/L. Samples from 4 of the field bins (FB5 – FB8; Neutral SUP, Moderate S HYP, High S HYP and Moderate S HYP) were found to have detectable Ra-266. For the purpose of this assessment, the average Ra-266 of the six samples with values above the ADL was calculated to be 0.030 Bq/L, less than 10% of the MMER limit. The average uranium concentration in those same six samples was measured to be 0.139 mg/L, resulting in a U to Ra-266 ratio of 0.46 mg/L of U per 0.1 Bq/L of Ra-226.

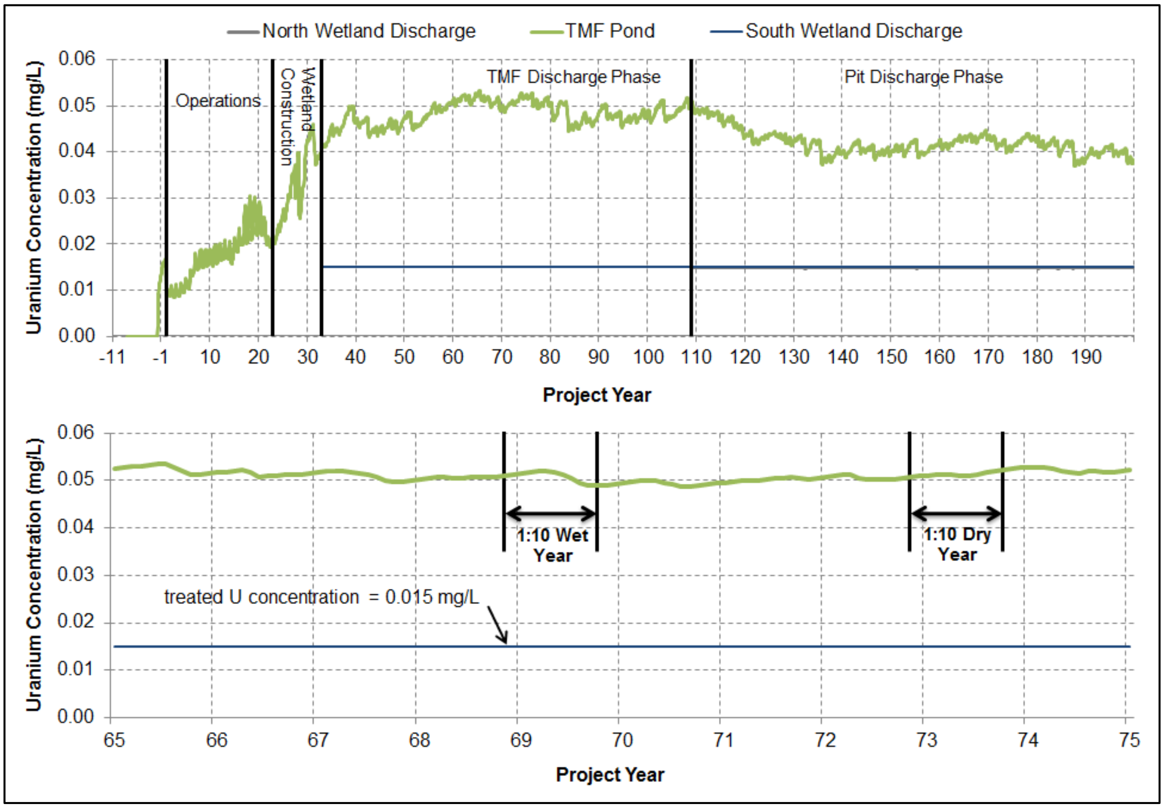
Water quality model output for U are shown in Figure B.7.7-1 for the TMF pond, and Figure B.7.7-2 in the water management pond. The highest predicted U concentration remained under 0.07 mg/L, which would correspond to a Ra-226 level of 0.02 Bq/L or less (i.e. 4% of the MMER limit). The results of this evaluation indicate that Ra-226 is not expected to exceed MMER limits in the TMF or WMP. If monitoring of the Casino operations begins to show Ra-226 values exceeding 0.1 Bq/L (i.e., 10x the detection limit, but still less than one-third the MMER limit), additional investigations will be undertaken to identify the source(s) of the Ra-226 and determine whether any mitigation strategies are warranted.

Table B.7.7-1 Concurrent radium-226 and Uranium Concentrations on September 7, 2011

Water Quality Sampling Station	Station Name	Results of Analysis	
		Ra-226 (Bq/L)	Total Uranium (mg/L)
W8	Casino Creek	< 0.01	0.001810
W11	Casino Creek	< 0.01	0.008290
W43	Adit Discharge	< 0.01	0.000765
W12	Proctor Gulch	< 0.01	0.007680
W7	Upper Canadian Creek	< 0.01	0.000056
W7	Upper Canadian Creek	< 0.01	0.000054

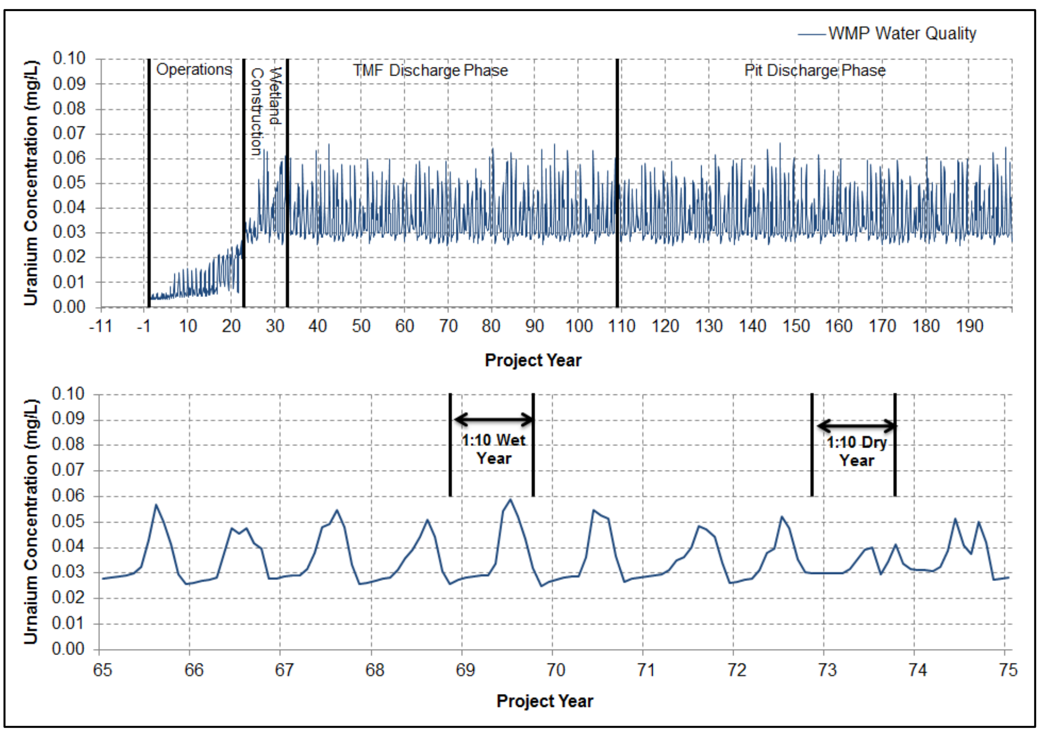
Table B.7.7-2 Concurrent radium-226 and Uranium Concentrations for Field Bin samples

Sample Name	Sample Location	Sample Date	Results of Analysis	
			Ra-226 (Bq/L)	Total Uranium (mg/L)
FB1	Field Bin 1	Aug-13-2015	<0.01	0.000117
FB1	Field Bin 1	Sep-24-2015	<0.01	0.000104
FB4	Field Bin 4	Aug-13-2015	<0.01	0.004800
FB4	Field Bin 4	Sep-24-2015	<0.01	0.009660
FB5	Field Bin 5	Aug-13-2015	0.044	0.234000
FB5	Field Bin 5	Sep-24-2015	0.03	0.253000
FB6	Field Bin 6	Sep-24-2015	0.018	0.092100
FB7	Field Bin 7	Aug-13-2015	0.06	Not analyzed
FB7	Field Bin 7	Sep-24-2015	0.032	0.119000
FB8	Field Bin 8	Aug-13-2015	0.032	0.070300
FB8	Field Bin 8	Sep-24-2015	0.026	0.067200
		Average of values >ADL	***0.030***	***0.139267***



Source: Appendix A.7B: SEA Ltd, Casino Project Water Quality Predictions, Feb 23, 2015, Appendix IV, Figure 6-8.

Figure B.7.7-1 Modelled Uranium Water Quality in the TMF



Source: Appendix A.7B: SEA Ltd, Casino Project Water Quality Predictions, Feb 23, 2015, Appendix V, Figure 6-9.

Figure B.7.7-2 Modelled Uranium Water Quality in the WMP

B.7.8 SUBMERGENCE OF PAG MATERIALS

B.7.8.1 R2-120

R2-120. A detailed description and characterization of the conditions of core material used in kinetic test work. Details should include:

a. storage conditions (e.g. degree of exposure to moisture); and

b. state of weathered core relative to release of contaminants of potential concern.

a. Core from the Casino Project is stored in closed core boxes that are stacked or placed in racks under cover. An example of the storage arrangement is illustrated in the photograph below (Figure B.7.8-1). While the core boxes will limit infiltration of meteoric water to some degree, it is expected that some precipitation will infiltrate into core boxes.

b. While drill core is exposed at the surface in core boxes, it will be subjected to some of the same weathering processes that will take place in an unsaturated waste storage environment (*e.g.*, waste rock dump). Oxidation of exposed sulphide minerals will lead to build up of oxidation products on surfaces and consumption of NP. This will lead to an overestimation of the water soluble metal load estimated in laboratory testwork.

Figure B.7.8-1 Stacked Core Storage at Casino Project Site

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B.8 – AIR QUALITY

B.8.1 INTRODUCTION

Section 8 of the Proposal evaluated the potential effects of the Project on air quality. Air quality is defined in the Proposal for the Casino Project (the Project) as the composition of outdoor air. Air quality was selected by Casino Mining Corporation (CMC) as a Valued Component (VC) because mining activities such as fuel consumption, vehicle movement, and material transfer generate air emissions that could cause deterioration of ambient air quality. As well, 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. Major air pollutants that were assessed include sulphur dioxide, nitrogen dioxide, carbon monoxide and particulate matter, as well as Greenhouse Gases (GHG).

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has six requests related to information presented in Section 8 Air Quality of the Proposal submitted on January 3, 2014 and in Section 8.A of the SIR-A as well as supporting appendices. These requests, and the sections of the SIR-B where the responses can be found, are outlined in Table B.8.1-1 and the responses are provided below.

The effects assessment presented in the Project Proposal concluded that the Casino Project is not likely to have significant adverse effects on air quality after the implementation of mitigation measures. The air quality predictions from the model are the "best estimate" available to inform YESAB's decision making with respect to air quality effects from the Project. The responses provided herein do not change the conclusions stated in the Proposal.

Table B.8.1-1 ARR No.2 Requests for Supplementary Information Related to Air Quality

Request #	Request for Supplementary Information	Response
R2-123	The data inputs, as requested by ARCADIS and noted above, for the air quality model.	Section B.8.2.1.1
R2-124	Mitigations to reduce or eliminate the frequency and extent of air quality exceedances modeled including evidence for each mitigation's effectiveness.	Section B.8.2.2.1
R2-125	Unclassed air quality model outputs in a standard GIS format.	Section B.8.2.2.2
R2-126	Predicted change in dust composition during construction and operations.	Section B.8.3.1.1
R2-127	Discussion on additional dust sources such as project induced wind-based erosion, blasting, and traffic in relation to dust quantity, including details on the inclusion of these sources in air quality modeling.	Section B.8.3.1.2

Request #	Request for Supplementary Information	Response
R2-128	Water requirements for dust management and dust prevention strategies and details on any water additives.	Section B.8.3.1.3

B.8.2 AIR QUALITY MODELLING

B.8.2.1 Model Inputs

B.8.2.1.1 R2-123

R2-123. The data inputs, as requested by ARCADIS and noted above, for the air quality model.

As stated in the response to R262, CMC provided supporting data for the CALPUFF and CALMET models in the form of a detailed emissions inventory, including the data inputs for the construction and operation phase Project activities with potential emissions sources in Appendix A.8A Emissions Inventory for Construction and Operations. As detailed in the Draft Proponent's Guide: Model Documentation (YESAB, 2015), required model documentation should include the information listed in the left-hand column of Table B.8.2-1. According to YESAB, "the draft guide is intended for proponents planning projects that use modeling to predict project effects and describes the general information YESAB will require in the project proposal" (YESAB, 2015). CMC did not submit a standalone air quality model report, as the Draft Proponent's Guide: Model Documentation (YESAB, 2015) was not available at the time of Proposal submission. In the absence of Yukon specific air quality modelling guidelines, best available practices from other jurisdictions were adopted for the Casino Proposal, including the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (BC MOE, 2008).

CMC believes that information provided in the Proposal and SIR A meets these information requirements, as listed in the right-hand column of Table B.8.2-1. Furthermore, CMC believes that replicating the air quality model is not warranted and will not further assist the Executive Committee to determine the appropriateness of the model and its predictions. The model input files have not been provided; however, further details on wind data, as requested, are provided below.

Table B.8.2-1 Model Documentation Provided for the Air Quality Model

Model Document Report Requirement*	Location of Documentation Provided
Description of the objective and scope of the model.	Section 8: Air Quality
Discussion of model selection, its applicability, limitations, and key assumptions.	Section 8.4: Project Specific Effects
Description of model conceptualization and modeling approach.	Section 8.4: Project Specific Effects
Summary of input data (e.g. baseline data) including derivation, uncertainty, documentation and source.	Section 8.3: Baseline Conditions Section 8.4: Project Specific Effects Appendix A.8A: Emissions Inventory for Construction and Operations
Summary of model parameters (e.g. dispersion rates of particulate in an air quality model) including derivation,	Section 8.4: Project Specific Effects Appendix A.8A: Emissions Inventory for Construction

Model Document Report Requirement*	Location of Documentation Provided
uncertainty, documentation, and source.	and Operations
Description of model validation and calibration including (if applicable) history matching, ground truthing, sensitivity analyses, comparison between synthetic and measured values etc	Section 8.4: Project Specific Effects
Presentation and discussion of model outputs including (if applicable) confidence, alternative scenarios, etc.	Section 8.4: Project Specific Effects

*From YESAB, 2015

As described in the Baseline Climate Report (Appendix 8A), wind speed and direction are measured on-site at the Casino climate station and data were provided from November 2008 through September 2012. A regional analysis to account for long-term variability in wind conditions was not deemed necessary as the measured site data are considered to be reasonably representative of expected long-term conditions.

The Project site wind speed data are presented in Table B.8.2-2. The mean annual wind speed 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 (see Table B.8.2-3, Figure B.8.2-1 and Figure B.8.2-2)

Table B.8.2-2 Monthly Wind Speed at the Project Site Climate Station 2008-2012

Year	Wind Speed (m/s)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	-	-	-	-	-	-	-	-	-	-	1.8	1.5
2009	2.0	2.0	2.9	2.2	2.5	2.7	2.5	2.4	2.2	2.3	1.6	1.5
2010	1.7	1.8	3.0	2.8	2.6	2.5	2.4	2.2	2.4	2.4	1.7	2.1
2011	-	-	2.0	2.7	2.9	2.4	2.2	2.3	2.5	1.9	1.7	2.2
2012	1.8	2.3	2.2	2.4	2.9	2.4	2.4	2.4	3.0	-	-	-
Average	**1.8**	**2.0**	**2.5**	**2.5**	**2.7**	**2.5**	**2.4**	**2.3**	**2.5**	**2.2**	**1.7**	**1.8**

Table B.8.2-3 Directional Wind Speed at the Project Site Climate Station 2008-2012

Direction	% of All Directions	Wind Speed (m/s)			
		<1	1-5	5-10	10-15
North	27%	18%	72%	10%	0.1%
North-East	8%	31%	65%	4%	0.0%
East	3%	32%	65%	4%	0.0%

Direction	% of All Directions	Wind Speed (m/s)			
		<1	1-5	5-10	10-15
South-East	9%	21%	69%	10%	0.3%
South	16%	20%	75%	5%	0.1%
South-West	21%	24%	75%	1%	0.0%
West	6%	39%	60%	1%	0.0%
North-West	10%	22%	70%	9%	0.2%
% of Total Wind Speeds		**23%**	**71%**	**6%**	**0.1%**

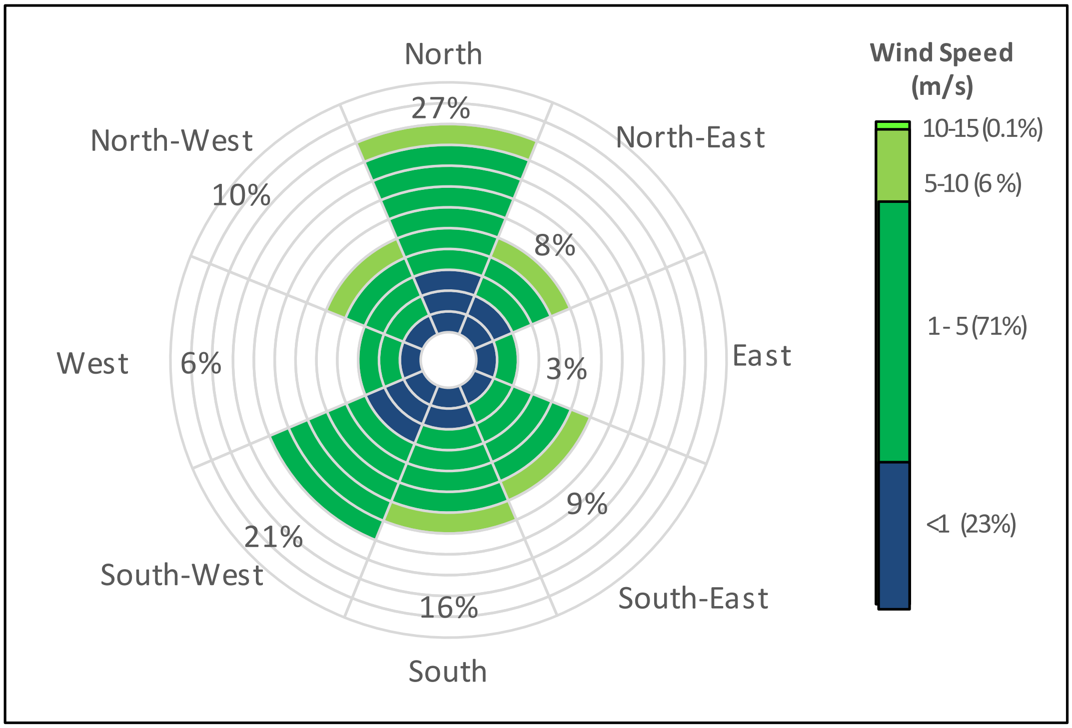

Figure B.8.2-1 Wind Rose for Project Wind Data 2008-2012

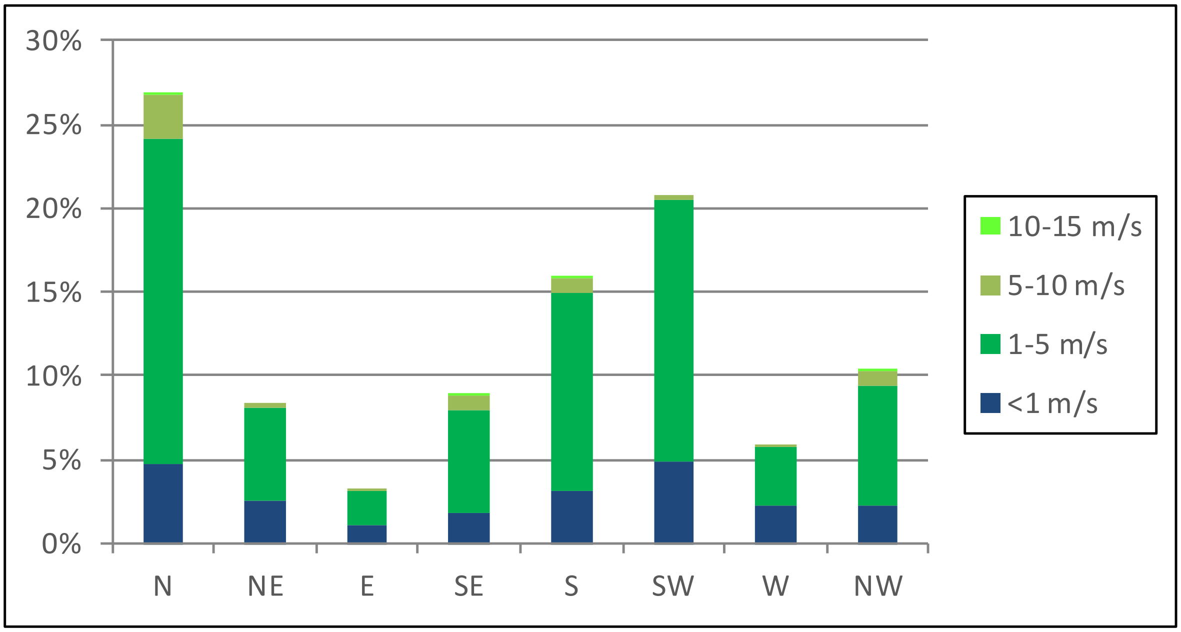

Figure B.8.2-2 Wind Data Distribution 2008-2012

B.8.2.2 Mitigations

B.8.2.2.1 R2-124

R2-124. Mitigations to reduce or eliminate the frequency and extent of air quality exceedances modeled including evidence for each mitigation's effectiveness.

As described in Section 8, 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.

The worst case scenario resulted in some exceedances of the Yukon Ambient Air Quality Standards largely due to the consumption of LNG at the power plant, with some impact to total suspended particulate matter (TSP) and dustfall within the mine site during mine construction. However, as it was the worst case scenario, these results are not expected to be applicable at all times but mitigations were proposed for this scenario.

Air quality mitigations for mining are derived from regulatory and non-regulatory standards published by various agencies and organizations. Monitoring during construction and operations will evaluate the effectiveness of measures that have been implemented. As described in Table 8.4-7 proposed mitigations include:

- Minimize land disturbance, grubbing and clearing activities;
- Adhere to the *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;
- Cover or use water sprays at dust generating area, and water unpaved portions of the road;
- Reduce drop heights for processing plants;
- Minimize wind exposure at conveyors, drop-off points and truck load/unload locations; and
- Establish blasting procedures for open pit activities to minimize dust.

The mitigations will be incorporated into the Dust Management Plan, Air Quality Monitoring Plan and Transport Management Plan to minimize potential guidelines exceedances, while also conducting long-term monitoring for air quality. These mitigations are comparable to mitigations used at other mine sites, including the Minto Mine, which has similar infrastructure to the Casino mine (i.e., open pit, unpaved roads, crusher and mill facilities). On-going monitoring of the Minto Mine indicates that these mitigation measures have been effective at keeping $PM_{2.5}$ 24-hour average values well below the Yukon Ambient Air Quality Standard (Capstone, 2013). Additionally, these mitigation measures are similar to those provided by Yukon Environment in the guidance for Dust Management Plans (Yukon Environment, 2014).

Descriptions of the proposed mitigation measures are provided below, including sources of proven effectiveness.

<u>Minimize land disturbance, grubbing and clearing activities</u>

By simply leaving material in-place, there is no opportunity for dust and particulate matter to be released from the soil. The minimization of land disturbance has been incorporated into the mine plan, by structuring the mine components as close together as possible.

<u>Adhere to the *Occupational Health and Safety Act*</u>

The Yukon Occupational Health Regulations (Yukon Workers' Compensation Health and Safety Board, 2006) under the *Occupational Health and Safety Act* (Yukon Government, 2006), requires that:

Section 8

(1) Airborne contaminants shall be controlled at their source by use of an effective local exhaust system; or where this is not practical, general ventilation systems, or a combination of the two shall be used.

(2) Local exhaust ventilation systems shall be designed so that under normal work procedures a worker is not located between the source of contamination and the exhaust intake.

(3) Where an exhaust system is installed, provision shall be made for an adequate supply of tempered make-up air. The opening of windows and doors is not adequate for this purpose.

(4) Ventilation systems shall be designed so that contaminated exhaust air is not recirculated to the work area or other work sites.

(5) Material or equipment, which will effect the efficiency of the ventilation system, shall not be piled or stored in front of ventilation openings.

(6) Wherever an operation or work process produces combustible or flammable dusts, vapours, smoke, fumes, or gases in concentrations that may exceed the lower explosive limit of that substance, such operation or work process shall be provided with an appropriate separate exhaust ventilation system.

(7) When there is a change in a work process, operation, machinery or equipment the ventilation system shall be modified as required to maintain the concentration of airborne contaminants below the levels prescribed in Tables 8 to 13 below.

And that:

Section 27. Air Contaminants

(1) A worker's exposure to airborne contaminants shall be limited to the stated permissible concentrations as specified in the tables and the preambles thereto.

(2) When there is exposure to a mixture of two or more substances listed in the air contaminant tables, the effects of such exposure shall be considered to be additive, unless it is known otherwise, and the equivalent exposure as computed below shall not exceed unity (1):

$$E = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \cdots + \frac{C_n}{L_n}$$

where E = equivalent exposure to the mixture C_1 = measured time weighted average concentration of first substance etc, C_2 = measured time weighted average concentration of second substance etc, L_1 = the 8-hour time weighted average for first substance L_2 = the 8-hour time weighted average for second substance, etc.

(3) Substances listed in Table 12 shall not exceed concentrations reducing the available oxygen below 18 per cent by volume in the work place atmosphere or which will present other hazards, such as fire and explosion.

(4) A worker's exposure to substances listed in Table 7 and Table 14 for periods of time greater than 8 hours in any 24-hour period shall be limited to the modified permissible concentration (M.P.C.) calculated as:

$$M.P.C = Permissible\ Concentration\ x\ \frac{8}{h}\ x\ \frac{24 - h}{16}$$

where Permissible Concentration are the values listed in Appendix A and B and h = number of hours of exposure on shift.

(5) When a worker's exposure to air contaminants exceeds permissible concentrations, the employer shall take immediate steps to reduce the worker's exposure to levels at or below the permissible concentration through engineering or administration controls.

(6) When engineering or administrative controls are not practicable the employer shall provide and the worker shall use personal protective equipment acceptable to the Chief industrial Safety Officer or the Chief Mines Safety Officer as a temporary means to control a worker's exposure to air contaminants, and the employer shall establish and maintain a health surveillance program to ensure that an exposed worker's body burden of harmful substances listed in Table 13 remains below the maximum acceptable levels.

(7) Clauses (1) and (2) do not apply

(a) when air contaminant is present in a location or at a time at which human access is impossible, or unnecessary, or not permitted, or

(b) in temporary or emergency situations or during cleaning and disposal operations, provided that workers involved have been properly trained and protective equipment worn.

Where tables 7 – 14 are defined in the *Occupational Health and Safety Act* (Yukon Government, 2006).

CMC is required to comply with the requirements in the *Occupational Health and Safety Act* and will do so to protect the health of workers.

<u>Use ultra-low sulphur content fuel</u>

Ultra-low sulphur diesel is that which contains less than 15 ppm sulphur. All on-road and off-road diesel fuel in Canada is required to be ultra-low sulphur diesel (Environment Canada, 2013). The sulphur limit is designed to enable compliance with diesel vehicle and engine emissions standards that have come into effect since 2010. Ultra-low sulphur is a cleaner-burning fuel, and the use of this type of fuel, in combination with newer, more efficient engines, greatly reduces NO_x and particulate matter emissions.

Use construction and mining equipment that meets the latest applicable Canadian emissions standards

Currently, construction and mining equipment must meet the *Off-Road Compression-Ignition Engine Emissions Regulations*, under the *Canadian Environmental Protection Act, 1999* (Government of Canada, 2012). The regulations are designed to reduce emissions of hydrocarbons, CO, NOx, particulate matter and other air pollutants (benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein and PM_{10}) from on-road and off-road vehicles and engines. The Regulations ensure that vehicles entering the Canadian market meet progressively more stringent emission standards.

Ensure regular equipment maintenance recommended by manufacturers

A poorly maintained engine can use up to 50% more fuel (D. Cope Enterprises 2004). Therefore, equipment and vehicles will be maintained as required by manufacturers, and regular inspections will be conducted with all parts showing signs of wear or damage replaced promptly.

Institute a policy for all equipment and vehicles to reduce and limit idling

Generally, each litre of gasoline used in vehicles results in 2.3 kg of CO_2 as well as CO, NO_x, criteria air contaminants and volatile organic compounds (Natural Resources Canada, 2013). Idling for more than 10 seconds uses more fuel and produces more CO_2 emissions than restarting of an engine (Natural Resources Canada, 2013), for gasoline powered engines.

Diesel powered engines (those most likely used at the mine site) produce 2.7 kg CO_2 per litre of diesel consumed (Natural Resources Canada, 2013), but consume less fuel overall due to the higher efficiency of diesel engines. Diesel engines produce more particulates and NO_x than gasoline engines, which can be eliminated when the vehicles are turned off.

Cover or use water sprays at dust generating area, and water unpaved portions of the road

Emissions from unpaved roads are generally due to the force of the wheels on the road surface, which causes pulverization of surface material, and subsequent lifting and dropping of particles from the rolling wheels and the air currents caused by the turbulent wake of the vehicle (EPA, 2006). Modeling estimates particulate emissions from re-suspended road surface material, vehicle exhaust, brake wear and tire wear. EPA (2006) describes three groupings of emission controls for unpaved roads:

1. Vehicle restrictions: including speed limits, weight limits, and limits on the number of vehicles on the road;
2. Surface improvements: including surface paving and gravel or slag to a dirt road; and
3. Surface treatment: including watering or chemical dust suppression treatments.

Surface treatment is proposed as an effective mitigation measure to prevent dust along unpaved portions of the mine and access road. Watering decreases dust by increasing the moisture content of the road surface, reducing the likelihood of the conglomerated particles becoming suspended when vehicles pass over the surface. The control efficiency depends on how fast the road dries after water is added. The frequency of watering depends on the amount of water added during each application; the weight and speed and number of vehicles traveling over the watered road and evaporation due to meteorological conditions (EPA, 2006).

Dust on unpaved roads is also greatly reduced as soon as freezing temperatures are encountered, approximately September through May.

Chemical dust suppressants are discussed further in the response to R2-128.

Reduce drop heights for process plants

Sources of process fugitive emissions may include crushing and screening operations, which exacerbate fugitive emissions by increasing the amount of fines in the material through fracturing, and the mechanical energy expended on the fines generates high velocity air streams within the process equipment (EPA, 1996). Generally, these processes are enclosed, and therefore the fugitive emissions escaping to the open air is reduced, but is still relevant due to process leaks (EPA, 1996). The calculation for fugitive emissions is directly dependent on the drop height from the process equipment (e.g., conveyor).

As such, source reduction measures recommended by the EPA (1998) includes drop height reduction through the use of hinged-boom conveyors, rock ladders, lower wells, etc., which may result in control efficiencies of 80%, 75% and 50%, respectively. Further, using choke-feed or telescopic chutes and washing down or scraping conveyor belts regularly is also cited as effective mitigation measures to minimize particulate matter generating materials (EPA, 1998).

Minimize wind exposure at conveyors, drop-off points and truck load/unload locations

Fugitive dust is emitted from mine sites at locations where the transfer, storage and handling of materials results in exposure to wind or machinery. Fugitive dust emissions result whenever material is added to or removed from a storage pile and is based on wind speed and material moisture content, the more moist and still the air is, the fewer emissions (EPA, 1996). Further, wind erosion of open aggregate piles and exposed areas within an industrial facility (e.g., conveyors) may also result in fugitive dust emissions (EPA, 1996). Minimizing the wind exposure at these areas results in a direct decrease in fugitive dust emissions, including PM_{10} emissions.

Other mitigations typically used on conveyor systems include loading the material onto the centre of the belt, adequately spaced impact idlers at transfer points, conveyor skirtboards to provide a dust seal between the skirtboards and the moving belt and dust curtains (U.S. Bureau of Mines, 1987).

Establish blasting procedures for open pit activities to minimize dust

Drills, blasting and crushers produce the most dust in hard rock open pit mines (Kissell, 2003). Drill dust can be controlled by water injected through the drill steel, which results in a 95% or better reduction in respirable dust (Kissell, 2003). During blasting, water is used to spray the blast area beforehand, and generally, the faces are shot during an off-shift, so no workers are in the mine at the time of the blasts (Kissell, 2003). In hard rock mines, the dust is usually cleared within 2 hours (Chekan and Colinet, 2002). Further, new enclosed cabs on drills and bulldozers can effectively control the operator's dust exposure, with good cab sealing and pressurization systems, and filtration/air conditions systems (Kissell, 2003).

B.8.2.2.2 R2-125

R2-125. Unclassed air quality model outputs in a standard GIS format.

Air quality model output files in GIS are attached to this submission in digital format as Appendix B.8.A. These files include:

- Construction:
  - CO: 1 hour & 8 hour
  - Daily dustfall
  - NO_2: 1 hour, 24 hour & annual
  - $PM_{2.5}$: 24 hour & annual
  - PM_{10}: 24 hour
  - SO_2: 1 hour, 24 hour & annual
  - TSP: 24 hour & annual
- Operations:
  - CO: 1 hour & 8 hour
  - Daily dustfall
  - NO_2: 1 hour, 24 hour & annual
  - $PM_{2.5}$: 24 hour & annual
  - PM_{10}: 24 hour
  - SO_2: 1 hour, 24 hour & annual
  - TSP: 24 hour & annual

B.8.3 DUST AND DUSTFALL

B.8.3.1.1 R2-126

R2-126. Predicted change in dust composition during construction and operations.

As described in Appendix A.8A, large unit construction activities are expected to have a beginning and an end and vary over the construction phase as activities change on a daily basis. General construction emission factors were used by assuming that each unit requiring erection would take around 90 days of heavy construction activity. Construction activities includes construction of the power plant, concentrator and crusher area for total emissions of ~63 tonnes/year, 30 tonnes/year and 4.5 tonnes/year of TPM, PM_{10} and $PM_{2.5}$, respectively. However, fugitive dust emissions during construction is dominated by dust from haul roads and, as summarized in Table A.8A.1-9, ~562 tonnes/year, 150 tonnes/year and 52 tonnes/year of TPM, PM_{10} and $PM_{2.5}$, respectively. The total emissions during peak construction year were provided in Table A.8A.1-10 in Appendix A.8A, and are provided in Table B.8.3-1 below.

Modeled total suspended particulate (TSP) and dustfall levels show exceedances within the mine site but not at the Freegold Road (Figures 8.4-9, 8.4-10 and 8.4-14). 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 (Figures 8.4-11 through 8.4-13).

Table B.8.3-1 Total Particulate Matter Emissions during Peak Construction Year

Mine Facility	Total TPM (tonnes/year)	Total PM_{10} (tonnes/year)	Total $PM_{2.5}$ (tonnes/year)
Roads			
Haul Road 1	184.4	48.8	4.9
Haul Road 2	148.3	39.3	3.9
Haul Road 3	192.0	50.8	5.1

Mine Facility	Total TPM (tonnes/year)	Total PM_{10} (tonnes/year)	Total $PM_{2.5}$ (tonnes/year)
Haul Road 4	58.2	15.4	1.5
Haul Road 5	0.4	0.1	0.03
Access Road	376.9	94.0	41.2
Airport Road	185.1	54.6	11.2
Crusher Unit			
Crusher	90.2	9.0	9.0
Truck Unloading	0.008	0.004	0.001
Sulphite Ore Plant			
Conveyor Drop Off	0.026	0.008	0.002
Sag Mill	-	-	-
Pebble Crushing	-	-	-
Cyclone	-	-	-
Ball Mill (Before Mitigation)	268.2	71.5	71.5
General Construction Activities *			
Power Plant	36.3	17.2	2.6
Concentrator	24.2	11.5	1.7
Second Crusher	2.0	1.0	0.1
Earth Moving/Surfacing			
Gold Ore Stockpiles	97.0	72.8	10.2
Supergene Oxide Ore Stockpiles	164.4	123.3	17.3
Waste Storage Dump	181.7	136.2	19.1
Loading/Unloading			
Gold Ore Stockpiles	2.3	1.1	0.2
Supergene Oxide Ore Stockpiles	1.1	0.5	0.1
Waste Storage Dump	0.56	0.26	0.04
Wind Erosion			
Gold Ore Storage Area	1.6	0.8	0.3
Low Grade Supergene Oxide Pile	0.5	0.2	0.1
Supergene Oxide Ore Stockpile	1.9	0.9	0.4
Marginal Grade Ore Pile	1.9	0.9	0.4
Low Grade Supergene Sulphite	0.5	0.2	0.1
Waste Storage Area	0.3	0.1	0.0
Topsoil Piles	10.1	5.0	2.0
Topsoil Overburden Piles	12.5	6.5	2.6
ANNUAL TOTAL (tonnes)	**2043**	**762**	**206**

*Assumed that construction at Power Plant, Concentrator Building and Second Crusher could take 90 days

Conversely, during the Operation Phase, the main contributors to emissions are the Power Plant, Open Pit activities, and Unpaved Roads, with unpaved roads continuing to be the largest source of particulate matter for the Project due to haul road distances between key Project infrastructure. As summarized in Table 8.4-5, air quality interactions that occur during operations and not construction include concentrate and ore and waste transport and loading, open pit particulate matter emissions, emissions from crushers and processing facilities, and wind erosion effects on ore stockpiles, waste stockpiles and the tailings beach. The total emissions during operations were summarized in Table A.8A.2-11 in Appendix A.8A, and are provided in Table B.8.3-2 below.

Table B.8.3-2 Total Particulate Matter Emission During Operations

Mine Facility	Total TPM (tonnes/year)	Total PM_{10} (tonnes/year)	Total $PM_{2.5}$ (tonnes/year)
Roads			
Haul Road 1	1539	395	40
Haul Road 2	33	8	1
Haul Road 3	26	7	1
Haul Road 4	3	1	0.1
Haul Road 5	117	30	3
Haul Road 6	92	24	2
Haul Road 7	478	123	12
Haul Road 8	3	1	0.1
Access Road	1508	1442	144
Airport Road	85	82	8
Crusher unit to sulphide ore facility			
Crusher	893.9	89.4	89.4
Truck Unloading	0.076	0.036	0.036
Crusher unit to oxide ore facility			
Crusher	155.1	15.5	15.5
Truck Unloading	0.062	0.029	0.004
Sulphide ore plant			
Conveyor Drop Off	67.0	24.6	24.6
SAG Mill	-	-	-
Pebble Crushing	-	-	-
Cyclone	-	-	-
Ball Mill	268.2	71.5	71.5
Oxide ore plant			
Conveyor Drop-Off	11.8	4.3	4.3
Screening	59.0	14.2	14.2
Secondary Crushing	235.9	111.6	16.9
Earth moving/surfacing			

Mine Facility	Total TPM (tonnes/year)	Total PM_{10} (tonnes/year)	Total $PM_{2.5}$ (tonnes/year)
Low Grade Supergene Stockpiles	164.4	123.3	17.3
Gold Ore Stockpiles	97.0	72.8	10.2
Supergene Oxide Ore Stockpiles	164.4	123.3	17.3
Low Grade Hypogene Ore Stockpiles	164.4	123.3	17.3
Low Grade Supergene Oxide Stockpiles	82.2	61.6	8.6
Waste Storage Dump	90.8	68.1	9.5
Loading/unloading			
Low Grade Supergene Stockpiles	0.028	0.013	0.002
Gold Ore Stockpiles	0.831	0.393	0.060
Supergene Oxide Ore Stockpiles	0.006	0.003	0.0004
Low Grade Hypogene Ore Stockpiles	0.028	0.013	0.002
Low Grade Supergene Oxide Stockpiles	0.0018	0.0008	0.0001
Waste Storage Dump	0.891	0.013	0.004
Wind erosion			
Gold Ore Storage Area	1.87	0.94	0.37
Low Grade Supergene Pile	1.87	0.94	0.37
Supergene Oxide Ore Stockpile	1.87	0.94	0.37
Low Grade Hypogene Ore pile	1.87	0.94	0.37
Low Grade Supergene Oxide	0.47	0.23	0.09
Waste Storage	0.09	0.04	0.01
Tailings Beach	13.42	6.72	2.68
ANNUAL TOTAL (tonnes)	**6362**	**3027**	**532**

During operations, TSP and dustfall levels show minor exceedances within the mine site but not at the Freegold Road (Figures 8.4-23, 8.4-24 and 8.4-28). 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 (Figures 8.4-25 through 8.4-27).

The assessment described above is a standard approach to model emission sources and air quality using guidelines issued by several regulatory agencies such as Environment Canada's Pits and Quarries Guidance (NPRI, 2009), United States Environmental Protection Agency AP-42 (US EPA 1995), and Australian Mining Emission Estimation Technique Manuals (NPI 2008, NPI 2012). The model predicts emissions of primary air pollutants including NO_x, SO_2, fine particles (TPM, PM_{10} and $PM_{2.5}$), CO and dustfall. Secondary pollutants, including toxic metals (e.g., cadmium, chromium, nickel, and manganese) are not predicted by the standard models. Additionally, the formation of secondary pollutants due to the emissions of primary pollutants is predicted to be negligible.

However, to ensure protection of human health, in the absence of the prediction of secondary pollutants, the Yukon Ambient Air Quality Standards or other relevant ambient air quality objectives (Table 8.4-1) can be considered *de facto* risk-based thresholds derived from the best available epidemiological and toxicological knowledge, and subjected to prior regulatory and scientific peer review. As described in the response to R444, the only identified exposure scenario for workers at the mine site is through the pulmonary (inhalation) exposure route. As described above in the response to R2-124, CMC will comply with requirements of the Yukon Occupational Health Regulations (Yukon Workers' Compensation Health and Safety Board, 2006) under the *Occupational Health and Safety Act* (Yukon Government, 2006) to maintain worker health.

Finally, CMC will be required to obtain an Air Emissions Permit for:

- Burning more than 5 kg per day of garbage; and
- Electricity generating facility with a capacity >1MW (Yukon Environment, N.D.).

As part of that permit, CMC will submit a Dust Management Plan, which will "*demonstrate how appropriate management techniques will reduce the potential for any dust-related adverse effect to public health or the environment, and describe the measures that will be undertaken to control dust generated by the operation*" and will include "*dust produced by bulk materials handling, storage activities, earth-moving, construction, demolition or vehicular movements*" (Yukon Environment, 2014). The Dust Management Plan will be submitted as part of the application for a permit under the Yukon's Air Emissions Regulations prior to the commencement of either of the above listed activities.

B.8.3.1.2 R2-127

R2-127. Discussion on additional dust sources such as project induced wind-based erosion, blasting, and traffic in relation to dust quantity, including details on the inclusion of these sources in air quality modeling.

For a full list of sources used as inputs in the air quality mode, the Executive Committee is referred to Appendix A.8A Emissions Inventory for Construction and Operations. However, for ease of consideration, the prediction of dust due to wind-based erosion, blasting and traffic, is summarized below, with the full numerical values of all sources in construction and operation summarized in Table B.8.3-1 and Table B.8.3-2, above.

Wind-based Erosion

Site historical meteorological data indicate that the Project does not experience wind gusts very often. The wind speeds exceeded 5.4 m/s hourly average only 4.4% of the time from 2008 to 2012 (Table B.8.2-3). Considering the gust speed and approximate silt contents, particulate matter emissions were estimated for each ore, waste, and topsoil stockpiles. Usually topsoil stockpiles are covered by grass however during the construction phase, it was assumed to be too early for vegetation growth and they are included in wind erosion estimations. During operations, the erosion related particulate emission were estimated and used in the model for exposed stockpiles and tailings beach. Wind erosion emission estimates are summarized in Table B.8.3-3.

Table B.8.3-3 Wind Erosion Emissions

Mine Facility	Construction Value (tonnes/year)			Operations Emission Factor (tonnes/year)		
	TPM	PM_{10}	$PM_{2.5}$	TPM	PM_{10}	$PM_{2.5}$
Gold Ore Stockpile	1.64	0.82	0.33	1.87	0.94	0.37
Low Grade Supergene Oxide Pile	0.47	0.23	0.09	1.87	0.94	0.37
Supergene Oxide Ore Stockpile	1.87	0.94	0.37	1.87	0.94	0.37
Low Grade Hypogene Ore Stockpile (4 ha)	-	-	-	1.87	0.94	0.37
Marginal Grade Ore pile	1.87	0.94	0.37	-	-	-
Low Grade Supergene Sulphite	0.47	0.23	0.09	0.47	0.23	0.09
Waste Storage Area	0.29	0.14	0.03	0.09	0.04	0.01
Topsoil Piles	10.06	5.04	2.01	-	-	-
Topsoil Overburden Piles	13	6.5	2.6	-	-	-
Tailings Beach (18 ha)	-	-	-	13.4	6.7	2.7

Blasting

Detailed blasting data were not available, therefore the ANFO use was estimated by using 0.25 times the powder factor and material extracted from the open pit in a year. It was assumed that blasting emissions would disperse in one hour which is the shortest modelling time interval for this study. The blasting was also assumed to occur once a day. Table B.8.3-4 summarizes the blasting emission estimations.

Table B.8.3-4 Blasting Emissions

Species	Emission Factor [a] (kg/Mg ANFO)	Construction			Operations		
		Daily ANFO [b] (tonnes)	Daily Air Emissions (kg)	Emission Rate [d] ($g/s/m^2$)	Daily ANFO [c] (tonnes)	Daily Air Emissions (kg)	Emission Rate [d] ($g/s/m^2$)
CO	34	28.34	963.55	$1.12x10^{-03}$	67.63	2299.33	1.18x10-03
NO_x	8	28.34	226.72	$2.62x10^{-04}$	67.63	541.02	2.78x10-04
SO_2	1	28.34	28.34	$3.28x10^{-05}$	67.63	67.63	3.48x10-05

a. EPA 2006
b. Assuming a powder factor of 0.250 Kg ANFO/tonnes with 41,376,000 tonnes extraction during year -1
c. Assuming a powder factor of 0.225 Kg ANFO/tonnes with 98,736,000 tonnes extraction during year 11
d. Assuming that blasting emissions will be released from 10,000 m^2 surface within one hour

Traffic

Fugitive dust from haul roads is the largest and most frequent contributor to particulate matter emissions. It was assumed that a dust control program (i.e. applying water to control dust emissions) would be applied and would control fugitive dust emissions from haul roads by approximately 75%, and natural mitigation (precipitation and snow cover) would also aid to suppress fugitive dust. The Whitehorse and Burwash weather stations were considered for natural mitigation data and Whitehorse was used in calculations (67.9%) as a conservative approach. Regular activity consists of ore/waste hauling, explosive transport, airport transportation and access road materials supply and concentrate transport. AP-42 Section Unpaved Roads (EPA, 2006) was used as the main reference to calculate emissions by using the following formula:

$$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

where:

- E = size specific emission factor (lb/VMT)
- s = surface material silt content (%)
- W = mean vehicle weight (tonnes)
- k (lb/VMT) = 0.15 for $PM_{2.5}$, 1.5 for PM_{10} and 4.9 for TPM
- a = 0.9 for $PM_{2.5}$ and PM_{10} and 0.7 for TPM
- b = 0.45 for $PM_{2.5}$, PM_{10}, and TPM

The truck trips were estimated by using the annual production schedule and the capacity of haul trucks. The summary of the unpaved road emissions is provided in Table B.8.3-5.

Table B.8.3-5 Unpaved Road Emissions

	Construction					Operations				
Road Type	**Avg. Weight**	**Travelled Distance**	**TPM**	**PM_{10}**	**$PM_{2.5}$**	**Avg. Weight**	**Travelled Distance**	**TPM**	**PM_{10}**	**$PM_{2.5}$**
	(tonnes)	**(km)**	**(tonnes/year)**			**(tonnes)**	**(km)**			
Haul Road 1 To Waste Storage Area	443	766	184.4	48.8	4.9	443	7097.3	1539	395	40
Haul Road 2 Low Grade Hypogene Stockpile	-	-	-	-	-	443	150.8	33	8	1
Haul Road 3 Low Grade Supergene Sulphide Stockpile	-	-	-	-	-	443	118.7	26	7	1
Haul Road 4 Low Grade Supergene Oxide Stockpile	-	-	-	-	-	443	12.9	3	1	0.1
Haul Road 5 Supergene Oxide Stockpile	443	617	148.3	39.3	3.9	127	537.5	117	30	3
Haul Road 6 Gold Ore Stockpile	443	798	192	50.8	5.1	127	426.5	92	24	2
Haul Road 7 Direct Mill Feed	443	242	58.2	15.4	1.5	443	2202.3	478	123	12
Haul Road 8 Explosive Storage	30	5	0.4	0.1	0.03	30	13.9	3	1	0.1
Access Road	30	1,617	376.9	94	41.2	30	6469.5	1508	1442	144
Airport Road	30	440	185.1	54.6	11.2	30	366.6	85	82	8

B.8.3.1.3 R2-128

R2-128. Water requirements for dust management and dust prevention strategies and details on any water additives.

CMC has proposed to mitigate exceedances of Yukon Ambient Air Quality Guidelines through water sprays at dust generating areas, watering unpaved portions of the road to minimize fugitive dust and watering of access corridors. The water used for dust management will be sourced from the freshwater pipeline (i.e., Yukon River).

If a dust suppressant other than water is being considered for use, for any of the following considerations, advance written approval will be obtained from Yukon Environment (Yukon Environment, 2014):

- Safety: Accident potential is increased due to loss of visibility;
- Health: Dust particles may become a health hazard;
- Vegetation: Dust may induce changes in vegetation due to increased heat absorption and decreased transpiration;
- Aquatic resources: Dustfall into aquatic systems may adversely affect aquatic plants and fish that are not adapted to high levels of sedimentation;
- Road maintenance costs: Treated roads can lower road maintenance costs by reducing gravel loss and blading time; and
- Aesthetics: dust produces an immediate visual impact (Government of the Northwest Territories, 2013).

Generally, engineering is used to construct well designed roads to withstand expected vehicle loads, that is well drained, and the size of materials in the surface layer is selected to achieve maximum durability (FCM and NRC, 2005). Where all reasonable engineered methods are not able to reduce dust emissions to minimize the above considerations, chemical dust suppressants (those which bind the particles in a road surface together to prevent escape to the atmosphere), may be considered.

Common dust suppressant additives (i.e., above and beyond just water) include:

- Lignin derivatives;
- Synthetic polymer emulsions;
- Bitumens, tars, and resins;
- Calcium chloride; and
- Magnesium chloride (FCM and NRC, 2005).

Each suppressant has functional, application, performance and environmental factors which must be considered when evaluating which suppressant to use. Yukon Highways and Public Works uses Bituminous Surface Treatments (BST) as an alternative to calcium chloride (Yukon Government, 2015). As stated above, any suppressant used by CMC will only be used following advanced written approval obtained from Yukon Environment.

Calcium chloride has been used in the Yukon effectively (Yukon Government, 2015). Using the manufacturer's specifications for water requirements, over the entire 120 km road, a water consumption volume is estimated at 1,000 m^3 of water per application. Depending on the number of applications, based on air temperature and precipitation, the total water consumption for 2 – 3 applications of calcium chloride per year would be ~3,000 m^3. Conversely, watering the road alone, without additives, would consume approximately 1,200 m^3 of water per application, and would need to be applied much more frequently, again depending on the air temperature and precipitation, therefore can be expected to be greater than 3,000 m^3.

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B.9 – NOISE

B.9.1 INTRODUCTION

Noise was selected by Casino Mining Corporation (CMC) as a Valued Component (VC) because airborne sound and ground vibration propagation has the potential to affect sensitive receptors. The Proposal presented baseline information for ambient noise for the Casino Project (the Project) area and predicted changes to ambient noise from Project activities (Section A.9 Noise).

Potential changes to ambient noise from Project activities were evaluated using a three-phased approach:

1. **Determination of baseline conditions**: a limited baseline ambient noise monitoring survey was completed to confirm that baseline sound levels are naturally low and that designation as a remote site according to British Columbia Oil and Gas Commission's (OGC) published standards (OGC, 2009) is appropriate.
2. **Modelling**: noise modelling was completed using sound propagation software CadnaA for selected Project activities to predict noise effects. Predicted sound levels include noise attenuation achieved with proposed mitigation measures.
3. **Guideline comparison**: predicted noise levels were compared with OGC published noise guidelines to identify the potential for adverse residual effects and noise sources requiring additional noise mitigation measures.

Based on the predicted changes in ambient noise after the implementation of mitigation measures proposed by CMC, the Proposal concluded that noise levels are predicted to remain below existing guidelines and the potential adverse residual effects of the Casino Project as a result of increased noise are Not Significant.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has six requests related to information presented in Section 9 Noise of the Project Proposal submitted on January 3, 2014 and Section A.9 Noise of the SIR-A. These requests are outlined in Table B.9.1-1, and responses are provided below.

Table B.9.1-1 ARR No.2 Requests for Supplementary Information Related to Noise

Request #	Request for Supplementary Information	Response
R2-211	Clarification of differences between the reference noise levels presented in the original proposal and the Supplementary Information Report.	Section B.9.2.1.1
R2-212	An assessment of effects, and any proposed monitoring and mitigations, due to non-modeled noise, in relation to wildlife, due to: air traffic; blasting; and cycloning.	Section B.9.2.1.2
R2-213	Rationale for a 45 dBA background sound level.	Section B.9.2.1.3

Request #	Request for Supplementary Information	Response
R2-214	Rationale for the use of A-weightings for assessing effects to wildlife and human annoyance (in relation to low frequency sounds), including how the use of A-weightings influence an effects assessment.	Section B.9.2.1.4
R2-215	Discussion on the temporal distribution of noise effects in communities, including Carmacks and Carcross, on a seasonal and diurnal basis	Section B.9.2.1.5
R2-216	Any anticipated effects, proposed mitigations, and monitoring to noise effects in communities including Carmacks and Carcross.	Section B.9.2.1.6

B.9.2 NOISE

B.9.2.1.1 R2-211

R2-211. Clarification of differences between the reference noise levels presented in the original proposal and the Supplementary Information Report.

The reference noise levels presented in Table 9.4-1 of the Proposal were the total sound pressure levels (dBA), and the reference noise levels presented in Table A.9.2-1 of SIR-A were the octave band spectrums (frequency – Hz). The values in the column “A” of Table A.9.2-1 are equal to those presented in Table 9.4-1. Total sound pressure levels are derived from octave band spectrums using the following equation:

$$L_A(dBA) = 10\ x\ \log_{10} \sum_{1}^{n} 10^{(L_p+A)/10}$$

Where L_p = octave spectrum frequency (Hz)

A = A-scale correction factor, as follows:

Frequency	A-weighting correction
31.5	-39.4
63	-26.2
125	-16.1
250	-8.6
500	-3.2
1000	0
2000	1.2
4000	1
8000	-1.1

The complete combined data is provided in Table B.9.2-1.

Table B.9.2-1 Noise Sources During Construction and Operations (Total Sound Pressure Levels and Octave Band Spectrum)

Noise Source	Source	Octave Spectrum - Frequency (Hz)									Total Sound Pressure Level (dBA)
		31.5	63	125	250	500	1000	2000	4000	8000	
Crushers	DEFRA 2006	0	91	91	88	87	85	83	78	69	90.1
Conveyor		0	71	69	68	71	75	67	63	57	90.1
Screening		0	84	82	79	79	74	74	71	64	81.1
Excavator		0	95	95	89	89	86	82	76	74	91
Loader		0	88	88	87	85	86	83	77	70	89.9
Dozer		0	89	90	81	73	74	70	68	64	80.1
Grader		0	88	87	83	79	84	78	74	65	86.5
Crane		0	78	69	67	64	62	57	49	40	66.6
Mid-Size Loader		0	83	89	92	80	71	69	64	58	85
Lighting Tower		0	78	71	66	62	59	55	56	49	65.5
Gas Turbine	Qui Hansen 2012	109.9	112.9	113.9	113.9	113.9	111.9	109.9	106.9	101.9	117.5
Steam Generator		62.5	74.7	79.8	81.3	85.7	86.9	86.1	85.9	83.8	117.9
Incinerator Fan		56.7	55.7	55.7	54.7	7	63.1	46.7	38.7	30.7	63.4
Water Pump		38.2	52.4	63.5	73	78.4	84.6	82.8	78.6	70.5	88.2
SAG mill	VDI 2571	0	118	117	118	114	111	108	110	95	117.5
Ball Mill		0	113	113	115	119	111	106	98	93	117.9
Transformer		89	95	97	92	92	86	81	76	69	92.4
Workshop		0	0	85	85	90	85	80	75	0	93.2

B.9.2.1.2 R2-212

R2-212. An assessment of effects, and any proposed monitoring and mitigations, due to non-modeled noise, in relation to wildlife, due to: air traffic; blasting; and cycloning.

As discussed in the response to R315, a 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).

Additionally, as discussed in the response to R321, noise modelling and potential wildlife displacement was considered in the effects assessment (Section 12 of the Proposal). Noise associated with project activity was considered a disturbance activity that could affect wildlife behaviour and distribution near Project facilities. All project disturbances and potential effects on wildlife were quantified within the various zones of influence used to quantify effects on wildlife. To quantify potential behavioural changes, habitat multipliers, or "downgrading" was applied to habitat within the zone of influence (Proposal Section 12.3.3 Caribou Effects Assessment). Habitats were considered "nil" (i.e., completely avoided) within the project footprint, with varying reduced habitat uses presumed correlated with distance from Project facilities. The justification for the size and response within a zone of influence, partly determined by noise, is provided in Proposal Section 12.3.3.2 (Potential Project Interactions with the Klaza Caribou Herd). All known relevant literature on caribou response to noise was considered in that section. Mitigation measures to reduce noise levels and, consequently, reduce sensory disturbance on wildlife are listed in Proposal Section 9, Table 9.4-4, and are as follows:

- 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.
- 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 flyrock effects.
- 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.

Additionally, as summarized in the response to R359, the effects assessment on birds was conducted considering, among other disturbance features, noise within a zone of influence. It was acknowledged that there will be some reduced habitat quality within the zone of influence. This reduced habitat quality was considered 'not adversely significant' within the bird regional assessment area.

For further details on the assessment of effects from air traffic on Dall Sheep, see the response to R2-177 in Section B.12.

B.9.2.1.3 R2-213

R2-213. Rationale for a 45 dBA background sound level.

As described in the response to R412, baseline ambient noise for the entire noise modelling study area was conservatively estimated as pristine, which is characterized as quiet and dominated by nature. To ensure that the characterization of the noise baseline as pristine was appropriate, baseline values at the nearest potentially sensitive receptor (Carmacks) were desired. The study conducted August 25 – 26, 2011, 30 m from the Freegold Road near Carmacks, resulted in average noise levels of 40.3 dBA during the daytime (7 am – 10 pm) and 33.9 dBA during the nighttime (10 pm – 7 am).

To predict potential changes in sound levels, a night-time average rural ambient sound level of 35 dBA Leq and a day-time adjustment of 10 dBA above the night-time level (i.e., 45 dBA) were used in the model. These sound levels were considered to be applicable as a year-round baseline noise level.

Even though the use of a baseline noise level of 45 dBA is higher than the actual measured average noise levels of 40.3 dBA near Carmacks, the 45 dBA background sound level value is more conservative than assuming a lower value, because it sets the baseline value at which the model starts at a higher value, resulting in an overall higher predicted noise value.

The values of 45 dBA Leq at nighttime and 55 dBA at daytime were used as Permissible Sound Levels (PSL) as per the British Columbia Oil and Gas Commission's (OGC) standards (OGC, 2009) as the Yukon does not currently have any published noise guidelines or regulations and there is no developed noise guideline for the mining industry. In comparison, Health Canada (2010) advises that "noise mitigation measures be considered…. if the Project L_{dn} exceeds 75 dBA".

Even with the more conservative higher baseline value of 45 bBA, during the construction phase, the modelling results show that the predicted equivalent sound levels during daytime and nighttime show only minor exceedances of the OGC guidelines within the mine site (Figures 9.4-1 and 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 OGC guidelines within the mine site and a small portion of the surrounding area (Figures 9.4-2 and 9.4-4). However, the nearest receptor is the accommodation camp, which modeling indicates is below the PSL.

For noise effects within the mine site, CMC will comply with Yukon Occupational Health and Safety Regulations, which include providing hearing protection, and if hearing protection is not able to be used, exposure will be kept to below the values in Table B.9.2-2 (YWCHSB, 2006).

Table B.9.2-2 Permissible Exposure Values (YWCHSB, 2006)

Steady State Noise		Impact Noise	
Noise Level (dBA)	**Maximum Daily Exposure Time Without Hearing Protection (Hours)**	**Peak Sound Pressure Level (dB)**	**Maximum Number of Impacts per 24-Hour Period**
85	8	118	14400
88	4	121	7200
91	2	124	3600
94	1	127	1800
97	½	130	900
100	¼	133	450
Over 103	0	136	225
		139	112
		140	90
		Over 140	0

B.9.2.1.4 R2-214

R2-214. Rationale for the use of A-weightings for assessing effects to wildlife and human annoyance (in relation to low frequency sounds), including how the use of A-weightings influence an effects assessment.

Noise is measured in a non-linear scale known as decibels (dB), which are then filtered to account for noise frequencies that are audible to humans (A-weighted), resulting in a value in dBA. Typical sound levels in A-weighted decibels are summarized in Table B.9.2-3.

Table B.9.2-3 Typical Sound Levels (A-weighted decibels)

Sound Range (dBA)		Source*
	0	Human hearing threshold
Faint	20	Rustling of leaves
	38	Whisper
	40	Humming refrigerator
Moderate	40	Quiet room
	50	Average rainfall
	60	Dishwasher, people talking
Loud	70	Vacuum cleaner
	80	Busy street, alarm clock
	88	Motorcycle
Very Loud	90	Lawnmower, food blender
	100	Chainsaw, snowmobile
	110	Symphony orchestra
Painful	120	Oxygen torch
	130	Shotgun
	140	Jet plane take-off
	150	Rock concert (peak)

*From Yale Medical Group, 2015.

While workers at the mine site are covered under the Yukon Occupational Health and Safety Regulations, as described above in the response to R2-213, Health Canada (2011) also recommends the assessment of sleep disturbance at on-site mine camps. Health Canada advises that sounds are dampened by 27 dBA if windows are closed, and 15 dBA if windows are opened. As the maximum noise level at the accommodation camp is 45 – 50 dBA (Figures 9.4-1 through 9.4-4), the indoor-dampened sound is at maximum 35 dBA with the windows open, but will more likely be around 13 dBA. The World Health Organization suggests that the indoor threshold for sleep disturbance be no more than 30 dBA for continuous noise (WHO, 1999). Therefore, no impact to the on-site mine camp is predicted.

While there are no federal or provincial/territorial regulations that specifically stipulate noise levels for mine development projects in terms of wildlife impacts, effects on wildlife are associated with the type of noise and the wildlife species. Environment Canada suggests that to prevent effects to wildlife, sound pressure level from mining activities should not exceed 55 dBA during the day, and 45 dBA at night (Environment Canada, 2009). These are consistent with the values used as Permissible Sound Levels (PSL) as per the British Columbia Oil and Gas Commission's (OGC) in the effects assessment presented in the Project Proposal. While minor exceedances of the PSL are predicted around the mine site, residual adverse effects are Not Significant.

B.9.2.1.5 R2-215

R2-215. Discussion on the temporal distribution of noise effects in communities, including Carmacks and Carcross, on a seasonal and diurnal basis

Noise effects in Carmacks and Carcross will be due to increased traffic in those communities. During construction, traffic requirements may vary seasonally in small amounts, however, the impact of traffic corresponds to the year of construction. As outlined in Table 4.3-5, total traffic ranges from 4 vehicles per day (3 "heavy" and 1 "light") in year -4 to a peak of 28 vehicles per day (14 of each "heavy" and "light") in year -2. Diurnally, traffic is likely to be heavier during the day (i.e., 6 am – 6 pm).

During operations, the mine site will be operating 24 hours per day, 365 days per year. Therefore, seasonal effects are not as significant as during the construction period. As described in Table 4.4-5, daily and seasonal variations may occur, with copper concentrate outbound loads reaching up to 24 loads per day in some years, compared to the average value of 17 loads per day. Similarly to during construction, traffic is likely to be heavier during the day (i.e., 6 am – 6 pm).

Carmacks

As described in the response to R414, at the time of completing the noise model, predictions were not completed for Carmacks because mine operations are not proposed within the area and Project-generated traffic would not pass through Carmacks during operations, as Project-related traffic would utilize the Carmacks by-pass.

Based on the existing model and predictions, noise levels in Carmacks during construction are anticipated to be consistent with the maximum daytime and nighttime noise levels predicted for the Freegold Road Extension during construction (see Figures 9.4-1 and 9.4-2 in the Proposal). These predicted noise levels are below the maximum daytime and nighttime thresholds identified in the OGC guidelines (i.e., 55 dBA during the day, and 45 dBA at night).

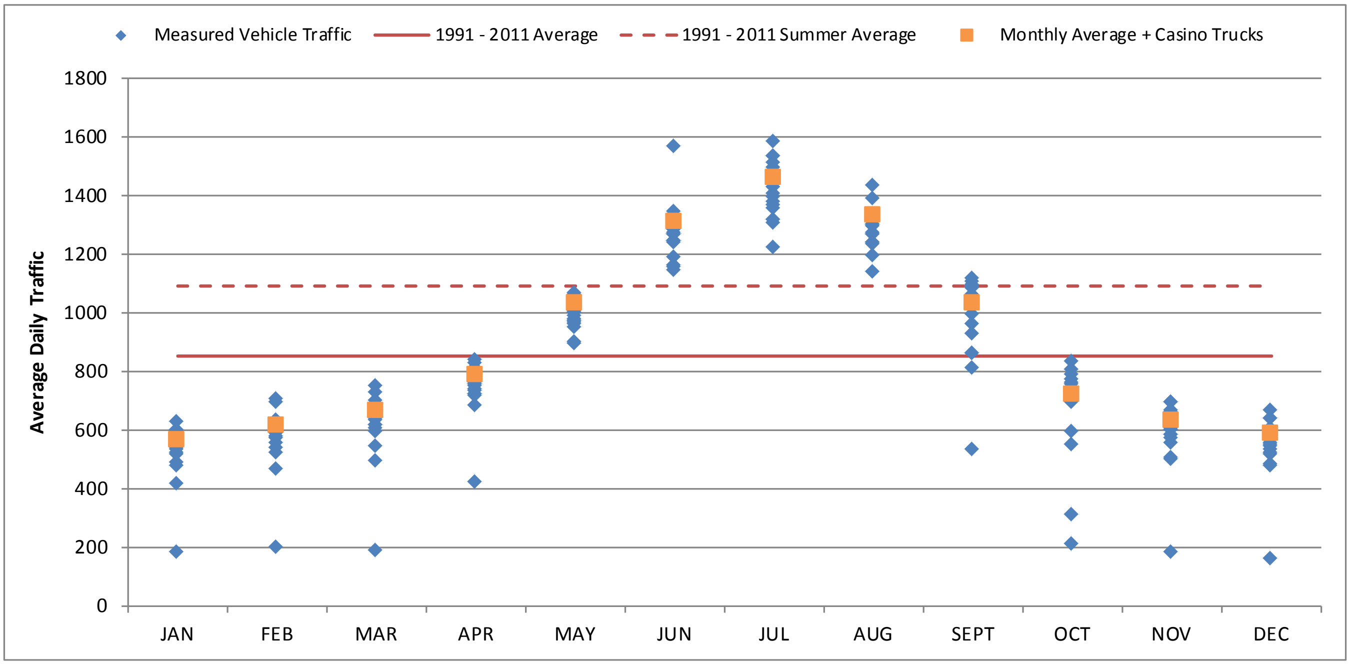
There will be a short time at the beginning of construction, when the Carmacks bypass is being constructed, that traffic will route through the Village of Carmacks. As detailed in Table 4.3-5, annual average daily traffic is estimated to be 3 "heavy" vehicles and 1 "light" vehicle, for a total of 4 extra vehicles per day during this time. The effect of this traffic on the Village of Carmacks is expected to be negligible, and vehicles will comply with all standards and guidelines established in the Traffic Management and Road Use Plans and with local speed limits.

Carcross

As described in the responses to R2-12 and R2-13, traffic through Carcross will be limited to copper and molybdenum concentrate vehicles travelling to Skagway for export, which at the maximum value, is 24 trucks per day and 4 trucks per day for copper and molybdenum concentrate, respectively. The range of monthly traffic through Carcross from 1991 to 2011, as measured by Yukon Highways and Public Works (Yukon HPW) traffic counter on the south side of Carcross on the Klondike Highway #2 is shown in Figure B.9.2-1. The average annual daily traffic through that location is 821 and the average summer daily traffic is 1092 (Yukon HPW, 2011). With the addition of 48 trucks through Carcross (i.e., 28 trucks to Skagway and 28 trucks returning from Skagway) from the Casino Project, the anticipated average daily vehicle traffic through Carcross (yellow square in Figure

B.9.2-1) is well within the range of historic traffic. Therefore, the traffic through Carcross will be only marginally greater than residents are used to seeing in an average month, and in most months are below the average summer traffic values.

Figure B.9.2-1 Anticipated Traffic through Carcross with Casino Trucks (Highway Data from 1991 – 2011)



*Data from Yukon Highways and Public Works, 2011

B.9.2.1.6 R2-216

R2-216.Any anticipated effects, proposed mitigations, and monitoring to noise effects in communities including Carmacks and Carcross.

As described above, no changes to background noise is predicted for either the community of Carmacks or Carcross. Noise levels in Carmacks during early construction prior to completion of the Carmacks Bypass are anticipated to be consistent with the maximum daytime and nighttime noise levels predicted for the Freegold Road Extension during construction which are below the maximum daytime (55 dBA) and nighttime (45 dBA) thresholds identified in the OGC guidelines. Traffic through Carmacks will be consistent with historic average daily traffic values (see R2-215), and hence noise effects are not greater than those that currently exist.

There are no anticipated residual adverse effects from noise on either the community of Carmacks or Carcross. CMC will work with the Yukon Government to determine if monitoring of noise in these communities is required and/or beneficial.

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B.10 – FISH AND AQUATIC RESOURCES

B.10.1 INTRODUCTION

Potential effects of the Project on fish and aquatic resources were evaluated in Section 10 of the Proposal. The assessment concluded that 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 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 fish habitat offsetting.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 18 requests related to information presented in Section 10 Fish and Aquatic Resources of the Project Proposal submitted on January 3, 2014 and Section A.10 of the SIR-A sumitted March 16, 2015. Two meetings (July 24th and August 8th, 2015) were held with YESAB to discuss the details of the requests and provide guidance on the response required. These requests are outlined in Table B.10.1-1 and the responses are provided below.

The effects assessment presented in the Project Proposal concluded that the Casino Project is not likely to have significant adverse effects on fish and aquatic resources following the implementation of mitigation measures. The responses provided herein do not change the conclusions stated in the Proposal.

Table B.10.1-1 ARR No.2 Requests for Supplementary Information Related to Fish and Aquatic Resources

Request #	Request for Supplementary Information	Response
R2-129	Discuss how the Project affects each of the commercial, recreation, or Aboriginal (CRA) fisheries and the species supporting those fisheries, which includes an understanding of the habitats but also the fish populations utilizing those habitats.	Section B.10.2.1.1
R2-130	Identification of project components likely requiring a paragraph 35(2)(b) Fisheries Act authorization.	Section B.10.2.1.2
R2-131	Demonstrate that proposed charge weights to be used in construction of the access road and infrastructure pads will not cause harm to fish and fish eggs.	Section B.10.3.1.1
R2-132	More information on the fish passage barrier in Taylor Creek, including clarification of its location and documentation that there are no upstream fish. If it is not available, the habitat upstream of the potential barrier in Taylor Creek should be included in calculation of habitat losses. This should follow the advice provided in Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (Research Document 2008/026): Protocol for the Protection of Fish Species at Risk in Ontario Great Lakes Area (Fisheries and Oceans Canada, 2008).	Section B.10.4.1.1

Request #	Request for Supplementary Information	Response
R2-133	Fish presence and habitat suitability maps that include information on freshwater species.	Section B.10.4.1.2
R2-134	A table including information on ephemeral channels and the likelihood of fish species presence during wetted periods.	Section B.10.4.1.3
R2-135	Additional information that allows for quantification of existing habitat value in Casino Creek.	Section B.10.4.1.4
R2-136	Additional quantitative baseline data including fish population and density estimates for all areas that will be impacted by changes in flows (reduced flows, changes in flow due to discharge and timing changes in flows). This should include a description of data quality objectives for both precision and accuracy relative to CPUE abundance estimates and how the data will be used to determine relative number of fish present for future comparisons (e.g. monitoring for change).	Section B.10.4.1.5
R2-137	Rationale and justification for the selection of reference sites and a description for how the data from the reference sites will be used for future comparisons (i.e. monitoring through all project phases).	Section B.10.4.1.6
R2-138	Final reports related to baseline data, if available, of appendices A – E for appendix 10A - Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.	Section B.10.4.2.1
R2-139	Additional information regarding the HEP including: a. methods and data used to calculate habitat gains; b. seasonal use by life stage for Arctic grayling; and c. incorporation of all life stages into the HEP.	Section B.10.5.1.1
R2-140	More information on information used in the PHABSIM model. This should include: a. A comparison of the streamflows from Knight-Piésold and that used in the PHABSIM model including tables and figures to illustrate the comparison; b. Clarity on assumptions and objectives of the modelling process regarding the estimation of impacts on fish habitat (e.g. average conditions, extreme flows, time periods etc.); c. Clarity around the consideration of fish stranding in the assessment (i.e. were extreme low flows considered in the assessment); and d. All sources of data used in the hydrology assessment and a detailed description of methods.	Section B.10.5.1.2
R2-141	An assessment of impacts to fish habitat related to culverted stream crossings on the Freegold Road.	Section B.10.6.1.1
R2-142	For each, if present, of spawning and rearing habitat, details regarding how pier construction and hydraulic forces will alter the habitat and over what area.	Section B.10.6.2.1
R2-143	The rationale for discounting this location as winter habitat, including consideration of juvenile fish species overwintering within substrate.	Section B.10.6.2.2
R2-144	Discussion of possible options for the bridge, including a no-pier option. This discussion should include a rationale detailing the options and alternatives considered if a no-pier option is not possible.	Section B.10.6.2.3
R2-145	A list of crossing details noting crossing properties and type of crossing, index by location as indicated in appendix 10B.	Section B.10.6.3.1
R2-204	A discussion of the potential effects of the Project to commercial, recreational and Aboriginal fisheries (e.g. Arctic grayling and Chinook salmon). This discussion should include:	Section B.10.6.3.2

Request #	Request for Supplementary Information	Response
	a. a geographic scope that includes areas downstream of Dip Creek up to and including the White River; b. consideration of the changes in rearing, spawning, and overwintering habitat; c. a consideration of the migratory nature of various fish species; and d. potential fish kills and stranding.	

B.10.2 FISHERIES ACT – FISHERIES PROTECTION PROVISIONS

B.10.2.1.1 R2-129

R2-129. Discuss how the Project affects each of the commercial, recreation, or Aboriginal (CRA) fisheries and the species supporting those fisheries, which includes an understanding of the habitats but also the fish populations utilizing those habitats.

As described in the response to R273, although the Proposal was submitted during the time of transition for the *Fisheries Act* legislation, and hence was consistent with the older version of the *Fisheries Act*. Based on CMC's interpretation of the new provisions, fish and aquatic resources within the Casino project area are still protected by the updated *Fisheries Act* legislation. Further, the new *Fisheries Act* provisions do not modify the size, number or nature of potential project effects on fisheries identified in the Fish and Aquatic Resources section of the Proposal.

However, CMC understands that the updated *Fisheries Act* (2013) now focuses on the protection of recreational, commercial and Aboriginal (CRA) fisheries and consequently, an evaluation of baseline field assessments was conducted to understand availability of fish habitat, fish presence as well as use of the habitat by the fish community. Although the fish habitat varies in its quality of function across the site, *all* water bodies either support CRA fisheries, or support fish in turn that support or contribute to the productivity of a CRA fishery, including those that are connected to such water bodies. Therefore *all* water bodies on site are subject to the prohibition against serious harm to fish as outlined in the federal *Fisheries Act*.

CMC has committed to avoiding and minimizing impacts to fish and aquatic resources. During the permitting phase of the Project, once the assessment phase has concluded and Project design has been completed, a self-assessment under the *Fisheries Act* for all project impacts will be conducted, and where *serious harm* cannot be avoided, a Request for Review will be submitted to Fisheries and Oceans Canada (DFO). Should DFO confirm that the project will cause serious harm to fish that are part of or that support a CRA fishery, an Application for Authorization will be submitted to DFO. CMC will work with DFO during the permitting phase to further mitigate impacts wherever possible, and where impacts are unavoidable, CMC will offset for these impacts through the Fish Habitat Offsetting Plan. The conceptual fish habitat offsetting plan (FHOP) was submitted in Appendix A.10A, and further details will be developed as part of the Application for Authorization.

Published data was used to determine the locations of historical and present Aboriginal fisheries, although as stated above, all water bodies will be treated as supporting CRA fisheries. Big Creek, which intersects the proposed Freegold Road, was mentioned as an important fishing area for both the Selkirk First Nation (SFN) and Little Salmon Carmacks First Nation (LSCFN) (Pearse and Weinstein, 1998). Documented Aboriginal fisheries in Big Creek included: grayling, whitefish, Chinook salmon, (and Chum salmon, but does not extend near proposed road corridor). Abundant Chinook salmon runs were also remembered by one Carmacks elder on Nordenskiold and Big Creeks (Pearse and Weinstein, 1998).

Further interpretation on potential project effects on fish that support CRA are provided below, on a species by species basis.

Chinook salmon:

- All Chinook salmon identified in the project study area contribute to the recreational and Aboriginal Yukon River fisheries.
- The majority of project activities will occur well away from Chinook rearing or spawning habitat (i.e. Casino Creek, Dip Creek, Canadian Creek); refer to Figure B.10.2-1 through Figure B.10.2-8 for an overview of distribution. No impacts are anticipated in the Yukon River, and it is noted that the entire Yukon River supports CRA fisheries.
- One exception is lower Britannia Creek which contains juvenile Chinook non-natal rearing habitat. Habitat loss due to the habitat offsetting diversion is proposed to provide a much greater amount of quality rearing and potentially overwintering habitat for this species, which will contribute to the fisheries productivity (Appendix A.10A).
- The access road crosses several Yukon River Chinook streams; however with appropriate construction timing windows to avoid sensitive life stages and sediment and erosion control methods identified in Section 10, the effect on this species, and therefore fisheries productivity, is anticipated to be very low.

Chum salmon:

- Chum salmon distribution in the project area is limited to the Nordenskiold River (DFO, 1985; DFO, 2015; NSC, 2010). Studies of local knowledge indicate that LSCFN had a fishing camp at the mouth of the Nordenskiold River (Charlie, 2003), and that the SFN would travel to Minto for chum salmon fishing during fall spawning runs (Pearse and Weinstein, 1998).
- As described in the Casino Project Land Use and Tenure Baseline Report (Appendix 19A), commercial fishing accounts for less than 5% of the fish harvested in the Yukon Territory (Yukon Environment, 2010). A small fishery is located in the Minto area, on the periphery of the regional study area (RSA) and the Canadian Commercial fishery is located in the Dawson area (Appendix 19A, p.23). These fisheries harvest summer and fall chum (Yukon Salmon Sub-Committee, 2014).
- As mentioned for Chinook salmon, effects are anticipated to be very low with applicable mitigation measures and Best Management Practices (BMP).

Arctic grayling:

- While Arctic grayling are found throughout the Project study area, they do not undergo major seasonal migrations such as salmon species and therefore are not accessible to most recreational or Aboriginal fisheries users which typically remain along the Yukon River and in accessible areas closer to Carmacks along the existing Freegold Road.
- Based on studies of traditional knowledge in the project area, it is known that Arctic grayling were captured in an early spring hook and line fishery through the ice of the Yukon and other rivers near Carmacks, including the Nordenskiold River (Pearse and Weinstein, 1998).
- Big Creek, which intersects the proposed Freegold Road, was mentioned as an important fishing area for both the SFN and LSCFN (Pearse and Weinstein, 1998); grayling could be captured at the outlet, middle and upper reaches.

- Arctic grayling fisheries closer to Carmacks are anticipated to have very low effects from road upgrading or construction due to BMPs.
- In areas where the majority of project effects are expected to occur (Casino Creek, Dip Creek, Canadian Creek), Arctic grayling will experience some habitat loss and alteration for adult and sub-adult life stages; however these areas are far from any road access or the Yukon River and therefore Project effects will be negligible on recreational or Aboriginal fisheries users.
- The only watershed in the mine area with connectivity to the Yukon River (and thus potential for direct contribution to CRA fisheries users) is Britannia Creek; however there will be a net gain in fisheries productivity in this watershed due to the proposed fish habitat offsetting activities (Appendix A.10A).

Slimy sculpin:

- Slimy sculpin are not directly fished by Aboriginal or recreational fisherman, however, they may provide food for predatory fish that are important CRA species such as Arctic grayling (detailed in the response to R276 in SIR-A). Within the mine area, potential impacts to recreational and Aboriginal fisheries users is limited to lower Britannia Creek near the Yukon River. In lower Britannia Creek, habitat loss due to the FHOP stream realignment may result in cascading trophic effects for Arctic grayling via impacts to slimy sculpin in this area. However, as a net gain of fisheries productivity is anticipated, indirect effects on Arctic grayling are expected to be overall beneficial.

Northern pike:

- Within the study area, northern pike is only found in the Nordenskiold River.
- Local knowledge for the area identified that LSCFN had a fishing camp at the mouth of the Nordenskiold River (Charlie, 2003).
- With applicable protection and mitigation measures during construction of the Nordenskiold Bridge, the potential effects to the Northern pike fishery in this river is anticipated to be very low.

Round whitefish:

- There are no known recreational or Aboriginal fisheries for round whitefish in the project study area.
- Round whitefish have been captured in Dip Creek, Murray Creek, Big Creek, and within the Nordenskiold River. Little is known about round whitefish populations in the Yukon, and they are not recognized as a popular angling species (Yukon Environment, 2010). While other species of whitefish are commercially harvested in the Yukon, round whitefish are not specifically targeted due to their smaller size. However, First Nations may harvest round whitefish for subsistence (Yukon Environment, 2010).
- In the literature surveyed, only Lake and Broad whitefish found in watersheds far removed (i.e. Tatlmain lake, Towhata Lake) from the study area were identified as historic important Aboriginal fisheries (Morrell, 1991; Pearse and Weinstein, 1998).
- With CMC's proposed protection and mitigation measures during road construction, the potential effects to any unknown Aboriginal round whitefish fishery in this river are anticipated to be either very low, or non-existent.

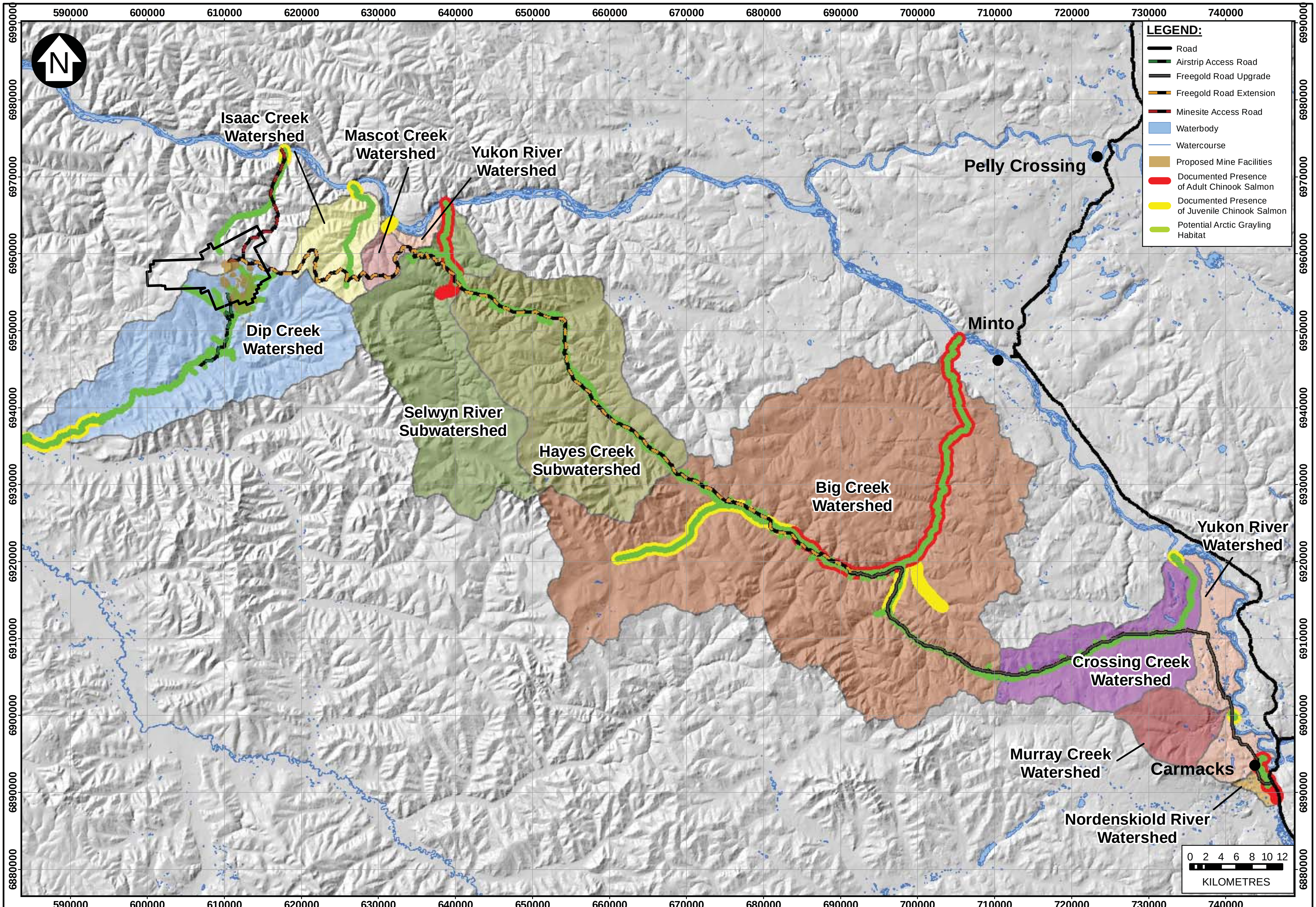
Longnose sucker:

- There are no known recreational fisheries for longnose sucker in the project study area.

- Longnose sucker is not recognized as a popular angling species (Yukon Environment, 2010). There is historical documentation of the SFN harvesting longnose sucker in the Pelly River drainage (Morrell, 1991); therefore, it is possible they were also harvested while fishing in other drainages such as Big Creek, if present.
- With CMC's proposed protection and mitigation measures during road construction, the potential effects to any unknown Aboriginal longnose sucker fishery in this river are anticipated to be either very low, or non-existent.

Rainbow trout:

- This species is stocked in Gloria Lake II near Carmacks and along the existing Freegold Road, 14 km north of Carmacks. Due to its close proximity to Carmacks, it is unlikely that the road upgrade will impact fishing pressures on this lake as it is already quite accessible.
- Also note that mine traffic will not be permitted to fish while using ANY section of the road (page 19-9 of Section 19).



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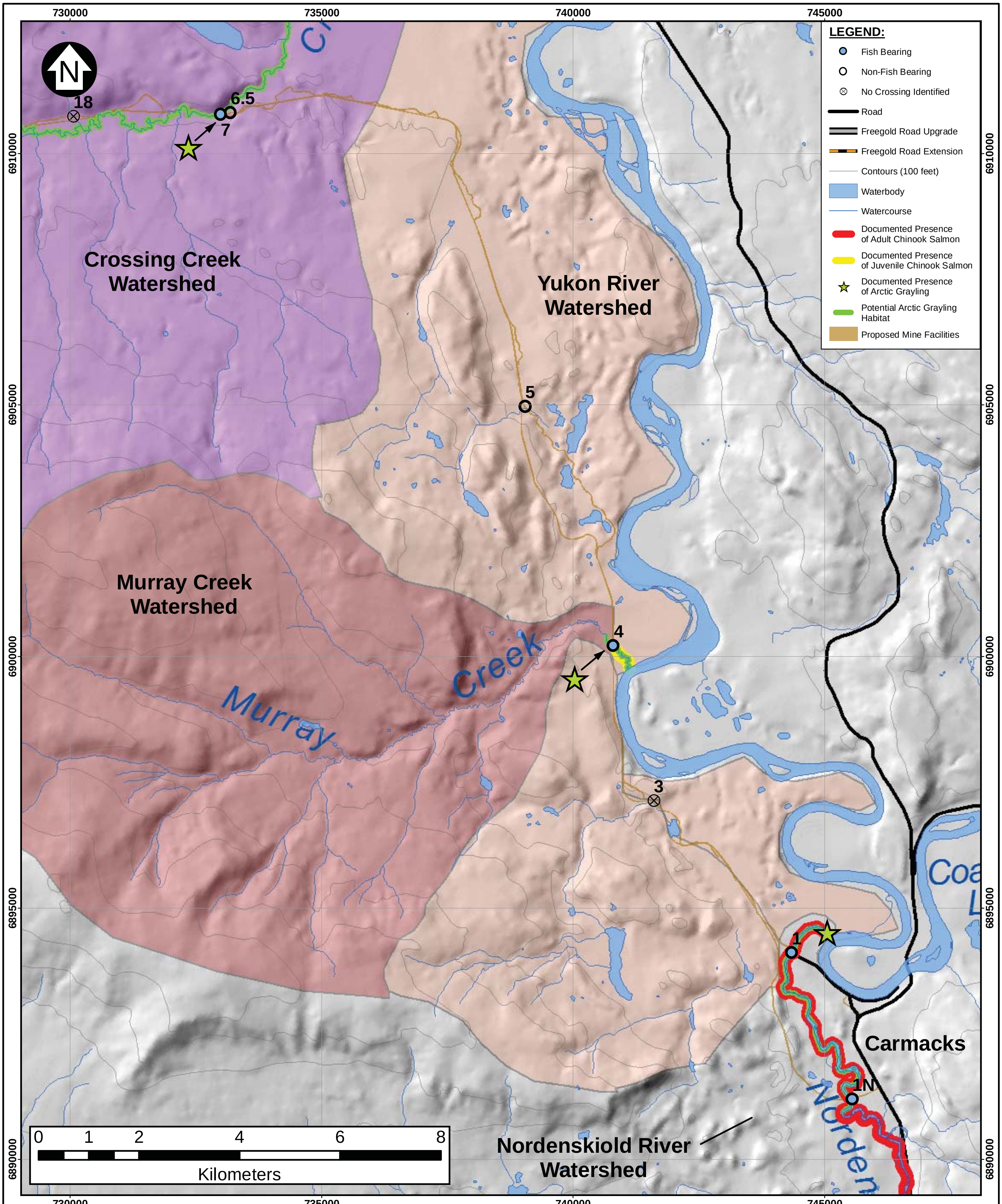
NOTES:
1. BASE MAP: Digital Elevation Model and 1:250,000 and 1:50,000 Topographic Spatial Data provided by Geomatics - Yukon Government via online source (www.geomaticsyukon.ca)
2. PROJECTION: NAD 1983 UTM Zone 7N
3. COORDINATE GRID: METRES
4. SCALE: 1:650,000

CASINO

CASINO PROJECT

Overview Map of the Casino Project

Figure B.10.2-1



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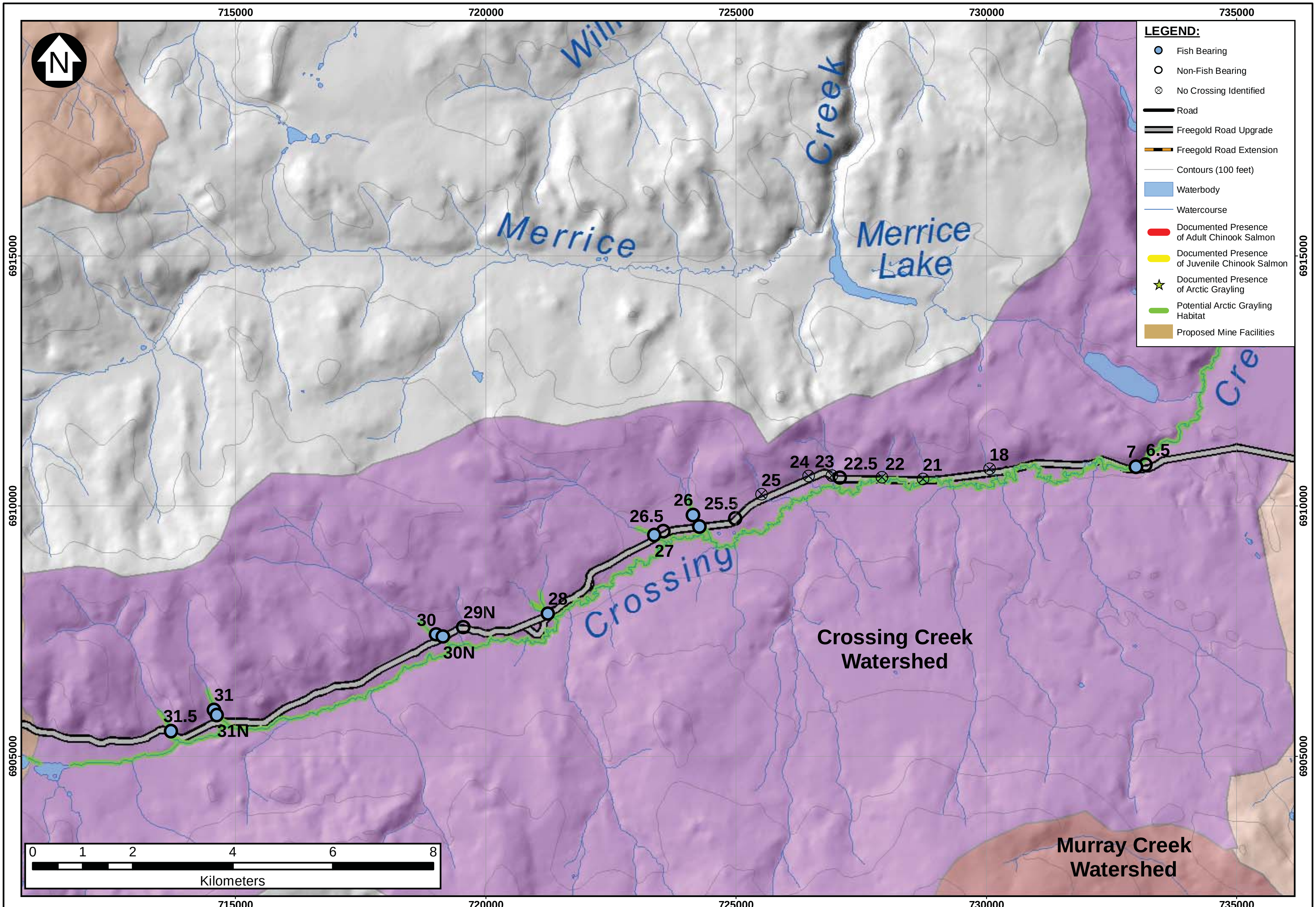
6. Documentation of presence of Arctic Grayling provided by: Summit (2012a, 2012b), and DFO (2015)

CASINO

CASINO PROJECT

Freegold Road Upgrade Fish Presence / Absence (Map 1)

Figure B.10.2-2



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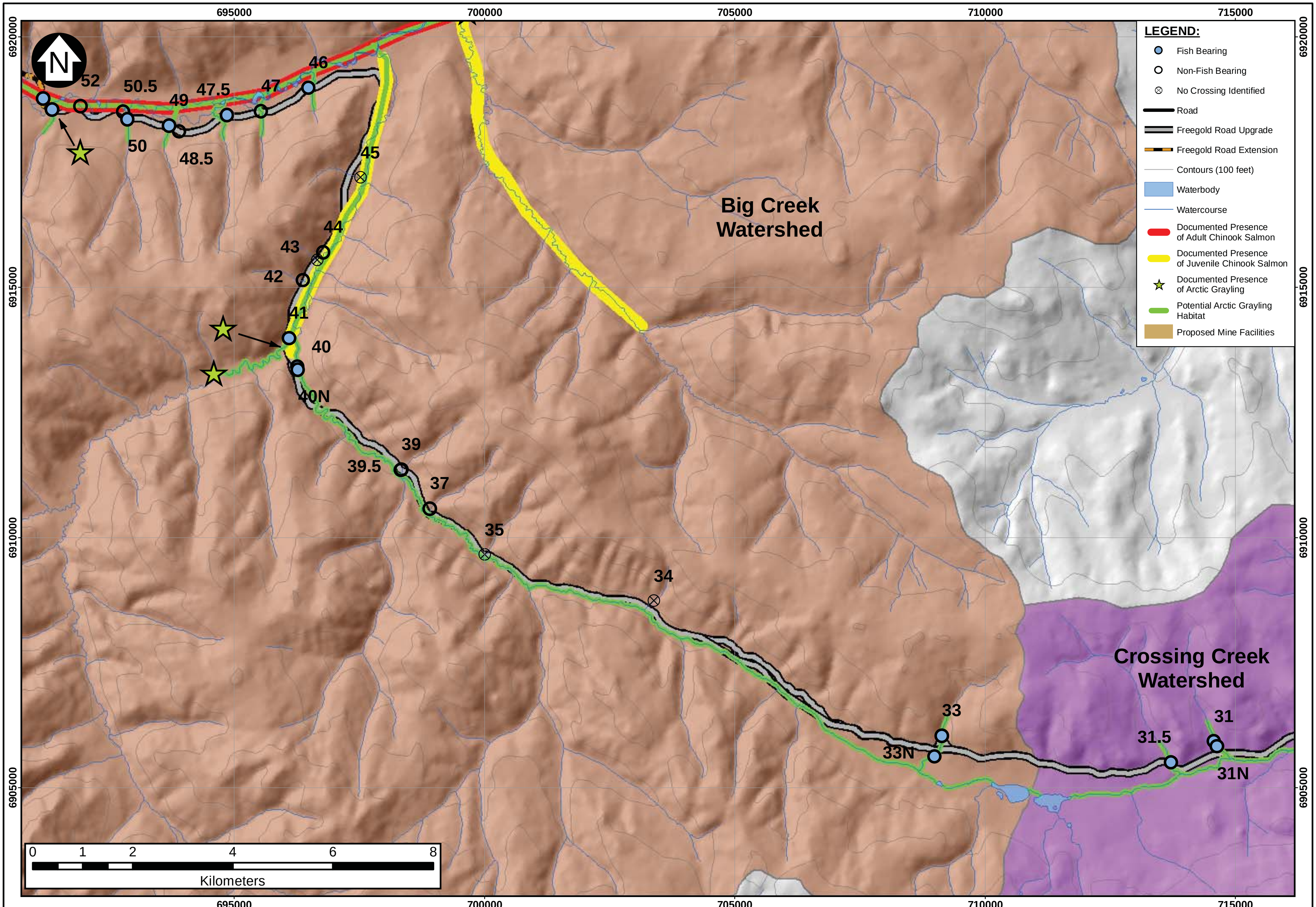
CASINO

CASINO PROJECT

Freegold Road Upgrade
Fish Presence / Absence
(Map 2)

Figure B.10.2-3



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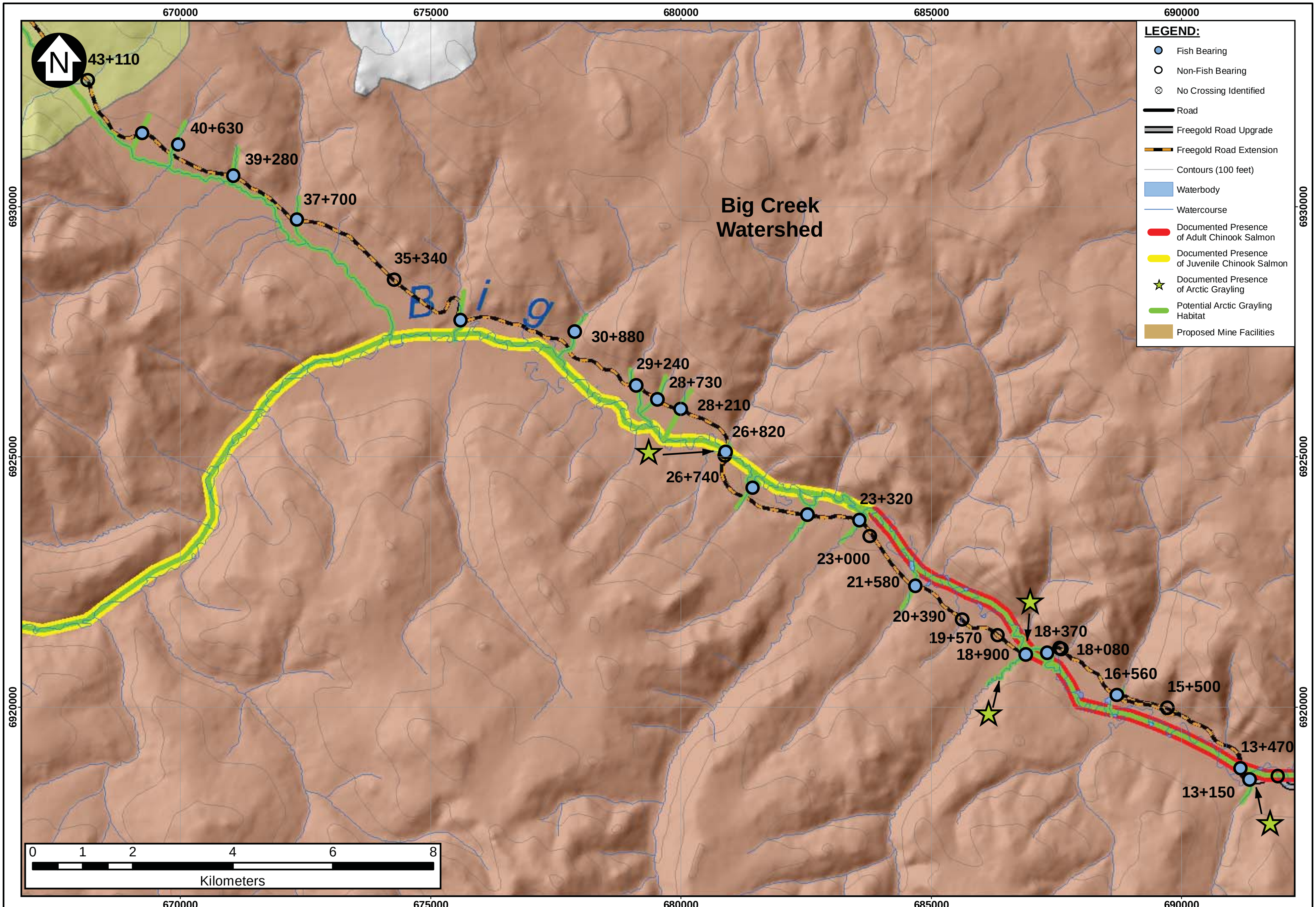
CASINO

CASINO PROJECT

Freegold Road Upgrade Fish Presence / Absence (Map 3)

Figure B.10.2-4



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CASiNO

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 1)

Figure B.10.2-5

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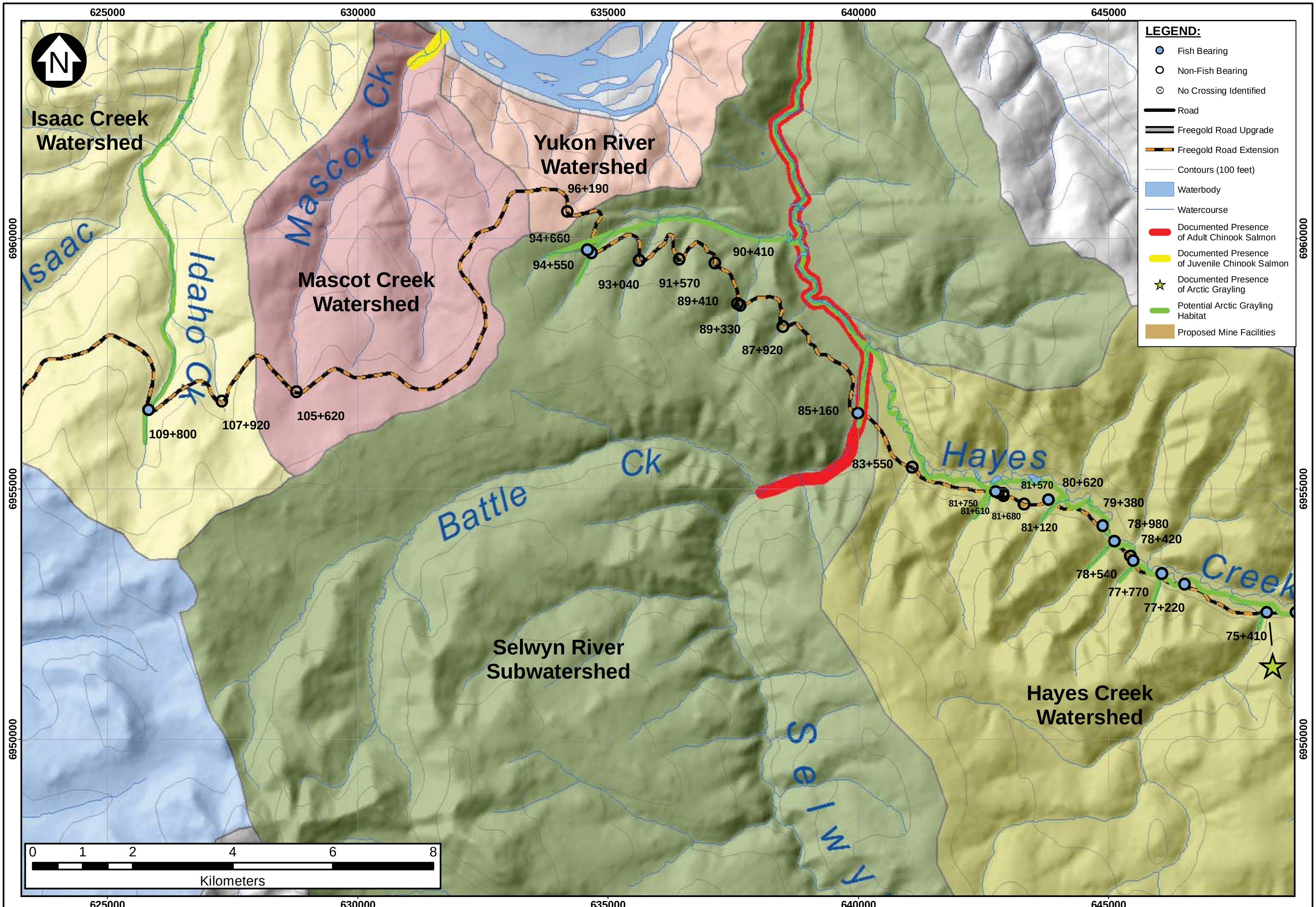
6. Documentation of presence of Arctic Grayling provided by: Summit (2012a, 2012b), and DFO (2015)

CASINO

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 2)

Figure B.10.2-6



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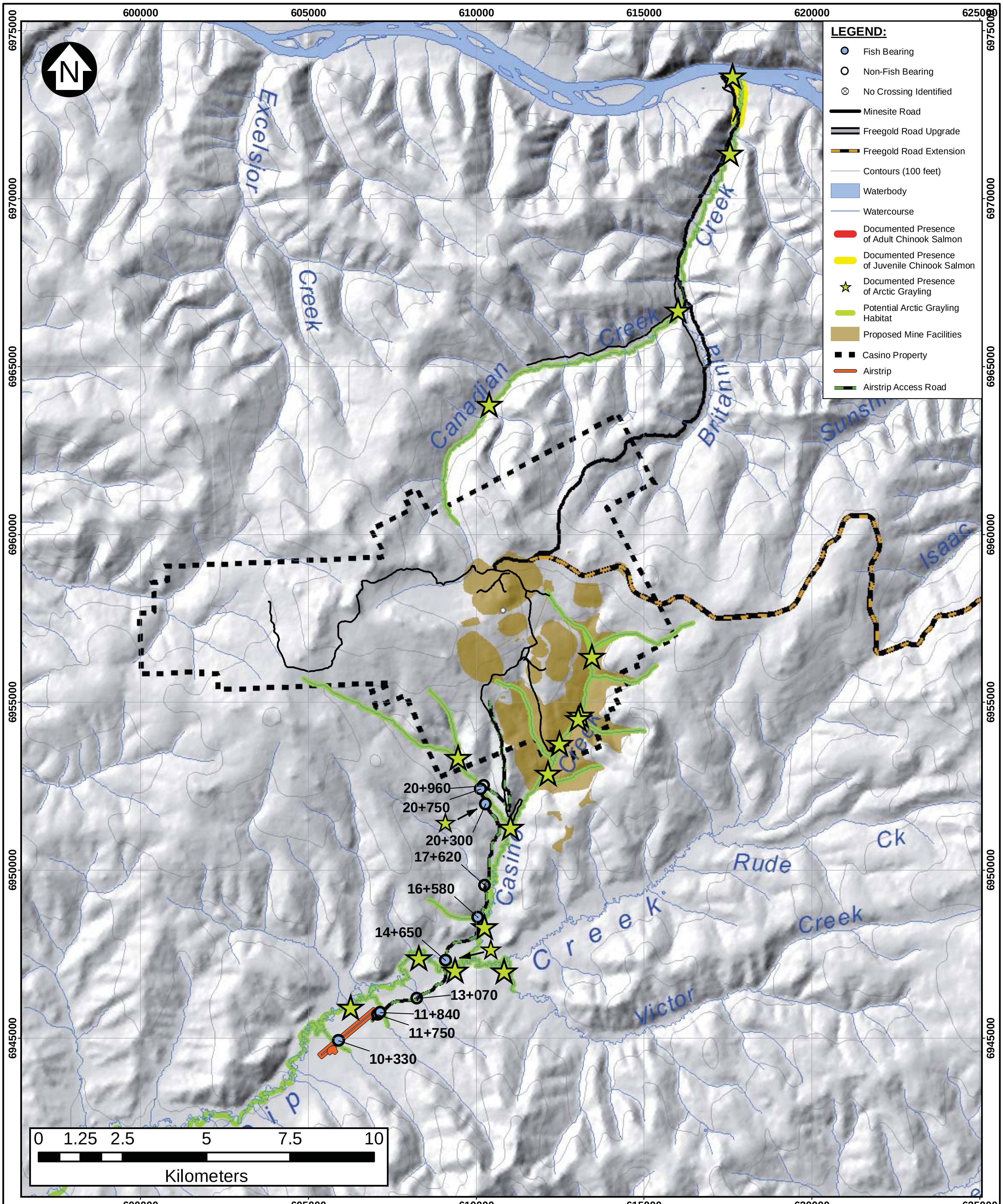
6. Documentation of presence of Arctic Grayling provided by: Summit (2012a, 2012b), and DFO (2015)

CASINO

CASINO PROJECT

Freegold Road Extension Fish Presence / Absence (Map 3)

Figure B.10.2-7



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DATE	29Oct'15

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: 1:150,000
5. Documentation of presence of adult and juvenile chinook salmon provided by DFO (1985), DFO (1994), Summit (2011) and EDI (2011)
6. Documentation of presence of Arctic Grayling provided by: Summit (2012a, 2012b), and DFO (2015)

CASINO

CASINO PROJECT

Airstrip and Airstrip Access Road Fish Presence/Absence

Figure B.10.2-8

B.10.2.1.2 R2-130

R2-130. Identification of project components likely requiring a paragraph 35(2)(b) Fisheries Act authorization.

The proposed Casino Mine infrastructure and access road will require the construction of a tailings management facility (TMF), open pit, airstrip and airstrip access road, and mine access road (the "Freegold Road") connecting the mine site to Carmacks. The Freegold Road construction will require 85 km of upgrading along the existing road segment, and 120 km of new road development along the Freegold Road extension. The open pit construction will require the diversion and eventual de-commissioning of a non-fish bearing section of upper Canadian Creek. In addition, as part of the proposed Fish Habitat Offsetting Plan, a 1.4 km portion of lower Britannia Creek will be re-aligned into its historical channel. The Casino Fish Habitat Offsetting Plan (FHOP) provided an updated overview of project components which may cause the destruction or permanent alteration of fish habitat in Table 3-8 of Appendix A.10A. Table B.10.2-1 and Table B.10.2-2 below are replicates of Tables 3-8 and 3-9 in Appendix A.10.A, however, estimated habitat loss from Taylor Creek, a tributary of upper Casino Creek, has been added here (please refer to the response to R2-132 for further detail on this change).

Of the project components listed above, it is anticipated that a *Fisheries Act* authorization may be required for the following items:

- Destruction of fish habitat in mid to upper Casino Creek (15,952 m^2), creating a potential residual impact on the carrying capacity of local Arctic grayling populations, resulting in a potential reduction of overall yield.
- Permanent habitat alteration in lower Casino Creek due to TMF construction upstream (wetted habitat loss of 3,157 m^2), creating a potential reduction in productivity per unit area of habitat for local fish species (Arctic grayling and slimy sculpin).
- Permanent habitat alteration in Dip Creek immediately downstream of Casino Creek due to TMF construction upstream (wetted habitat loss of 1,001 m^2), creating a potential reduction in productivity per unit area of habitat for local fish species (Arctic grayling, slimy sculpin).
- Permanent habitat alteration in Canadian Creek due to construction of the open pit, which is expected to cause minor flow alterations in fish-bearing waters downstream (wetted habitat loss of 299 m^2), and may result in a potential reduction in productivity per unit area of habitat for local Arctic grayling populations
- Destruction of fish habitat in lower Britannia Creek due to a component of the project's fish habitat offsetting plan (4,112 m^2), creating a potential reduction of the carrying capacity of local fish species that reside in this 1.4 km avulsed stream section (e.g., Arctic grayling, slimy sculpin, juvenile Chinook salmon)
- Destruction of fish habitat in the Dip Creek tributary intersecting the airstrip (330 m^2); the habitat is of low quality and unlikely to support fish, however due to its seasonal connection there is the possibility for a minor residual impact on local fisheries productivity.
- Permanent habitat alteration at road crossing sites along the proposed Freegold and airstrip access roads. Currently short-span bridges are being proposed at all fish-bearing crossings (with the exception of the Nordenskiold Bridge which will have a single pier). There will be placement of riprap materials below the high water mark at all bridges to minimize erosion and sedimentation into watercourses. The permanent alteration of stream banks at the majority of crossings has the potential to reduce the productivity per unit area of habitat for local fish species along the road corridor.

- Destruction of fish habitat due to the Nordenskiold Bridge pier (estimated 6 m^2 footprint), and permanent habitat alteration of the immediate local area around the pier due to minor changes in stream and sediment conveyance. The placement of the pier may have a small impact on local fisheries productivity, further described in the response below to requests R2-142, R2-143 and R2-144.
- No death of fish is anticipated due to project activities.

In addition to in-stream habitat loss, total riparian habitat loss was quantified in the FHOP (Table 3-9, Appendix A.10A). Estimated riparian habitat loss was for noted areas that will experience destruction of fish habitat, as detailed in Table B.10.2-2.

Table B.10.2-1 Estimated In-stream Habitat Loss

Watercourse or Subwatershed (project impact in parentheses)	Stream Length (m)		Stream Area (m^2)		Modelled Area (m^2)	
	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing
Total Habitat Loss within project footprint[a]						
Lower Britannia Creek (reinstatement of historical channel for offsetting)	1,405	0	11,263	0	4,112	n/a
Upper Canadian Creek (diversion into Open Pit)	0	3,483	0	17,415	n/a	n/a
Upper Casino Creek watershed above Reach 2/3 break (TMF footprint)[c]	10,280	4,509	25,501	7,572	10,125	n/a
Upper Casino Creek watershed below Reach 2/3 break (TMF footprint)[d]	12,832	0	25,384	0	5,827	n/a
95 watercourse crossings (Freegold Extension)	0	1,031	0	787	n/a	n/a
37 watercourse crossings (Freegold Upgrade)	0	30	6[f]	24	6[g]	n/a
Unnamed tributary of Dip Creek (diversion around Airstrip)	1,479	0	2,203	0	330	n/a
10 watercourse crossings (Airstrip Access Road)	0	91	0	54	n/a	n/a
Wetted Habitat Loss due to stream flow reductions[b]						
Lower Canadian Creek (downstream of open pit)	7,000	0	801	0	299	n/a
Lower Casino Creek (downstream of TMF)[e]	6,500	0	1,438	0	3,157	n/a
Dip Creek (downstream of TMF)	8,500	0	2,342	0	1,001	n/a
Total	**47,996**	**9,144**	**68,938**	**25,852**	**24,857***	**n/a**

[a] Areas experiencing "Total Habitat Loss" were obtained from a combination of field and 1:50,000 GIS base mapping measurements (Impacted Stream Area (m^2)), and from HEP analyses (Impacted Modelled Area (m^2)) (PECG and Normandeau, 2014)

[b] Areas experiencing "Wetted Habitat Loss" were obtained from in-stream flow (PHABSIM) modelling results, where Impacted Stream Area (m^2) is the total change in rearing habitat as it represented the median loss of habitat for the entire ice-free season (May 15 – September 30); and Impacted Modelled Area (m^2) is based on the calculated change in usable Arctic grayling wetted habitat, where habitat loss was considered by project phase, with the maximum values by phase reported here (PECG and Normandeau, 2014).

[c] Includes Casino Creek Reach 3, Taylor Creek, Proctor Gulch and Tributary 3.

[d] Includes Casino Creek Reach 2, Meloy Creek, Tributary 1 and Tributary 2.

[e] Includes Casino Creek Reach 1 (i.e., downstream of Brynelson Creek).
[f] Habitat loss from the Nordenskiold River bridge pier.
[g] No modeled value available as there were no habitat limitation criteria identified.
* Denotes final *Fisheries Act* authorization value

Table B.10.2-2 Estimated Riparian Habitat Loss

Watercourse or Subwatershed (Project Impact in parentheses)	Stream Length (m)		Riparian Area (m^2)		
	Fish-bearing	Non-fish-bearing	Fish-bearing	Non-fish-bearing	Total Area
Lower Britannia Creek (Reinstatement of Historical Channel for Offsetting)	1,405	0	46,495	0	46,495
Upper Canadian Creek (diversion into Open Pit)	0	3,483	0	34,830	34,830
Upper Casino Creek watershed (TMF footprint)	22,571	6,241	435,450	62,410	497,860
95 watercourse crossings (Freegold Extension)	728*	481	31,590	4,810	36,400
37 watercourse crossings (Freegold Upgrade)	286*	195	10,140	1,950	12,090
Unnamed tributary of Dip Creek (Diversion around Airstrip)	1,449	0	43,470	0	43,470
10 watercourse crossings (Airstrip Access Road)	73*	68	2,190	680	2,870
Total			**569,335**	**104,680**	**674,015**

Note: 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 and the upper Casino Creek watershed where fish use is rare (i.e., 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.

B.10.3 CHARGE WEIGHTS

B.10.3.1.1 R2-131

R2-131. Demonstrate that proposed charge weights to be used in construction of the access road and infrastructure pads will not cause harm to fish and fish eggs.

Current engineered design indicates that the majority of project blasting activities will occur outside of water and at safe distances from fish. Should detailed engineering indicate that blasting will be required along the access road or for construction of infrastructure pads, CMC will work with DFO as part of the permitting process under the *Fisheries Act* to develop site-specific impact assessment and mitigation. Mitigation measures that will be followed by CMC for all blasting activities in and around water include the following recommendations as outlined by DFO:

- Blast charge weights will be minimized and each charge will be subdivided into a series of smaller charges in blast holes (i.e. decking) with a minimum 25 millisecond (1/1000 seconds) delay between charge detonations.
- If blasting in water, blast holes will be back-filled with sand or gravel to grade or to streambed/water interface to confine the blast.
- Blasting mats will be placed over top of holes to minimize scattering of blast debris around the area.
- Ammonium nitrate based explosives will not be used in or near water.

- All blasting debris and other associated equipment/products from the blast area will be removed following blasting.

Safe setback distances, as described in DFO guidance (Wright and Hopky, 1998) will be adhered to for all blasting activities in and near watercourses. A key mitigation measure that will be employed is adherence to fisheries timing windows, which will protect sensitive life cycle stages. Road construction is currently proposed during June to August, which may conflict with Chinook salmon spawning windows in some locations. Exact blasting locations will be refined following the completion of site specific investigations. Priorities for blasting along the road alignment will be ranked according to avoidance of fisheries timing windows, and in particular avoidance of Chinook salmon spawning windows. The Registered Professional Biologist responsible for *Fisheries Act* approvals will provide locations of fish habitat, including locations of spawning beds, rearing areas and migration areas, as well as species and life stages of fish using the habitat when blasting is proposed. The construction teams and the fisheries biologists will work together to determine the most effective environmental protection and mitigation plans. Project planning will focus on scheduling to avoid sensitive life stages, such as embryos in gravel, as well as adult spawning migrations. Additional protection measures could include isolating or dewatering the work area, localized fish relocations from the zone of impact, or creating pressure wave interference. All sites will be surveyed for debris post-blasting and any disturbed streambanks will be restored within the same season. These mitigations are considered best management practices for blast management in fish habitat.

B.10.4 BASELINE DATA

B.10.4.1.1 R2-132

R2-132. More information on the fish passage barrier in Taylor Creek, including clarification of its location and documentation that there are no upstream fish. If it is not available, the habitat upstream of the potential barrier in Taylor Creek should be included in calculation of habitat losses. This should follow the advice provided in Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (Research Document 2008/026): Protocol for the Protection of Fish Species at Risk in Ontario Great Lakes Area (Fisheries and Oceans Canada, 2008).

As previously described in Section 10 and in SIR A.10, the fish passage barrier noted on Taylor Creek was determined as likely to obstruct fish passage under the majority of standard flow conditions. Further, the shallow, low quality habitat of Taylor Creek, lack of perennial habitat noted upstream, and lack of fish caught during the 2014 season further suggests that the stream provides little to no contribution to fisheries productivity. In addition, multi-year fish sampling at sites further downstream with relatively better habitat quality and a closer connection to downstream areas (e.g. F07 in upper Casino Creek) clearly demonstrates the low frequency of fish residing in the upper Casino Creek watershed (e.g., Table 6-8, Appendix 10A). Thus, the potential for fish to reside in even smaller, further upstream reaches with measurably lower habitat suitability is considered to be highly unlikely.

Information regarding the location of the barrier was erroneously stated as being 400 m upstream of its confluence of Casino Creek in Appendix A.10B. The actual location of the barrier has been verified by both desktop GIS methods and in the field using a hip chain, with results varying from 250 – 300 m. The previously provided habitat loss calculations incorporated the upper of the two estimates (300 m), as this represents the more conservative value for potential habitat loss.

Despite the unlikeliness of Taylor Creek supporting any CRA fisheries either directly or indirectly, habitat loss for the creek has been calculated here and added to the overall habitat budget as a conservative measure and to address reviewer concerns. The new addition of instream habitat loss to the overall budget is 1,225 m^2 for the section of Taylor Creek upstream of the barrier to the creek headwaters calculated as follows:

Stream length above barrier = 3,063 m

Total stream area = 6,126 m^2

Habitat Evaluation Procedure HSI Score=0.2

$6{,}126\ m^2 \times 0.2 = 1{,}225\ m^2$

The updated value has been included in Table B.10.2-1 and Table B.10.2-2 above. Please refer to SIR Appendix A.10B for details on Habitat Evaluation Procedure (HEP) methods.

B.10.4.1.2 R2-133

R2-133. Fish presence and habitat suitability maps that include information on freshwater species.

Project activities will adhere to recommended fisheries timing windows as provided by DFO, which includes avoiding work in and around water from April 16 – June 30 for watercourses that may support spring spawners such as Arctic grayling. Figures A.10.4-1 to A.10.4-8 previously identified documented presence of Chinook salmon spawning and rearing areas. These figures have now been updated to indicate both documented Arctic grayling presence and potential presence as based on a review of the DFO Fish Information Summary System for the Yukon (DFO, 2015), and information provided in Appendix 10B Freegold Road Baseline Report. Updated figures are provided in Figure B.10.2-1 through Figure B.10.2-8. While habitat suitability will vary by site, a conservative approach was taken to include all fish-bearing sites along the road corridor as potentially supporting spring spawning fish species. For further site-specific information, please refer to details found in Appendix 10B.

B.10.4.1.3 R2-134

R2-134. A table including information on ephemeral channels and the likelihood of fish species presence during wetted periods.

Table A.10.4-2 has been updated in Table B.10.4-1 to include wetted period, likely fish presence, and any additional assessment comments to aid in the review of non-fish-bearing habitat along the road. Qualifiers for fish presence *during wetted periods* ranged from very likely (>75% chance of fish presence), likely (25-75% chance of fish presence), very unlikely (<25% chance), to not possible (0%).

Table B.10.4-1 Rationale for Non-Fish-Bearing Status along the proposed Freegold Upgrade, Extension, and Airstrip and Airstrip Road

Crossing #	Rationale for Non Fish Bearing Status	Wetted Period	Fish presence during wetted periods	Comments
Freegold Upgrade Section:				
29N	Creek flows underground downstream of crossing due to major channel disturbance	n/a – not connected to areas downstream	No fish access	
39	Dry ephemeral	After large rainfall events and snowmelt	Very unlikely	Site photos and illustration demonstrate that ephemeral runoff disperses over the road; no channel connection by culvert (Appendix 10B)

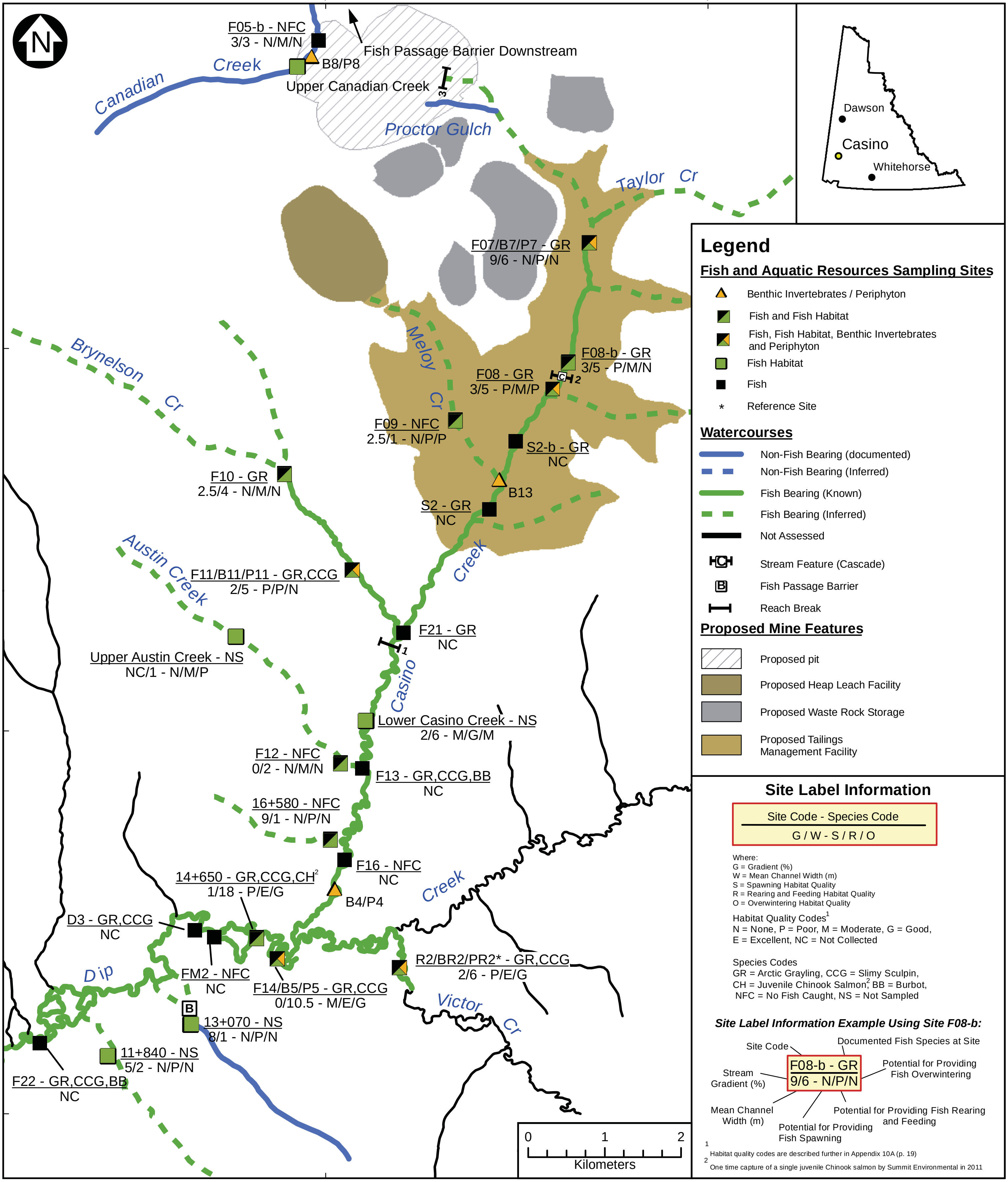
Crossing #	Rationale for Non Fish Bearing Status	Wetted Period	Fish presence during wetted periods	Comments
39.5	Stream is not permanent and contains a series of ponds and intermittent short connector channels which originate from groundwater pool 20m above crossing	Intermittent (likely becomes discontinuous in late summer)	Very unlikely	Site is highly disturbed and flow originates 20m upstream of crossing
47	Dry ephemeral channel with perched culvert	After large rainfall events and snowmelt	No fish access due to perched culvert	
48.5	Dry ephemeral channel with perched culvert	After large rainfall events and snowmelt	No fish access due to perched culvert	
50.5	Bog habitat separated from Big Creek side channel with metal grate	Year-round bog habitat	Very unlikely	Stagnant water present, grate over culvert prohibits larger fish movement
Freegold Extension Section:				
15+500	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
19+570	disconnected shallow oxbow marsh	n/a – no fish access		
20+390	very small turbid runoff, channel not well defined	Intermittent (likely becomes discontinuous in late summer)	Very unlikely	Watercourse was small, highly turbid and had little to no channel definition
22+960	dry intermittent, no connection to Big Creek downstream	After large rainfall events and snowmelt	No connection to Big Creek; no fish access	
23+000	dry intermittent, no connection to Big Creek downstream	After large rainfall events and snowmelt	No connection to Big Creek; no fish access	
26+740	no visible channel, standing pools of water without connector streams	After large rainfall events and snowmelt	No connection to Big Creek; no fish access	
35+340	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
43+110	stream is not permanent: flow goes underground and dries up in several areas downstream of crossing	After large rainfall events and snowmelt	No connection to Hayes Creek; no fish access	
45+150	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
53+590	underground flow, small poorly defined channel, muddy flow	After large rainfall events and snowmelt	Very unlikely; no fish access under most flow scenarios	Segments of underground flow were present
58+070	dry ephemeral upstream, flow goes underground downstream	After large rainfall events and snowmelt	No connection to Hayes Creek; no fish access	
60+220	stream not permanent, low flow barriers noted both	Intermittent (likely becomes	Very unlikely	

Crossing #	Rationale for Non Fish Bearing Status	Wetted Period	Fish presence during wetted periods	Comments
	upstream and downstream of crossing	discontinuous in late summer)		
60+870	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
69+110	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
71+290	no defined channel, very low flow grass swale	Intermittent (likely becomes discontinuous in late summer)	Very unlikely	
81+120	dry ephemeral	After large rainfall events and snowmelt	Very unlikely	
81+570	small shallow muddy poorly defined channel, no direct fish habitat	After large rainfall events and snowmelt	Very unlikely	
81+680	small shallow poorly defined intermittent channel over shallow permafrost; goes underground upstream	After large rainfall events and snowmelt	Very unlikely	
81+610	small shallow poorly defined channel not providing direct fish habitat	After large rainfall events and snowmelt	Very unlikely	
Airstrip Section:				
11+750	intermittent flow; stagnant disconnected puddles	After large rainfall events and snowmelt	Very unlikely	
17+620	small shallow muddy flow, goes underground downstream of crossing	n/a – no fish access downstream		
20+960	no surface flow downstream of crossing	n/a – no fish access downstream		

B.10.4.1.4 R2-135

R2-135.Additional information that allows for quantification of existing habitat value in Casino Creek.

Figure A.10.4-9 has been updated and expanded to provide additional clarity regarding the fish and fish habitat information in Casino Creek, provided in Figure B.10.4-1. In addition, Table B.10.4-2 provides an outline of the number of sites and available information provided in Figure B.10.4-1, as well as links to additional information. In summary, there were a total of four fish habitat sites on the mainstem of Casino Creek, and 6 fish habitat sites on the Casino Creek tributaries. Fish presence is summarized in the column labelled “Fish Species” and indicates all fish species caught at each site, or if no fish were captured. In addition to these discrete habitat sites, Physical Habitat Simulation (PHABSIM) and Habitat Evaluation Procedure (HEP) methods completed as part of in-stream flow studies provided habitat information collected along long continuous distances of each watercourse. This additional data has not been summarized here due to its magnitude, however, has been provided in Appendix A.10B.



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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: 1:65,000

CASINO

CASINO PROJECT

Casino Creek Fish and Aquatic Resources Baseline Summary Map

Figure B.10.4-1

Table B.10.4-2 Guide to Fish and Fish Information in Casino Creek, Upper Dip Creek, and Upper Canadian Creek as presented in Figure A.10.4-9

Watercourse	Site	Fish Species	Stream Gradient (%)	Mean Channel Width (m)	Habitat Quality			Additional Information Reference
					Spawning	Rearing or Feeding	Over-wintering	
Canadian Creek	F05-b / Upper Canadian Creek	NFC	3	3	N	M	N	Appendix 10A (Project Proposal): P. 29: fish community; P. 30: barrier assessment; P. 33-36 fish habitat survey results; P. 37-38: watershed summary; P. 43: Table 6-2 Fish Sampling Sites; P. 45: Table 6-3 Barrier Assessment; P. 53: Table 6-12 Fish Habitat Characteristics
Casino Creek (mainstem)	F07/B7/P7	GR[1]	9	6	N	P	N	Appendix 10A (Project Proposal): P. 28-29: fish community; P. 33-36 fish habitat survey results; P. 36-37: watershed summary. P. 43: Table 6-2 Fish Sampling Sites; P. 53: Table 6-12 Fish Habitat Characteristics [1]Note: Three adult Arctic grayling were captured in summer 2014 and thus the information was not included in the Baseline Report.
Casino Creek (mainstem)	F08-b	GR	3	5	P	M	N	Please refer to F07/B7/P7
Casino Creek (mainstem)	F08	GR	3	5	P	M	P	Please refer to F07/B7/P7
Casino Creek (mainstem)	S2-b	GR	NC	NC	NC	NC	NC	Please refer to F07/B7/P7
Meloy Creek	F09	NFC	2.5	1	None	P	P	Please refer to F07/B7/P7
Casino Creek (mainstem)	S2	GR	NC	NC	NC	NC	NC	Please refer to F07/B7/P7
Casino Creek (mainstem)	F21	GR	NC	NC	NC	NC	NC	Please refer to F07/B7/P7
Brynelson Creek	F10	GR	2.5	4	N	M	N	Please refer to F07/B7/P7
Brynelson Creek	F11/B11/P11	GR, CCG	2	5	P	P	N	Please refer to F07/B7/P7
Casino Creek (mainstem)	Lower Casino Creek	NS	2	6	M	G	M	Please refer to F07/B7/P7
Casino Creek (mainstem)	F16	NFC	NC	NC	NC	NC	NC	Please refer to F07/B7/P7
Austin Creek	Upper	NS	NC	1	N	M	P	Please refer to F07/B7/P7

Watercourse	Site	Fish Species	Stream Gradient (%)	Mean Channel Width (m)	Habitat Quality			Additional Information Reference
					Spawning	Rearing or Feeding	Over-wintering	
	Austin Creek							
Austin Creek	F12	NFC	0	2	N	M	N	Please refer to F07/B7/P7
Casino Creek (unnamed tributary)	16+580	NFC	9	1	N	P	N	Please refer to F07/B7/P7
Casino Creek (mainstem)	F13	GR, CCG, BB	NC	NC	NC	NC	NC	Please refer to F07/B7/P7
Victor Creek	R2/BR2/PR2 *	GR, CCG	2	6	P	E	G	Appendix 10A (Project Proposal): P. 30: fish community; P. 33-36: fish habitat survey results; P. 38: site summary; P. 43: Table 6-2 Fish Sampling Sites; P. 53: Table 6-12 Fish Habitat Characteristics.
Dip Creek (mainstem)	F14/B5/P5	GR, CCG	0	10.5	M	E	G	Appendix 10A (Project Proposal): P. 29: fish community; P. 30: spawning survey; P. 33-36: fish habitat survey results; P. 37: watershed summary; P. 43: Table 6-2 Fish Sampling Sites; P. 53: Table 6-12 Fish Habitat Characteristics.
Dip Creek (mainstem)	14+650	GR, CCG, CH[2]	1	18	P	E	G	Appendix 10B (Project Proposal): P. 30-32, 36, 52-53 and Site Card in Appendix D (found within Appendix 10B)
Dip Creek (mainstem)	FM2	NFC	NC	NC	NC	NC	NC	Please refer to F14/B5/P5
Dip Creek (mainstem)	D3	GR, CCG	NC	NC	NC	NC	NC	Please refer to F14/B5/P5
Dip Creek (unnamed tributary)	13+070	NS	8	1	N	P	N	Appendix 10B (Project Proposal): P. 30-32, 36, 52-53 and Site Card in Appendix D (in Appendix 10B)
Dip Creek (unnamed tributary crossing airstrip)	11+840	NS	5	2	N	P	N	Appendix 10B (Project Proposal): P. 30-32, 36, 52-53 and Site Card in Appendix D (found within Appendix 10B)
Dip Creek (mainstem)	F22	GR, CCG, BB	NC	NC	NC	NC	NC	Please refer to F14/B5/P5

Habitat Quality Codes: N = None, P = Poor, M = Moderate, G = Good, E = Excellent, NC = Not Collected;
Species Codes: GR = Arctic Grayling, CCG = Slimy Sculpin, CH = Juvenile Chinook Salmon, BB = Burbot, NFC = No Fish Caught, NS = Not Sampled;
Habitat quality codes are described further in Appendix 10A (p. 19) of the Project Proposal;
[2]One time capture of a single juvenile Chinook salmon by Summit Environmental in 2011.

B.10.4.1.5 R2-136

R2-136. Additional quantitative baseline data including fish population and density estimates for all areas that will be impacted by changes in flows (reduced flows, changes in flow due to discharge and timing changes in flows). This should include a description of data quality objectives for both precision and accuracy relative to CPUE abundance estimates and how the data will be used to determine relative number of fish present for future comparisons (e.g. monitoring for change).

The objective of the baseline studies was to obtain information on the existing fish community, species diversity, and use of habitat. The selection of fish sampling sites and sampling methods were comparable to other environmental baseline studies found in remote locations of western Canada (e.g. Eagle Gold Project, Galore Creek Copper-Gold-Silver Project, Kitsault Mine Project). Further, site locations were established following the BC MOE fish inventory guidelines (BC MOE, 2001), which included the following techniques to achieve systematic and representative sampling:

- Sampling covered the range of habitats present (e.g., riffle, pool, run), and site lengths were often extended to adequately capture the proportion and type of habitats available in a particular stream reach;
- Fishing techniques were appropriate to the habitats being sampled, and the fish species and life stages that may be present;
- A minimum of two sampling methods were used at all sites;
- Reasonable effort was undertaken to ensure that all species present were represented in the catch; and
- Sampling site lengths for electrofishing typically followed the recommended protocol (the greater of 100 m or 10 times the bankfull width).

In addition to following the BC MOE protocol, a minimum of one site per reach was identified using the professional judgement of biologists familiar with fish habitat in the project area. Areas with greater project related impacts were designed to have a higher concentration of sites and were sampled more frequently in order to better capture any potential baseline variability.

Creeks which may experience changes in flow due to project activities are outlined in Section 10 of the Project Proposal, and include Casino Creek, Dip Creek, and Canadian Creek. In order to capture any potential baseline variability among sites or years, multiple fish and aquatic resources sites were established in these creeks and surveyed over multiple years during the baseline program (see Tables 6-1 and 6-2 and Figures 6-1 and 6-2 in Appendix 10A for an overview of baseline sampling details). All sampling details were recorded diligently and presented in the baseline study and are thus comparable among sites and years where similar methods are applied. Method standardization permits repeatable measures of CPUE to be taken.

Fish abundances are clearly stated as relative and not total abundances and should be interpreted as such. The use of relative abundance as a metric to infer fish population size is standard practice of fisheries monitoring elsewhere (Seber, 1992; Kohler and Hubert, 1993), as one-pass electrofishing methods allow for a greater area to be sampled with less expenditure in time, effort, and resources, which is important for successfully completing large watershed-scale studies (Hense, et. al., 2010). In addition, studies have demonstrated that results from one-pass methods can be accurately used to infer population-level phenomena (Kruse, et. al., 1998; Hense, et. al., 2010). Each sampling site consisted of several habitat types representative of the broader study area, allowing future comparisons at the same site or other areas equally representative of the stream reach under study (BC MOE, 2001). Three-pass removal experiments that provide total abundance values were attempted and later determined to be ineffective for the following reasons:

1. Low densities of fish in the majority of sampling areas did not generally show a pattern of decreasing catch per electrofishing pass, invalidating the model assumption of constant catchability;
2. Larger streams with higher densities could not be adequately isolated to produce the assumption of a closed study area;
3. Many of the stream reaches are only seasonally inhabited, which is problematic for both estimating and interpreting a stable 'resident' population estimate.

Fish catch per effort was standardized with the CPUE index (e.g., fish caught per 100s of electrofishing) for comparability. Various fishing techniques were chosen in accordance with the habitat types being sampled, and the fish and life history stages known to be present (BC MOE, 2001). Different fishing techniques (e.g., electrofishing vs. minnow trapping) are not meant to be compared against each other, but are meant to monitor for changes over time at the same locations using the same fishing methods.

B.10.4.1.6 R2-137

R2-137. Rationale and justification for the selection of reference sites and a description for how the data from the reference sites will be used for future comparisons (i.e. monitoring through all project phases).

As outlined in the Fish and Aquatic Resources Baseline Report (Appendix 10A), two sites were established as reference sites, R2 on Victor Creek and F19 on Coffee Creek, with both being carefully selected. As a variety of stream habitat types are being altered due to the Casino Project, the two sites were chosen to represent the range of habitat types and species present. For example, R2 is more typical of lower Casino Creek or upper Dip Creek (downstream of Casino Creek), as it is a larger stream with a higher density of slimy sculpin. As slimy sculpin display high site fidelity, the relative proximity to the project will not compromise its ability to serve as a reference site. Further, the lack of fish caught in one year at this site was an important baseline point, as sculpin populations may undergo small migrations, or experience periodic winter kill depending on site conditions.

In contrast, F19 on a tributary of upper Coffee Creek is a higher altitude, smaller watercourse containing mainly adult and sub-adult Arctic grayling, and is more typical of mid Casino Creek or Canadian Creek. While it is true that there is proposed development on an independent tributary of Coffee Creek far downstream (>10 km), it is unlikely that Arctic grayling would be utilizing both areas during summer, and neither tributary contains evidence for overwintering habitat. Thus, the potential for cumulative project effects is low.

Finally, the online Yukon Placer Secretariat database which contains information regarding development or potential development in the vicinity of the project reveals that there is extensive exploration activity in this region, which complicates the identification of pristine reference sites that are accessible, have fish, and are relatively similar to sites in the project area. CMC has spent considerable time locating suitable reference sites for the Project, and have selected two sites that meet the basic criteria of monitoring comparability as described above.

Data from reference sites will continue to be compared to data from impact sites in order to monitor for changes through all project phases. As outlined in the Fish and Aquatic Resources Baseline (Appendix 10A), metrics for comparison may include catch-per-unit-effort as a measure of relative fish abundance, fish growth (i.e. length-at-age), fish life history use (i.e. fish age and size), fish community composition, concentration of metals in fish tissues, fish habitat quantity and quality, and characteristics of periphyton and benthic invertebrate communities. Through the permitting process, the frequency of monitoring as well as the number and location of monitoring sites and metrics to be employed will be identified in order to evaluate any potential effects of mining on aquatic resources.

B.10.4.2 Missing Appendices Documenting Baseline Data

B.10.4.2.1 R2-138

R2-138. Final reports related to baseline data, if available, of appendices A – E for appendix 10A - Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.

Appendices A through F of the Fish and Aquatic Resources Baseline Report (Appendix 10A) were provided as Appendix A1 – A5 of the Water and Sediment Quality Baseline Report (Appendix 7A) and are not provided herein, but can be found in the Proposal.

Appendix A (2008 Aquatic Studies Report) was re-issued in SIR-A as Appendix A.7E with a cover letter indicating that while the report was issued as a "draft for discussion", the report was in fact finalized. Missing figures were also included in Appendix A.7E.

Additionally, while the cover letter of Appendices C and D (2010 and 2011 Aquatic Studies Reports) indicate that the report is "draft for discussion", the reports themselves are final versions of the reports.

Therefore, the final reports related to baseline data have been provided, and can be found in:

- Appendix 7A;
- Appendix A.7D; and
- Appendix A.7E.

B.10.5 PHYSICAL HABITAT SIMULATION MODEL AND HABITAT EVALUATION PROCEDURE

B.10.5.1.1 R2-139

R2-139. Additional information regarding the HEP including:

a. methods and data used to calculate habitat gains;

b. seasonal use by life stage for Arctic grayling; and

c. incorporation of all life stages into the HEP.

a. Habitat losses and corresponding habitat gains were modeled using the same tools. In streams that would experience a reduction in flow, PHABSIM was used, whereas HEP was used in streams that would be completely removed under the proposed mine plan. As part of the offsetting plan for lower Britannia Creek, habitat gains were calculated using a River 2D model in conjunction with the HEP analysis. Once constructed, the River 2D model provided the ability to predict flow information and habitat parameters in the dry channel, through the calculation of depths and velocities, for a supplied stream flow (http://www.river2d.ualberta.ca/description.htm). Habitat quality was calculated in the Britannia channel through the use of a "virtual HEP". Using the River 2D model, and a discharge equivalent to a normal low flow for lower Britannia Creek, each habitat unit in the model was measured. Overall habitat quality in the channel was then input into, and calculated, using the HEP analysis, as used elsewhere for the project. HEP modeling for the channel resulted in 100% usability, based on the availability of pool habitat in the channel. All additional identified offsetting opportunities were/will be calculated as 100% useable, as habitat may be created and/or modified as necessary in order to assure maximum usability for the target species. If habitat is used for offsetting that cannot be modified to provide maximum usability, additional models or analyses may be used to calculate usability at that time.

b. It is recognized that Arctic grayling have complex migration behaviour, utilizing different habitats for spawning, rearing and overwintering. HEP data collection for the Casino mine project included collecting specific data for areas deemed appropriate for all life-stages. Additionally, data was collected and analyzed such that habitat units suitable for rearing by either adults, juveniles or fry could be separately analyzed, as per the appropriate habitat suitability indices. Since the HEP analysis relies on the most limiting habitat in order to calculate habitat usability, percent pool for Arctic grayling rearing was most often the HSI utilized in calculation of useable area.

c. As noted in b., all life stages of Arctic grayling were considered in the HEP analysis. A HEP analysis identifies limiting environmental variables for the entire life-cycle of a species. Each variable in the model was chosen because it incrementally limits the survival and abundance of either a single or multiple life-stages. If any of the variables is poor quality (i.e. has a low suitability index) that variable will limit the carrying capacity of the stream reach. The variable with the lowest habitat quality will control the carrying capacity of the reach. In this case five habitat variables were chosen as being potentially limiting: % spawning substrate, % fines in spawning areas, % total fines, overwintering habitat, and % pools and backwaters. Since the HEP applies to the entire life-cycle all life-stages are included by design even if the most limiting environmental factor applies to only one life-stage such as spawning or rearing.

B.10.5.1.2 R2-140

R2-140. More information on information used in the PHABSIM model. This should include:

a. A comparison of the streamflows from Knight-Piésold and that used in the PHABSIM model including tables and figures to illustrate the comparison;

b. Clarity on assumptions and objectives of the modelling process regarding the estimation of impacts on fish habitat (e.g. average conditions, extreme flows, time periods etc.);

c. Clarity around the consideration of fish stranding in the assessment (i.e. were extreme low flows considered in the assessment); and

d. All sources of data used in the hydrology assessment and a detailed description of methods.

a. The synthetic flow series provided in the Hydrology Baseline Report (Appendix 7B) was used to inform the PHABSIM models for Casino, Canadian and Dip Creeks. As data for only the open water season was necessary for portions of the analysis (Spawning, Fry, Juvenile and Adult rearing), data used was constrained to May 15 to September 30 of each year. Years 1990 to 2012 were selected for the analysis, as these provided data with lower potential error. Further analysis revealed that using the entire synthetic data set resulted in virtually identical results across all life stages.

The time series flow data presented in the Appendix A.10B, Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study (page 55) appears different than the Baseline synthetic flow series (Appendix 7B) data because the time series flow data is presented as *daily* flows as opposed to average *monthly* flows. The synthetic flow series used the average monthly flow data to determine the percent change in flow between the baseline flow and the flow during the different phases of construction, operation, and closure. The average monthly flow plots in the synthetic flow series are smoother and do not exhibit the same variation as the daily flows presented in the Fish Habitat Evaluation. While the plots appear different, the plots utilize the same time series flow data. Figure B.10.5-1 depicts how different averaging periods affect the data.

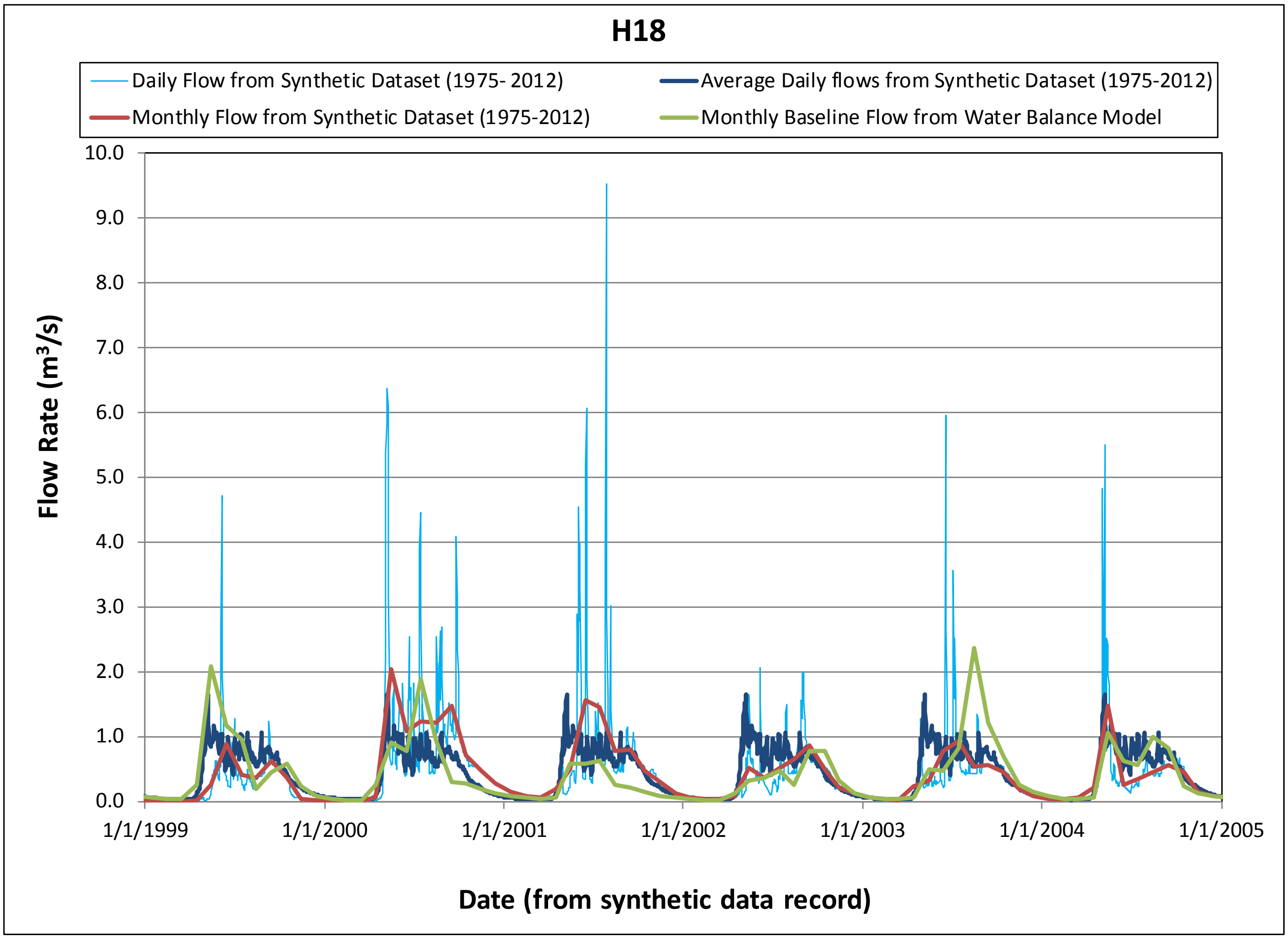

Figure B.10.5-1Flow time series for station H18, Middle Casino Creek.

b. The synthetic flow time series provided in the Hydrology Baseline Report (Appendix 7B) was used in the PHABSIM modeling process for Casino, Dip and Canadian Creeks. The period of 1990 to 2012 was included in the modeling. The habitat time series uses a combination of the habitat/flow relationships and the flow time series data set. The daily flow time series time step ensures that all flow variation within the time range between 1990 and 2012 is preserved and is exhibited in the time-series graphs in the Appendix A.10B, Fish Habitat Evaluation: Instream Flow and Habitat Evaluation Procedure Study (pages 56 to 59). Figure B.10.5-1 shows that the high and low flows are included by using the daily time step. Using the flow time series with 22 years of daily flows ensures that wet, dry, and normal years are included in the analysis.

c. The response to R287 provided information on the potential for fish stranding in Casino Creek due to project effects. Fish stranding is most often caused by rapid changes in flow within a creek, which is not typical for Casino Creek. However, an analysis was conducted using representative transects from lower Casino Creek, and the synthetic time series and predicted project effects provided in the Hydrology Baseline Report (Appendix 7B). Plots of low gradient riffles were created using simulated water levels generated from the flows predicted by the water balance model. In the response to R287, plots were developed for both the summer and winter seasons at the shallowest riffle transect (LGR182). To expand, the figures below (Figure B.10.5-2 through Figure B.10.5-6) illustrate water levels during the low-flow month of September for all riffle transects in Casino Creek. Stranding was deemed to most likely occur in September, as water levels are at their lowest of the open-water season (May – October), and Arctic grayling are moving downstream out of summer rearing habitats to overwintering areas in larger creeks and rivers.

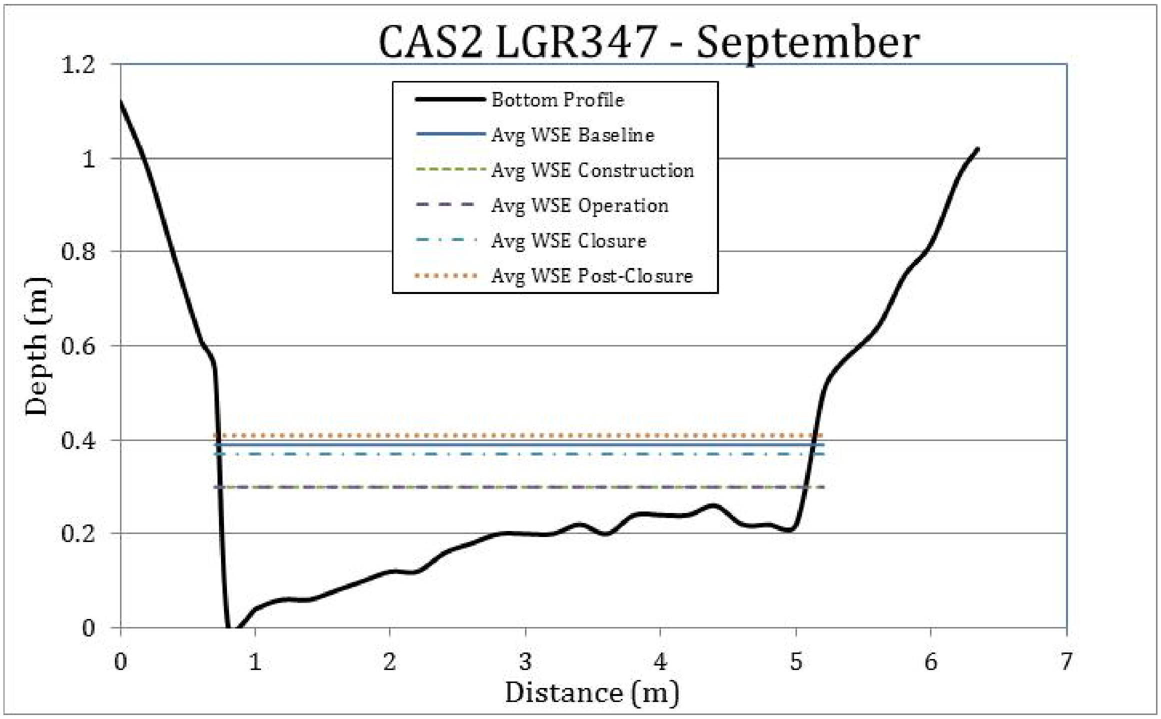

Figure B.10.5-2Average September Water Surface Elevations (WSE) at Low Gradient Riffle LGR347

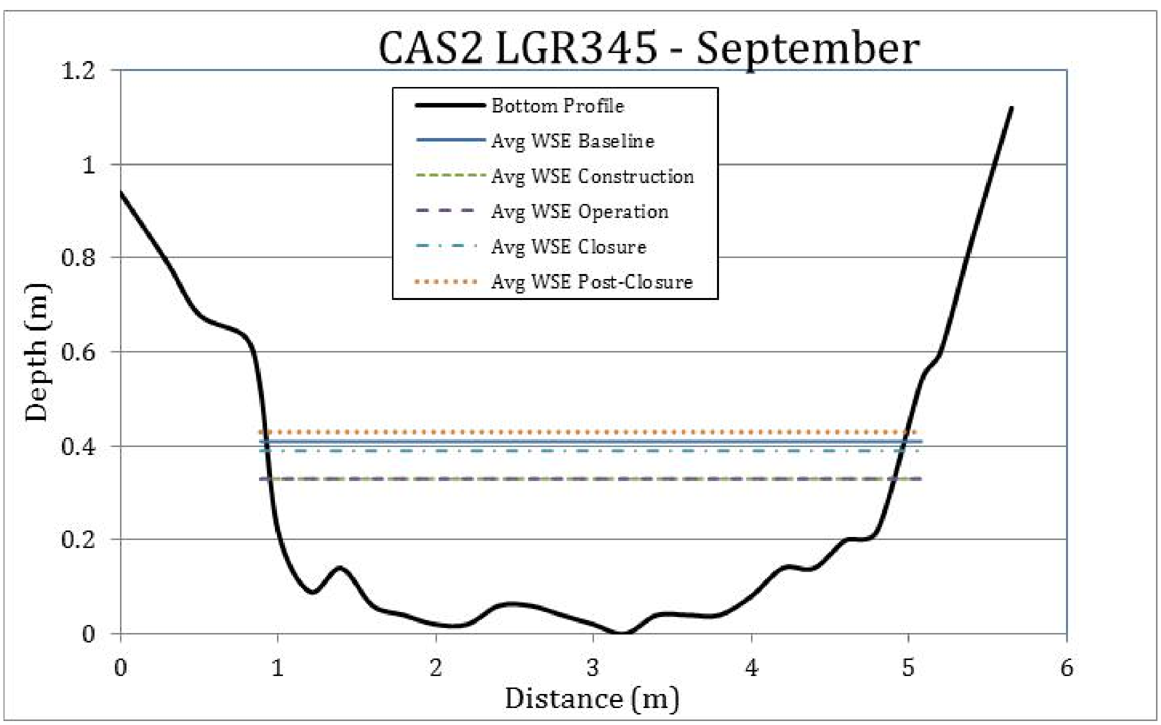

Figure B.10.5-3Average September Water Surface Elevations (WSE) at Low Gradient Riffle LGR345

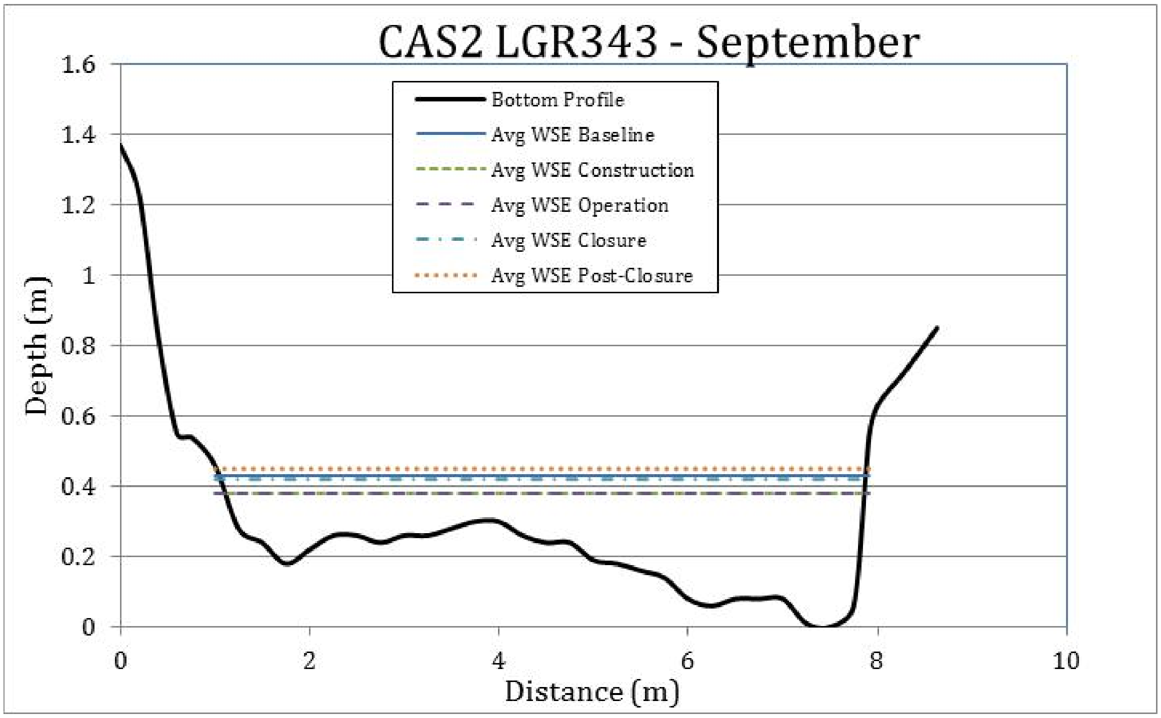

Figure B.10.5-4Average September Water Surface Elevations (WSE) at Low Gradient Riffle LGR343

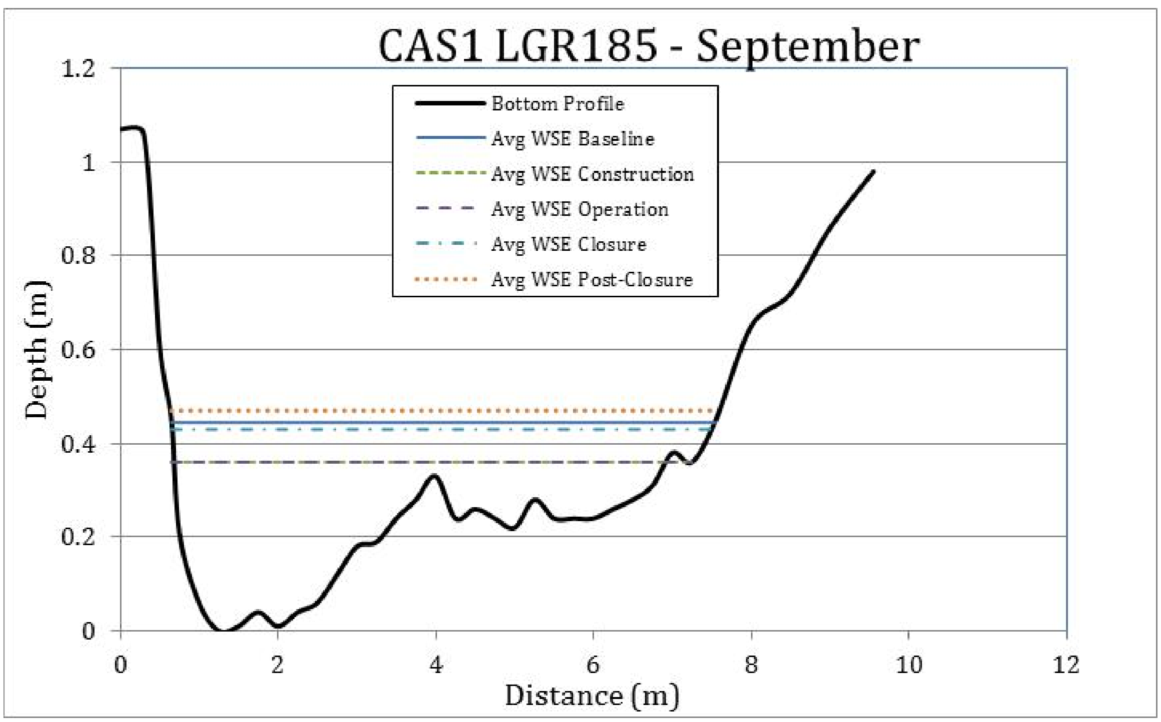

Figure B.10.5-5Average September Water Surface Elevations (WSE) at Low Gradient Riffle LGR185

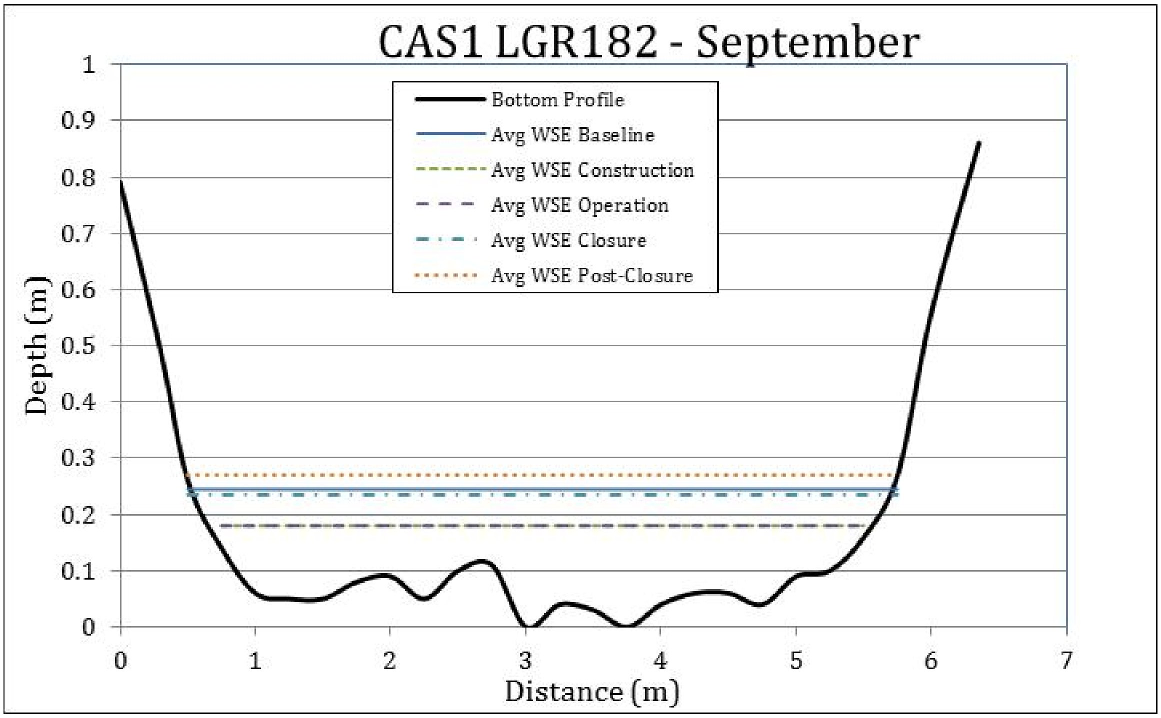

Figure B.10.5-6Average September Water Surface Elevations (WSE) at Low Gradient Riffle LGR182

d. A description of the methods used to collect and produce the hydrology data used can be found in the Casino Baseline Hydrology Report (Appendix 7B). Methods used to create the baseline synthetic flow series can be found in Appendix 7H Casino YESAB Proposal – Project Effects on Water Quantity.

B.10.6 WATERCOURSE CROSSINGS

B.10.6.1 Embedded Culverts on Fish Bearing Streams

B.10.6.1.1 R2-141

R2-141. An assessment of impacts to fish habitat related to culverted stream crossings on the Freegold Road.

As described in the response to R297, the Freegold Road design is at feasibility level design and short span bridges will be the preferred design at all fish bearing crossings. Short-span bridges are low-impact and will not generally result in the loss of fish habitat. All disturbed riparian areas will be restored and construction will abide by all relevant BMPs. For short span bridges, no instream activities are anticipated, however construction timing will still abide by relevant timing windows when spawning habitat is present.

There will be some crossings not suitable for bridges from a safety and engineering perspective (high fills, on sharp corners etc.). In these situations, another crossing design will be required, likely embedded single-cell culverts. These will likely be precast units so that installation will be quick and in the applicable timing window, therefore limiting construction time and temporal scale of impacts. These details and exact crossing locations will be determined during detailed design of the proposed road route. This provides opportunity to site crossings where there will be minimal impact and loss of fish habitat.

Each proposed water crossing requiring a culvert will be visited by a Registered Professional Biologist responsible for *Fisheries Act* approvals for further fisheries assessment to identify environmental constraints and opportunities for each crossing. The biologist will then work with the engineers to determine the exact placement of culverts (where bridges are not suitable). Placement of culverts will avoid spawning habitat wherever possible. Although there will be direct loss of stream substrate from the footprint of culverts, this loss will be offset to ensure no overall loss to fisheries productivity (according to the *Fisheries Act*). CMC will demonstrate that sensitive spawning areas have been avoided, and that where culverts are installed, that fish passage is maintained so that there is no loss of access to habitat upstream of the culverts. Culverts will be designed to maintain stream width and be appropriately sized to allow passage of all fish species found in the watercourse, and the culvert footing will be embedded and native substrate maintained. Construction will occur in the dry, during appropriate timing windows, and will therefore avoid disrupting spawning migrations.

Details on each proposed culvert crossing location will be provided to DFO for review, including an assessment of effects following DFO Pathways of Effects; applicable Measures to Avoid Harm; and a calculation of disturbed or lost habitat from the installation of culverts.

The following commitments and best practices will be used to guide each culvert crossing location and design:

- Detailed fish and fish habitat assessments will be conducted at each proposed culvert crossing location;
- Culvert crossings will be located upstream of important spawning, rearing or overwintering areas where possible;
- Crossings will be placed upstream from existing natural barriers to fish passage, where present;
- Culvert crossings will be avoided at braided channels and will be placed in straight reaches with relatively shallow water depths; and,
- Crossing locations will be selected where stream beds and banks are stable and relatively resistant to erosion.

B.10.6.2 Nordenskiold River Bridge

B.10.6.2.1 R2-142

R2-142. For each, if present, of spawning and rearing habitat, details regarding how pier construction and hydraulic forces will alter the habitat and over what area.

The responses to R300 and R301 provide details on the fish community and a fluvial geomorphological impact assessment at the proposed Nordenskiold River Bridge. Further construction details of the Nordenskiold River Bridge will be provided prior to construction, and as part of detailed design and permitting. The placement of the bridge pier will result in the direct loss of river substrate and fish habitat of approximately 6 m^2, at a location where the mainstem river area is estimated at 1.43 km^2. There will be likely some minor changes in stream and sediment conveyance from the new pier structure, but considering the small area and mid-channel location, this is unlikely to result in significant impacts to fisheries in the river. CMC will conduct further detailed fish habitat assessments in support of the detail design of the bridge and to provide further environmental protection and mitigation measures in support of permitting. The proposed bridge site may support spawning and rearing habitat for any of the documented fish species in the river, including Chinook and Chum salmon. Protection measures and BMPs will be in place during the bridge construction so minimal impacts are expected from pier construction.

B.10.6.2.2 R2-143

R2-143. The rationale for discounting this location as winter habitat, including consideration of juvenile fish species overwintering within substrate.

As depths at the proposed bridge site are less than 1m, it is unlikely that any significant overwintering habitat will be lost. CMC will conduct further detailed fish habitat assessments in support of the detail design of the bridge and to provide further environmental protection and mitigation measures in support of permitting.

B.10.6.2.3 R2-144

R2-144. Discussion of possible options for the bridge, including a no-pier option. This discussion should include a rationale detailing the options and alternatives considered if a no-pier option is not possible.

Engineers evaluated alternative river bridge crossings, but safety and constructability factors were key considerations in the chosen option. The bridge was designed for one pier support, which will have less impact than multiple piers in the water. A supporting pier is required based on the length of the bridge structure, and the load on the piles. Constructing a clear span bridge would require much larger and deeper girders, which would have more impact on the stream banks, and greater impact on fish habitat.

B.10.6.3 Classification of Crossings

B.10.6.3.1 R2-145

R2-145. A list of crossing details noting crossing properties and type of crossing, index by location as indicated in appendix 10B.

As described in the response to R297 updated in the response to R2-8 (Section B.4), two options are proposed for crossing fish bearing streams: short span bridges, and embedded CSP flush passable culverts. Short-span bridges are the preferred alternative; however, selection of the appropriate crossing option will be based on site conditions, environmental and fisheries requirements, geotechnical considerations, constructability, schedule and cost. It is expected that culverts will be selected where the proposed road geometry such as high fills or sharp curves would require a longer bridge. Stream crossing evaluations and site specific designs will be completed during the detailed design phase of the project.

For culverts installed in fish bearing streams will be 1600 mm or 2400 mm in diameter and embedded by a depth of 40% of the culvert diameter with material replicating the natural streambed. The embedded elevation and grade will match the existing stream channel. To prevent subsurface flow through the embedded material during low flow periods, a watertight sill plate will be installed at the outlet. This sill plate will also prevent the embedded material from washing out during high flows, in addition to forcing the stream to flow at depth above the embedded material. Figure B.10.6-1 shows a sample culvert installation and embedment detail.

Culverts will be installed in the dry, which will involve isolating the culvert work site. Isolation of the work site may be carried out using cofferdams, or temporary stream channel diversions. Where practical, water can be pumped from the upstream side to the downstream of the work site. If pumping is used to isolate the worksite, fish screens will be placed at all pump intakes.

Alternatively, culverts could be installed adjacent to the existing stream and a new stream channel constructed to divert flow through the new culvert location. This method may have less impact on the natural stream during construction, and be more favourable from a constructability perspective as cofferdams, and pumping of the creek would be avoided.

The steps below outline the typical installation of a culvert:

Step 1: Layout of the culvert and any temporary channel diversions.

Step 2: Install erosion and sediment control measures.

Step 3: Isolate work site so the culvert can be installed in a dry condition. This can be done through coffer dams, diversion channels, or pumping of the water from the upstream to the downstream channel.

Step 4: Excavate the culvert location to the lines and grades shown on the detailed design drawings.

Step 5: Place and compact the bedding material.

Step 6: Install culvert and place substrate to replicate the natural streambed in the culvert bottom. Embedment depth will be 40% of the culvert diameter.

Step 7: Backfill and compact culvert excavation with suitable backfill material.

Step 8: Install riprap and slope protection at the culvert inlet and outlet.

Step 9: Allow flow through installed culvert and remove any temporary cofferdams, stream channel diversions, or drainage structures.

Any fish-bearing crossings requiring culverts will be designed to ensure fish passage and habitat losses will be assessed and offset accordingly. The installation of culverts will follow the general best management practices and standard project considerations as outlined by the Province of British Columbia (BC) and Fisheries and Oceans Canada (DFO) for instream works (BC & DFO, 2015a), which include:

- Consultation with a Qualified Professional (QP) or team of professionals;
- Continued monitoring of the project, including an environmental monitor;
- Consider regional timing windows for fish or species at risk and nesting birds, avoid in-channel works in the presence of species at risk and incorporate weather considerations to minimize impacts from sedimentation;
- Prevent the release of silt, sediment or other contaminants;
- Isolate the work area appropriately;
- Complete and fish and amphibian salvage before the start of works;
- Implement erosion and sediment control measures throughout the project;
- Minimize impacts to vegetated areas;
- Restore the site appropriately; and
- Operate temporary diversion systems (e.g., conduits, coffer dams, ditches), in consideration of the best management practices for those systems.

Additionally, removal of culverts will be conducted in accordance with the BC and DFO Standards and Practices for Instream Works – Culverts (BC & DFO, 2015b), including:

- Adequate rip rap or wing walls to protect the road embankment and stream channel from erosion;

- Prevent eroding inlets and outlets through rip rap amoring;
- Materials placed within the average high water mark must be free of silt, overburden or debris; and
- Use proper erosion and sediment control measures to protect exposed areas of the stream channel and culvert.

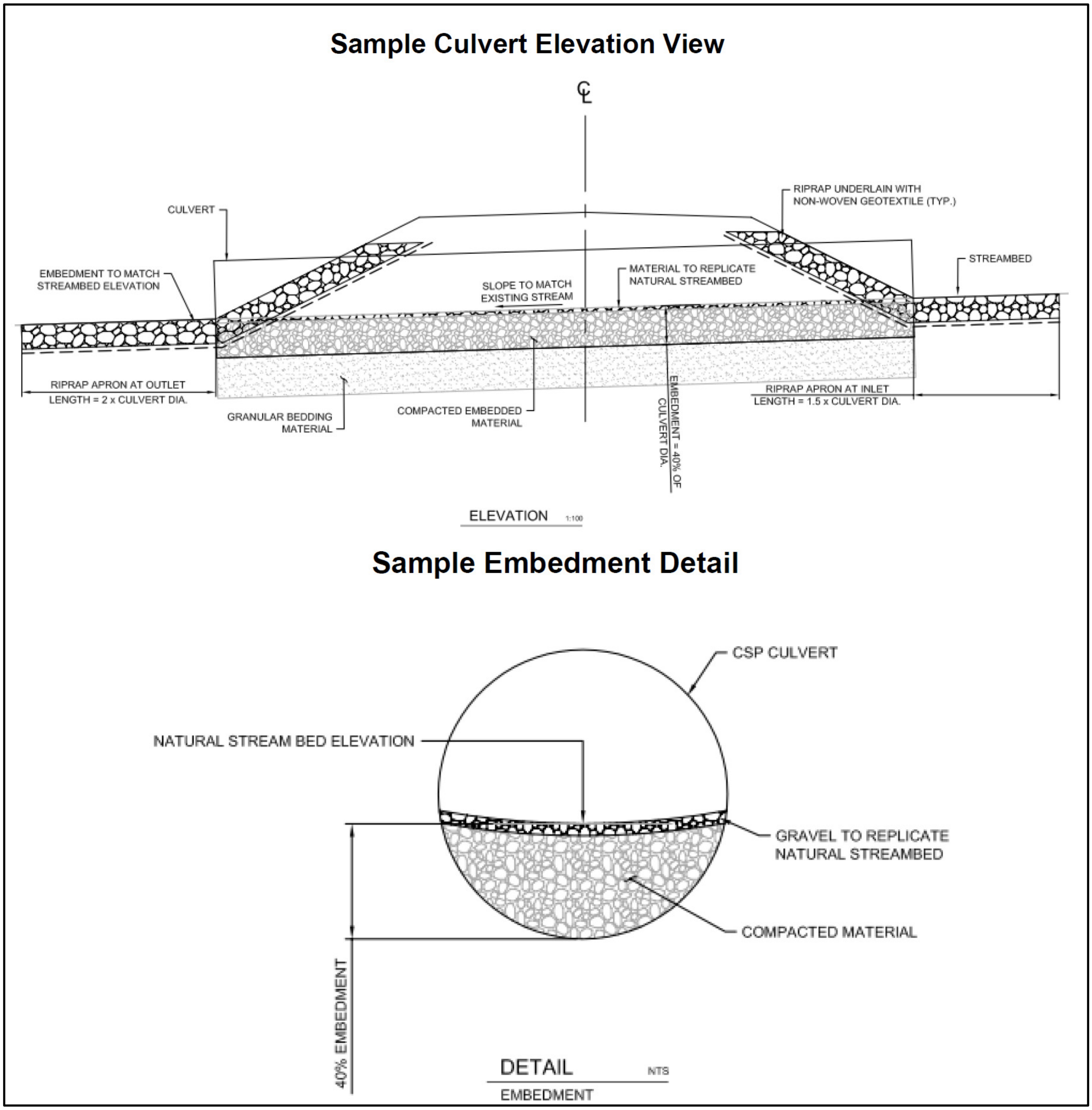

Figure B.10.6-1Sample Culvert and Embedment Detail

B.10.6.3.2 R2-204

R2-204. A discussion of the potential effects of the Project to commercial, recreational, and Aboriginal fisheries (e.g. Arctic grayling and Chinook salmon). This discussion should include: a geographic scope that includes areas downstream of Dip Creek up to and including the White River; b. consideration of the changes in rearing, spawning, and overwintering habitat; a consideration of migratory nature of various fish species; and d. potential fish kills and stranding.

The requested information is available elsewhere in previously submitted project proposal documents. Please see below for determining where the information is available by section:

- The response to request R2-129 provides further detail on CRA fisheries and potential effects throughout the project regional study area. The response to R276 lists fish species distribution, life history, and their contribution to CRA fisheries. The Fish and Aquatic Resources Effects Assessment contains lengthy information regarding potential effects throughout the study area (Section 10). The Assessment boundaries are outlined in Section 10 of the project proposal (pages 10-2 to 10-3) and do not include areas downstream of Dip Creek (such as the Klotassin or White Rivers). The boundaries indicate the limit of any predicted far-field or cumulative effects of the Project and are considered conservative.
- Changes in habitat are extensively detailed in Section 10 and Section A.10. The response to request R285 specifically addresses potential changes in overwintering and spawning habitat in Casino Creek.
- The response to request R276 lists fish species distribution, life history (including fish migrations) and their contribution to CRA fisheries.
- The response to request R287 specifically addresses the risk of fish stranding in Casino Creek. No death of fish is anticipated due to project activities.

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B.11 – RARE PLANTS AND VEGETATION HEALTH

B.11.1 INTRODUCTION

The Casino Project will interact with vegetation, which includes vascular plants and lichens. Section 11 of the Proposal provided an assessment of potential Project and cumulative effects on rare plants and vegetation health. It also included proposed mitigation to reduce Project effects on vegetation. The assessment focussed 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 were described.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

The Executive Committee has 4 requests for supplementary information related to Section 11 and Section A.11 Rare Plants and Vegetation Health of the Project Proposal and SIR. These requests, and the sections below where the requests are responded to, are outlined in Table B.11.1-1.

Table B.11.1-1 Requests for Supplementary Information Related to Rare Plant and Vegetation Health

Request #	Request for Supplementary Information	Response
R2-146	A discussion of the potential effects of the construction, operation, and possible decommissioning of project infrastructure in areas with elevated potential for rare plant species. Details should include: a. how the lack of baseline data will be addressed; b. how effects would be detected; and c. what adaptive management measures would be undertaken if effects occur.	Section B.11.2.1.1
R2-147	An analysis of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands, with a focus on downslope wetland impacts due to changes in ground and surface water flows. This analysis should consider all wetland types occurring in the LSA.	Section B.11.2.1.2
R2-148	An analysis of the potential effects to wetlands and suggested mitigation measures related to the construction and use of the airstrip.	Section B.11.2.1.3
R2-149	An assessment of critical habitat, potential project effects, and proposed mitigations to Yukon Podistera (Podistera yukonensis).	Section B.11.2.1.4

B.11.2 RARE PLANTS AND VEGETATION HEALTH

B.11.2.1.1 R2-146

R2-146.A discussion of the potential effects of the construction, operation, and possible decommissioning of project infrastructure in areas with elevated potential for rare plant species. Details should include:

a. how the lack of baseline data will be addressed;

b. how effects would be detected; and

c. what adaptive management measures would be undertaken if effects occur.

The Executive Committee requests more information to determine the impacts of the Project on vegetation communities and sensitive habitats, based on a comment from SLR that the potential project effects to habitat with elevated potential for rare species were "based on aerial surveys, which would not be sufficient to identify rare plant species, particularly when performed out of breeding or flowering season" (YOR 201-0002-400-1). CMC wishes to clarify that a total of 15 days of rare plant surveys were conducted at the Casino site which were by helicopter, vehicle and on foot. Aerial surveys were used to assess specific areas and vegetation communities likely to contain rare species, and these were verified by on-the-ground surveys (Appendix 11A). When a rare plant population was observed, location and elevation were recorded using a GPS. Habitat type, associated species, population size, phenology, and other relevant information were noted. Voucher specimens were collected, and/or photos taken, for each rare species. Following fieldwork, specimens of rare and possibly rare species were sent to the coordinator of the Yukon Conservation Data Centre (YCDC) in Whitehorse, to confirm identification or for submission to experts in a particular genera). Collected voucher specimens in 2010 were sent to the herbarium at the University of British Columbia (UBC), with the exception of Botrychium alaskense, which was sent to the herbarium at Agriculture and Agri- Food Canada in Ottawa. Specimens from the 2012 survey were sent to the UBC herbarium and B.A. Bennett herbarium in Whitehorse. This methodology is standard practice for rare plant baseline assessments (e.g., Capstone, 2013, Victoria Gold, 2011). CMC re-iterates that adequate baseline surveys for rare plants within the project footprint have been completed and does not consider rare plant baseline data to be lacking. Reviewers should refer to Appendix 11A for more details.

Nonetheless, CMC recognizes that the Project may affect rare plants and vegetation health, as detailed in Section 11.5.1, 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.

And therefore, CMC has proposed to mitigate potential effects to rare plants 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, 2014).

- Implementing dust control measures, as per the air quality management guidelines.

In areas where construction must occur within areas mapped as having a high likelihood of hosting rare plants (Figure 4.1 in Appendix 11A), pre-clearing surveys for rare plants may be considered. Vegetation communities that have increased potential for rare plant species, which were surveyed during the rare plant surveys, include:

- Dry, steep slopes dominated by grass;
- Open aspen and/or white spruce forests;
- Alpine and subalpine areas;
- Rock outcrops, including tors;
- Wetlands, including fens;
- Disturbed sites; and
- Riparian areas.

Effects on rare plants would be detected through monitoring activities. Table 5.7 in the Wildlife Monitoring and Mitigation Plan (WMMP – Appendix A.12A) provides information on monitoring of vegetation health, which includes monitoring a variety of habitat types, including vegetation communities that have an elevated potential for rare plant species. If monitoring suggests that the Project is having adverse effects on rare plants, or ecosystems known to host rare plants, then the Yukon Conservation Data Centre will be contacted to discuss the appropriate course of action.

B.11.2.1.2 R2-147

R2-147. An analysis of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands, with a focus on downslope wetland impacts due to changes in ground and surface water flows. This analysis should consider all wetland types occurring in the LSA.

Airstrip

As described in Appendix 4B, the proposed airstrip is located in the Dip Creek Valley and it is aligned in the northeast – southwest direction. It will have a runway length of 1,600 m long and 60 m overruns on either end (Figure B.11.2-2). At the northeast end of the runway several facilities are proposed including a taxiway, apron, parking area, buildings, and the starting point of the access road. Buildings will consist of a maintenance building and a small terminal building for passengers in transit and temporary storage for luggage and supplies.

The airstrip would be constructed with granular fill material on top of the existing ground (Figure B.11.2-1). As described in Appendix A.10A, the airstrip is proposed to extend onto a gentle alluvial fan across which a small, unnamed tributary of Dip Creek flows. In order to ensure stability and safety of the airstrip, the small tributary must be diverted around it, rather than being conveyed beneath it through a culvert. The tributary and local surface runoff were originally going to directed around the airstrip along a straight, gravel-filled interceptor drain along the toe of a berm, built about 120 m upslope from the airstrip. This local filling of fish habitat and disconnection of the watercourse upstream of the airstrip would have resulted in a substantial amount of lost fish habitat.

As described in Appendix A.10A, in order to avoid as much as 9,000 m^2 in total lost fish habitat (length times width), CMC has changed its surface water diversion strategy to create a naturalized airstrip diversion channel to by-pass the airstrip and drain into an existing, natural drainage path (another distributary channel on the alluvial fan) (Figure B.11.2-3). The diversion will begin at the apex of the gentle alluvial fan on which the southern portion of the airstrip is proposed, and will follow a natural drainage path along the southern edge of the fan downstream to its confluence with Dip Creek, the outlet of an oxbow lake. The diversion channel will be constructed with a form that mimics existing, natural channel morphology, minimizes disturbance to surface organics and underlying permafrost, and mitigates the risk of downstream sedimentation to Dip Creek. A pilot swale will be carefully formed to accommodate fish passage, and low gravel ‘ribs’ will be placed amongst the mosses and sedges to allow for future recruitment of alluvial gravels and to promote sedimentation against their upstream flanks. This decision to construct a naturalized diversion channel will reduce the amount of lost usable habitat to 330 m^2. Additionally, losses to riparian habitat will be offset by the proposed diversion channel’s existing, mature riparian vegetation.

Surface runoff from the airstrip will flow overland through dense ground vegetation, where it will gradually infiltrate, thereby avoiding potential effects on in-stream water quality or quantity. Appropriate erosion and sediment control measures will be identified during detailed design and used during the construction of the diversion channel, in order to protect the surrounding environment from off-site sedimentation.

There are no predicted effects on groundwater, as the existing flows will be re-directed around the airstrip, and remain within the same groundwater catchment.

Construction of the airstrip will result in some loss of available habitat, as was assessed in Section 11 and 12 of the Proposal.

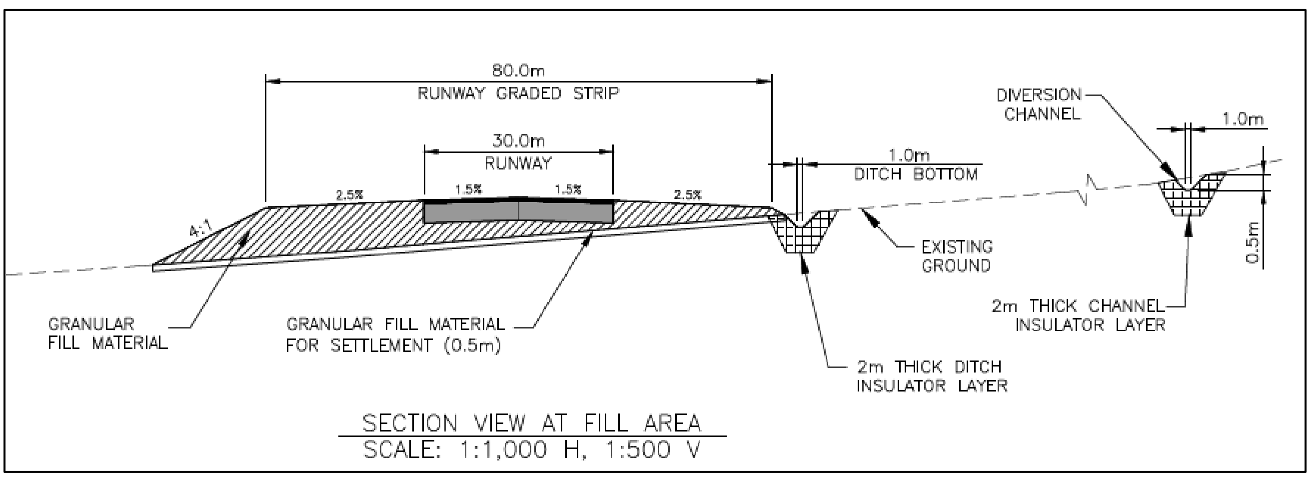
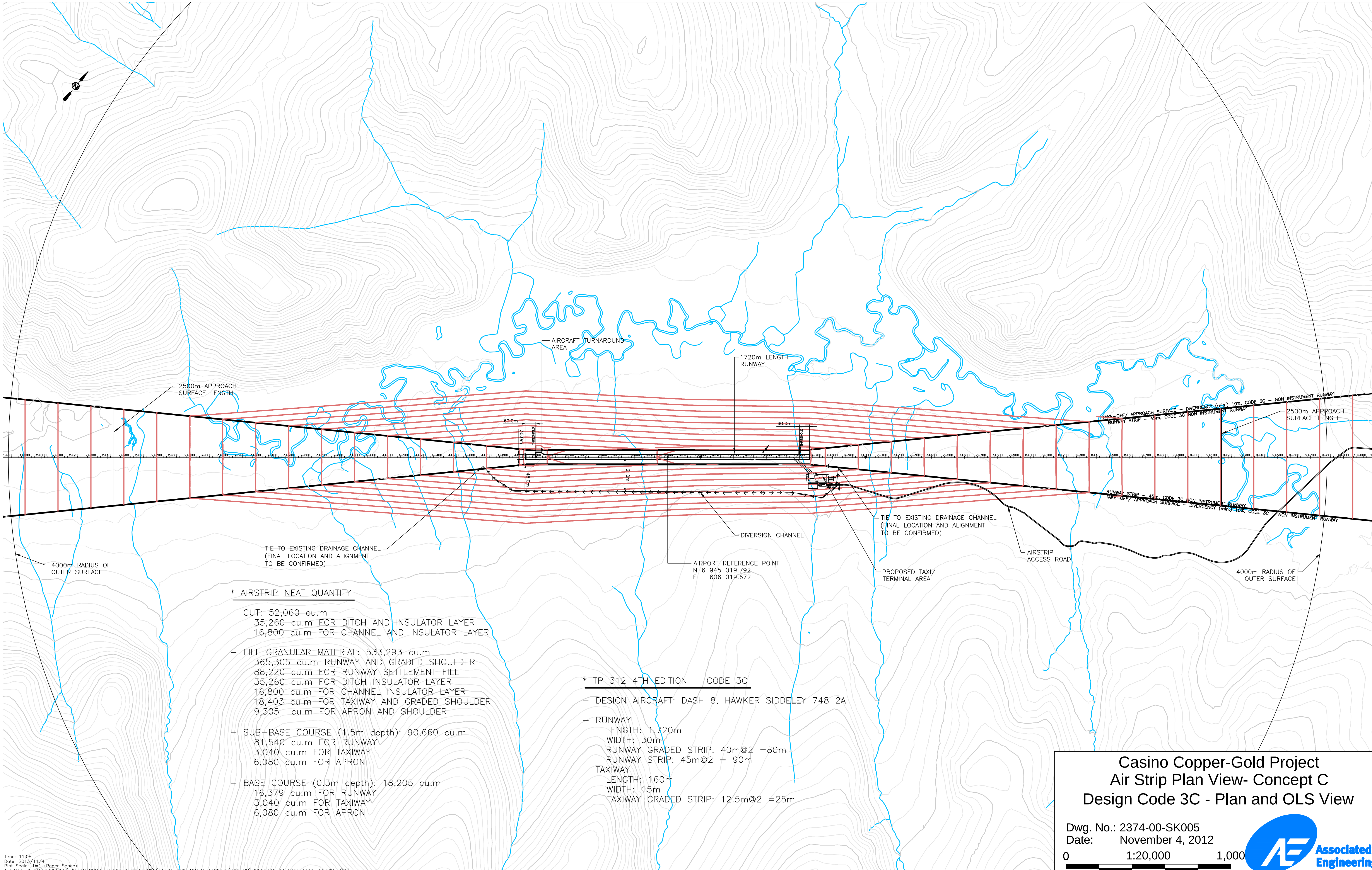


Figure B.11.2-1Airstrip Plan View Section



* AIRSTRIP NEAT QUANTITY

- CUT: 52,060 cu.m
  - 35,260 cu.m FOR DITCH AND INSULATOR LAYER
  - 16,800 cu.m FOR CHANNEL AND INSULATOR LAYER
- FILL GRANULAR MATERIAL: 533,293 cu.m
  - 365,305 cu.m RUNWAY AND GRADED SHOULDER
  - 88,220 cu.m FOR RUNWAY SETTLEMENT FILL
  - 35,260 cu.m FOR DITCH INSULATOR LAYER
  - 16,800 cu.m FOR CHANNEL INSULATOR LAYER
  - 18,403 cu.m FOR TAXIWAY AND GRADED SHOULDER
  - 9,305 cu.m FOR APRON AND SHOULDER
- SUB-BASE COURSE (1.5m depth): 90,660 cu.m
  - 81,540 cu.m FOR RUNWAY
  - 3,040 cu.m FOR TAXIWAY
  - 6,080 cu.m FOR APRON
- BASE COURSE (0.3m depth): 18,205 cu.m
  - 16,379 cu.m FOR RUNWAY
  - 3,040 cu.m FOR TAXIWAY
  - 6,080 cu.m FOR APRON

* TP 312 4TH EDITION – CODE 3C

- DESIGN AIRCRAFT: DASH 8, HAWKER SIDDELEY 748 2A
- RUNWAY
  - LENGTH: 1,720m
  - WIDTH: 30m
  - RUNWAY GRADED STRIP: 40m@2 =80m
  - RUNWAY STRIP: 45m@2 = 90m
- TAXIWAY
  - LENGTH: 160m
  - WIDTH: 15m
  - TAXIWAY GRADED STRIP: 12.5m@2 =25m

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Date: 2013/11/4
Plot Scale: 1=1 (Paper Space)
AutoCAD File: P:\20092374\00_CASINOMINE_ACCESS\ENGINEERING\03.04_CIVIL_NOTES_DRAWINGS\SKETCH\20092374-00-SK05_CODE 3C.DWG (SC)
Xrefs: 2374-00-r-101_contours

Casino Copper-Gold Project
Air Strip Plan View- Concept C
Design Code 3C - Plan and OLS View

Dwg. No.: 2374-00-SK005
Date: November 4, 2012

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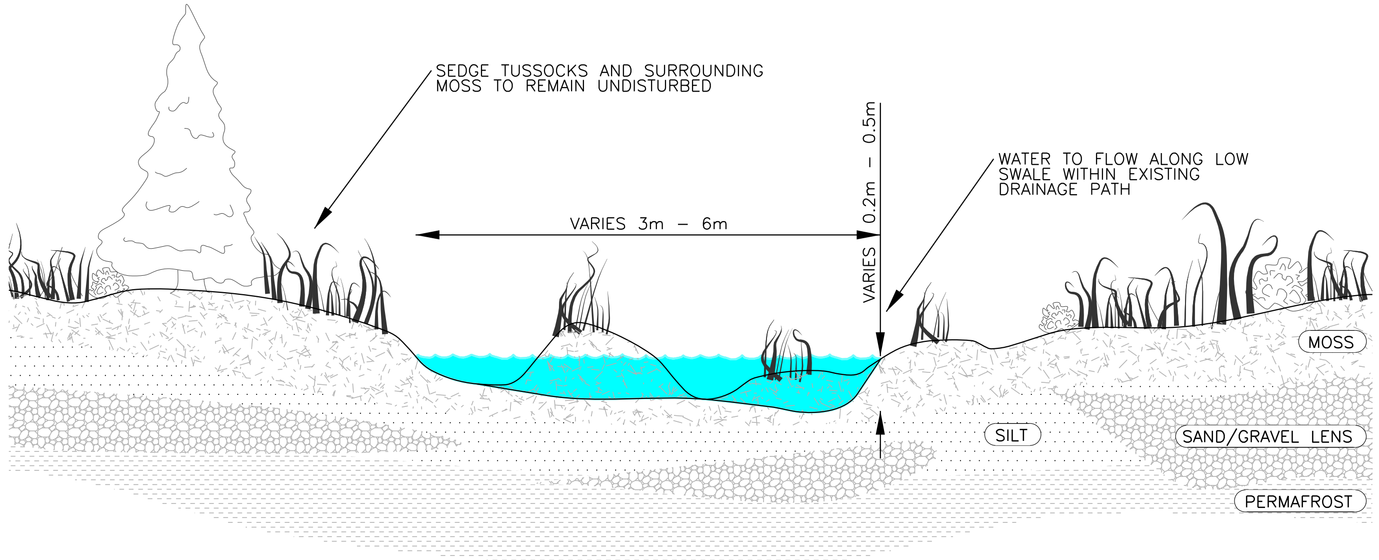
Associated Engineering

TYPICAL SWALE SECTION A-A



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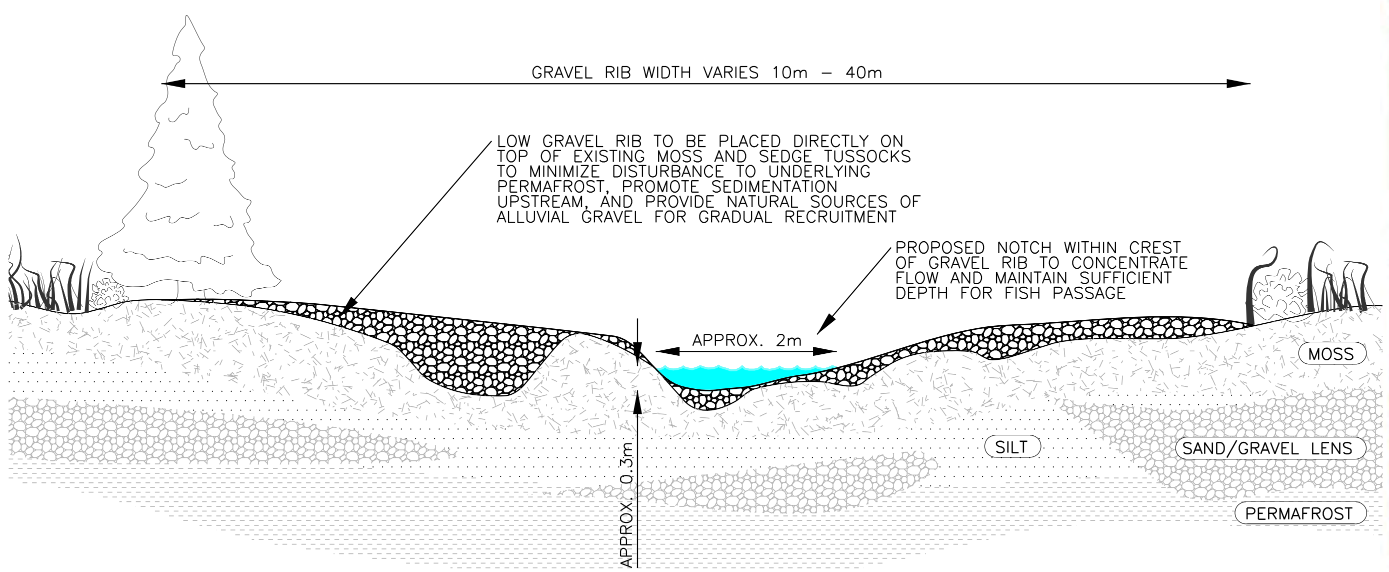
TYPICAL GRAVEL RIB SECTION B-B



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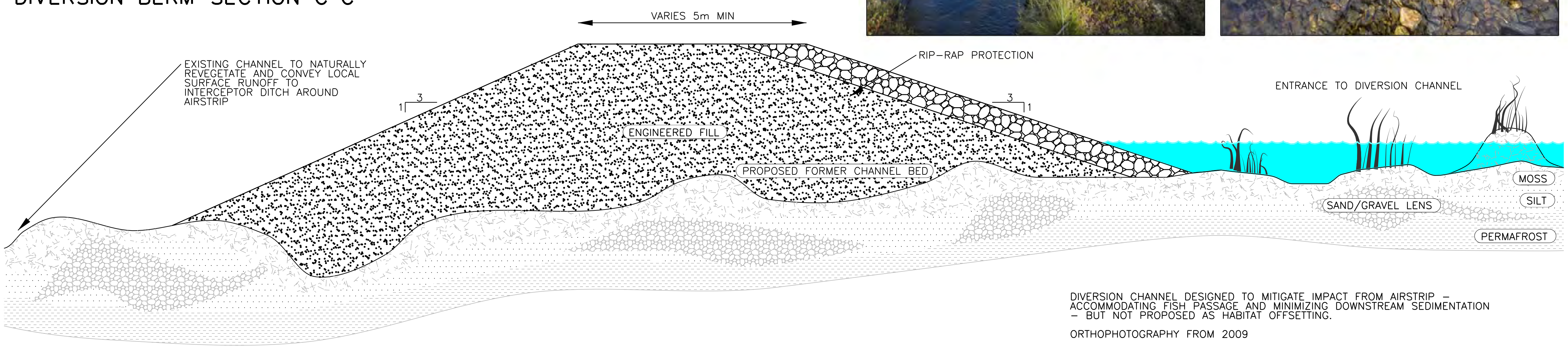
DIVERSION BERM SECTION C-C



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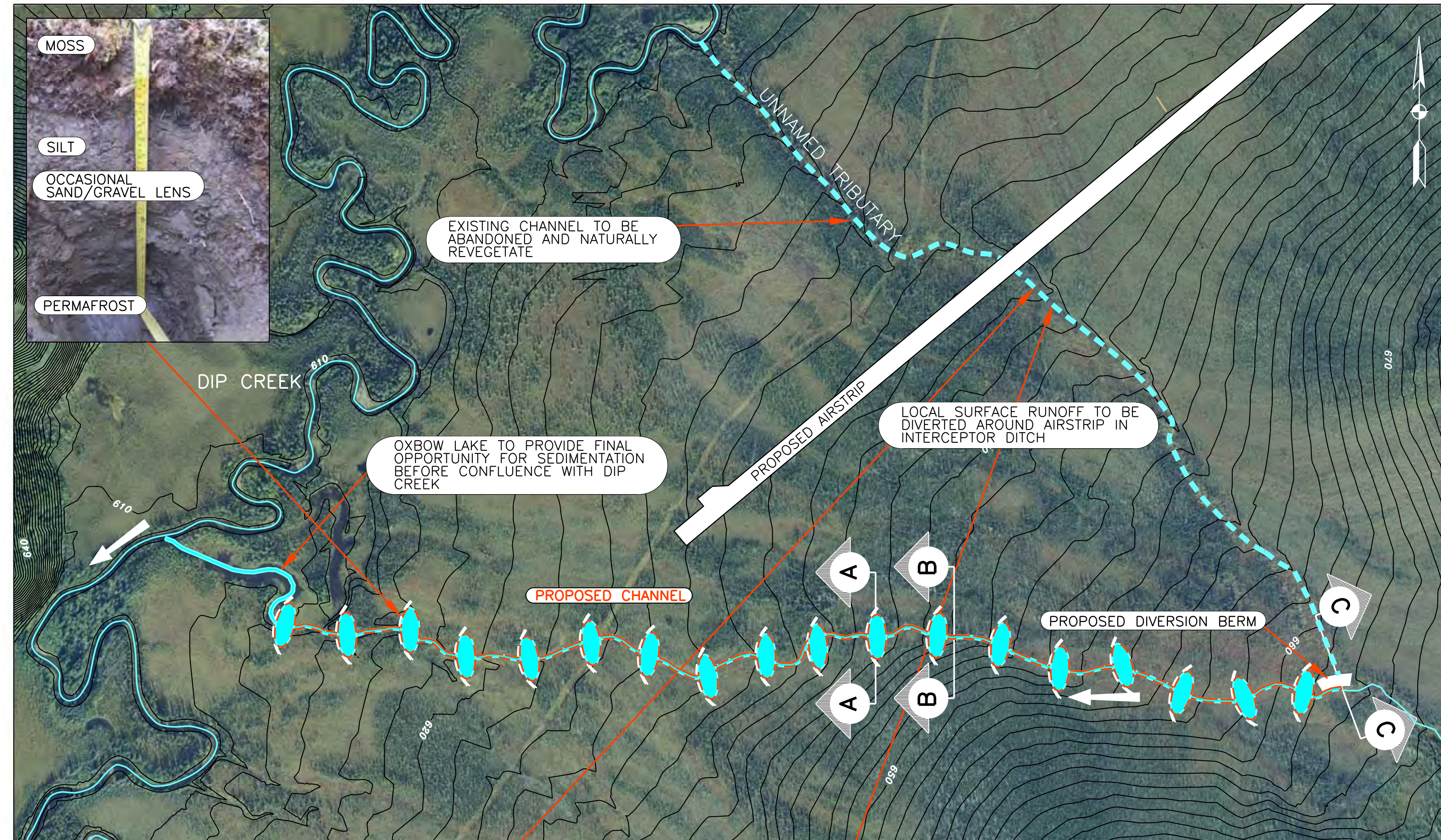

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DIVERSION CHANNEL DESIGNED TO MITIGATE IMPACT FROM AIRSTRIP – ACCOMMODATING FISH PASSAGE AND MINIMIZING DOWNSTREAM SEDIMENTATION – BUT NOT PROPOSED AS HABITAT OFFSETTING.

ORTHOPHOTOGRAPHY FROM 2009

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

GRECK AND ASSOCIATES LIMITED
WATER RESOURCES AND ENVIRONMENTAL ENGINEERING
57 MILL ST. N. UNIT 306, BRAMPTON, ONTARIO, L6X 1S9

DESIGN BY PALMER ENVIRONMENTAL CONSULTING GROUP INC.
DESIGN REVIEW AND DRAFTING BY GRECK AND ASSOCIATES LIMITED.

DATE	REVISION	BY
11/21/2014	DRAFT FOR REVIEW	E.G.

AIRSTRIP DIVERSION CHANNEL

CASINO PROJECT

CONCEPT DESIGN

DATE: NOVEMBER 21, 2014	DESIGN BY E.G.	CHKD. BY B.G.	APPD. BY R.M.
SCALE: AS SHOWN	DRAWING NO.		
	SHEET NO. FIGURE 3-3		

Airstrip Access Road

As described in Appendix 11A, wetlands are mainly limited to slope toes and valley floors and are generally small in size, with the exception of the Dip Creek area near its confluence with Casino Creek, Big Creek and Hayes Creek. As described in Appendix 4B, the Airstrip Access Road originates from a parking area adjacent to the aircraft apron at the northeast end of the proposed airstrip, then heads east along the southeast slope staying above the poorly drained Dip Creek valley bottom. Therefore, there are no impacts to wetlands predicted for the airstrip access road as the road avoids areas of possible wetlands.

B.11.2.1.3 R2-148

R2-148. An analysis of the potential effects to wetlands and suggested mitigation measures related to the construction and use of the airstrip.

The construction of the airstrip and airstrip access road will result in some loss of riparian and wetland associated vegetation, as was assessed in Section 11 and 12 of the Proposal. As described in the response to R309, as rusty blackbird are typically found within shrubby habitats at the edge of ponds or lakes and shrubby wetlands, the assessment of effects on this species can be acknowledged as an acceptable assessment for wetlands in general. Wetland habitat types within the vegetation mapping area were rated as low under the assumption that wetland habitats without open water areas would provide some nesting opportunities but were likely not preferred. The results of the habitat model indicate that over 99% of the LSA is considered low or nil value habitats for rusty blackbird. The available high value habitat is scattered in small pockets, generally at mid- to low elevations, throughout the Project and these results can be considered comparable for wetlands in general.

To offset this loss of habitat, as described in the response to R2-147, a naturalized airstrip diversion channel to by-pass the airstrip and drain into an existing, natural drainage path (another distributary channel on the alluvial fan) (Figure B.11.2-3). Losses to riparian habitat will be offset by the proposed diversion channel's existing, mature riparian vegetation. Surface runoff from the airstrip will flow overland through dense ground vegetation, where it will gradually infiltrate, thereby avoiding potential effects on in-stream water quality or quantity. Appropriate erosion and sediment control measures will be identified during detailed design and used during the construction of the diversion channel, in order to protect the surrounding environment from off-site sedimentation.

B.11.2.1.4 R2-149

R2-149. An assessment of critical habitat, potential project effects, and proposed mitigations to Yukon Podistera (Podistera yukonensis).

Yukon Podistera (*Podistera yukonensis*) is an endemic plant species with global populations restricted to west-central Yukon and a small area in eastern Alaska (COSEWIC, 2014; NatureServe, 2015). It was designated Special Concern in November 2014 (COSEWIC, 2014). In Yukon, it is distributed in unglaciated areas of the Yukon River drainage in two disjunct regions, including the southern Ogilvie Mountains and Dawson and Ruby ranges. Approximately 90% of the global range for Yukon Podistera is within Yukon, thereby warranting an assessment of habitat for this species within the local study area of the proposed Casino mine. The habitat requirements for Yukon Podistera are considered "narrow", as it is a species that is "intrinsically vulnerable due to habitat specificity" (NatureServe, 2015). The following habitat information has been sourced from NatureServe (2015) and the *COSEWIC Assessment and Status Report on Yukon Podistera Podistera yukonensis in Canada* (2014).

Yukon Podistera is restricted to dry, well-drained, rock-dominated habitat with scant vegetation and minimal soil development. It is found on talus slopes, rocky tors and outcrops, river bluffs, and cliff crevices with exposed bedrock that become snow-free early in the season. Sites are typically volcanic or sedimentary and never associated with limestone. It is associated with substrates where surface materials move slowly, through frost action, downslope. Yukon Podistera is considered shade-intolerant. It is found primarily on south-facing slopes; however, a small number have been found in sheltered microsites. Yukon Podistera has frequently been found growing on talus slopes comprised of lichen-covered cobble and boulders and sparsely covered forbs and low stature grasses are present. In this habitat, it has been documented growing along the edges of thin strips of vegetation, orientated downslope, where only a thin layer of soil was present. Slopes where it has been found ranged from 5-40° with a few on east and west-facing slopes where aspect ranged from 70-280°. In Yukon, it has been found growing at low elevations (below 800 m) at Chandindu and Miller's Ridge; however, the highest sub-population was found at 1,757 m near Sekulmun Lake.

Rare plant surveys were conducted in the Project area, August 16–27, 2010 and July 18–22, 2012 (Appendix 11A). Priority sites where surveys were conducted included dry steep slopes, rocky outcrops, alpine and subalpine areas, as well as other sites representative of the vegetation of the entire study area. Yukon Podistera was not found during these surveys.

Section 11.5 of the Project proposal summarizes potential effects on rare plants, including Yukon Podistera.

As detailed in Section 11.5 of the Project proposal, proposed mitigations for reducing potential effects on rare plants, including Yukon Podistera, include:

- 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.

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B.12 – WILDLIFE

B.12.1 INTRODUCTION

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015. This document addresses comments related to the terrestrial environment and wildlife.

Most of the information requests in ARR No. 2 were requesting further elaboration on the information provided by CMC in SIR-A. Since CMC had provided adequate information in SIR-A, and it was unclear exactly what the additional information request was concerning, and sometimes its relevance to an effects adequacy review, CMC suggested that YESAB convene a technical workshop for the YESAB executive committee and technical reviewers to provide CMC with further clarification on their requests in ARR No.2. In preparation for that workshop, CMC met with YESAB in July 2015 to identify the need for additional discussion to the written information requests so that further responses would adequately address YESAB's concerns. During the July workshop, YESAB determined that the workshop's discussions would be limited to the following Information Requests (noted in Table B.12.1-1):

- R2-150
- R2-151
- R2-154
- R2-162
- R2-167
- R2-176
- R2-177
- R2-178
- R2-180

YESAB directed CMC to address the 30 remaining information requests as written responses with no further discussion provided at the workshop.

On October 1, 2015, the technical working group meeting included YESAB staff, YESAB wildlife consultants, technical reviewers from Yukon Government Department of Environment, Little Salmon/Carmacks First Nation, Selkirk First Nation, Tr'ondëk Hwëch'in First Nation, and Environment Canada. The objectives of the workshop were to:

1. Have the proponent (CMC) provide background review of the information provided in the Project Proposal and Supplementary Information Report (SIR-A) to address the 9 specific information requests;
2. Clarify with reviewers additional information required to meet the requests of the Executive Committee for proposal adequacy; and
3. Identify an approach to responding to the 9 information requests.

The daylong workshop provided CMC some clarification on the information requests, and the information for the nine requests are presented herein.

Responses to all 39 requests for supplementary information related to Section 12 and Section A.12 of the Project Proposal and SIR are provided below (as outlined in Table B.12.1-1). CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and the Proposal, when considered together, is adequate to commence Screening.

Table B.12.1-1 Requests for Supplementary Information Related to Wildlife

Request #[1]	Request for Supplementary Information	Response Section
R2-150*	**Initiatives that CMC will lead to monitor and address the issue of potential increased predation, mortality, and disturbance to caribou and Dall's sheep in relation to the Freegold Road.**	**Section B.12.2.1**
R2-151*	**An analysis of how baseline data will be established and how predation mortality will be monitored and addressed.**	**Section B.12.2.2**
R2-152	Supporting evidence for the assertion that road design is a sufficient mitigation to the barrier effects of the Freegold Road.	Section B.12.2.3
R2-153	A review of available data for population demographics (sex and age ratios related to surveys in the RSA). Use of demographic data for harvest and surveys will provide valuable insight into the sensitivity of regional populations to potential impacts from road maintenance and operations	Section B.12.2.4
R2-154*	**A discussion of the proposed Klaza caribou model based on draft components. This should include how the model supports project effects assessment and determination of significance. The review should include available population demographic data from harvest and surveys.**	**Section B.12.3.1**
R2-155	A discussion of noise associated with the Project in relation to the habitat suitability model using the most recent reference materials available. This discussion should include consideration of noise from all project activities and baseline conditions (see R2-212, R2-213, R2-314).	Section B.12.3.2
R2-156	A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds for actions which may mitigate adverse effects.	Section B.12.3.3
R2-157	Discussion on the effects to the Fortymile caribou herd in the event of overlap, including extend, duration, magnitude, and significance. The analysis should consider herd size and demographics.	Section B.12.3.4
R2-158	Discuss how the RSF model accounts for variability in caribou distribution based on environmental conditions and among years. This should include consideration of available data on actual caribou distribution from the 1980's – present.	Section B.12.3.5
R2-159	Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.	Section B.12.3.6
R2-160	Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.	Section B.12.3.7
R2-161	Information on the frequency, extent, and methods for monitoring of the pipeline route including: a. Prior to construction to inform the route, and b. During construction and operations	Section B.12.3.8

Request #[1]	Request for Supplementary Information	Response Section
	c. Geotechnical and topographical information that will be used to determine which (if any) sections of the pipeline are buried.	
R2-162*	**Initiate additional bear den surveys, utilizing suggestions by Government of Yukon, and indicate when information will be available during the screening process.**	**Section B.12.3.9**
R2-163	A discussion of how denning may affect or be affected by project activity and suggested mitigations to prevent disturbance.	Section B.12.3.10
R2-164	Updated habitat suitability and effectiveness which take into consideration the comments from Yukon government and SLR.	Section B.12.3.11
R2-165	Detailed information on how timing of food sources has been incorporated into the models.	Section B.12.3.12
R2-166	An updated security areas model using a maximum altitude of 1 900 m and incorporating low intensity disturbance.	Section B.12.3.13
R2-167*	**Additional information on Table 8.1 of the grizzly bear effects assessment, including:** **a. proportion of males and females harvested;** **b. a discussion of how the numbers in part a relate to the population estimate; and** **c. a discussion of the population-level effects of direct mortality.**	**Section B.12.3.14**
R2-168	A discussion and analysis of the significance of mortality estimates based on population density estimate of 11 bears/1 000 km² and annual allowable mortality rate of 4 percent.	Section B.12.3.15
R2-169	Revised traffic effect analysis, including road kills, using all project traffic not just loaded vehicles.	Section B.12.3.16
R2-170	Information on how effects on known sites of collared pika occupancy will be avoided or minimized. This should include mitigation measures to ensure the health of the population.	Section B.12.3.17
R2-171	A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.	Section B.12.3.18
R2-172	A risk assessment for wolverines which considers the habitat suitability model. The assessment should identify potential effects to natal and maternal den sites and proposed measures for avoiding disturbance of females with kits.	Section B.12.3.19
R2-173	Detailed information on study methodology for the July, 2014, bat survey.	Section B.12.3.20
R2-174	Results and discussion of additional field work needed to determine the presence of little brown myotis and its roosts and hibernacula.	Section B.12.3.21
R2-175	Monitoring and mitigation measures that will be undertaken for this species if their presence is determined. This will require more detailed information in the Wildlife Mitigation and Monitoring Plan.	Section B.12.3.22
R2-176*	**Additional baseline information on Dall sheep that will allow for population and demographic monitoring in the future.**	**Section B.12.3.23**

Request #[1]	Request for Supplementary Information	Response Section
R2-177*	**A discussion of the indirect effects to Dall sheep based on: a. Increased hunter access; b. Disturbance related to land and air traffic; and c. Changes in predator-prey dynamics. d. The discussion should include seasonal variation as well as proposed mitigation and monitoring measures.**	**Section B.12.3.24**
R2-178*	**Rationale on the exclusion of the identified species (rock ptarmigan, white-tailed ptarmigan, and short-eared owl) as key indicators as compared against other species of concern, including available baseline information, or the inclusion of these species as key indicator species (either as a group or individually).**	**Section B.12.4.1**
R2-179	Baseline data and assessment of effects in relation to red-necked phalarope.	Section B.12.4.2
R2-180*	**Spatial information on the presence of alpine meadows or alpine open areas.**	**Section B.12.4.3**
R2-181	Description of how the WMMP will address and protect the identified species (e.g. olive sided fly catcher, rusty blackbird, common nighthawk, short-eared owl, horned grebe, and other human intolerant species of concern.)	Section B.12.4.4
R2-182	A description of how the WMMP will address and protect wetland habitats and their occupants.	Section B.12.4.5
R2-183	Effects assessment of the TMF wetland on waterfowl. This should include: a. Discussion of pathways by which waterfowl accumulate detrimental levels of metals and negative effects of trace metals, particularly with respect to bioaccumulation; b. Inclusion of other trace metals found in elevated levels according to baseline surveys; and c. Consideration of the availability of open water bodies in the LSA relative to the RSA (i.e. likelihood of waterfowl staging in the project footprint.)	Section B.12.4.6
R2-184	Thresholds for trace metal (e.g. selenium, arsenic, lead) concentrations at which waterfowl/TMF wetland monitoring would occur during the construction, operation, and decommissioning phases and a discussion of how this information will be factored into mitigation measures. This should include a discussion of additional deterrence measures that would be utilized if thresholds are crossed and an analysis of their effectiveness.	Section B.12.4.7
R2-185	A discussion of amending the Wildlife Mitigation and Monitoring Plan to include a vegetation monitoring and management plan aimed at removing/minimizing plant growth around the TMF and Pit pond.	Section B.12.4.8
R2-186	Information on the authority of the Wildlife Working Group (i.e. how are recommendations from the group incorporated into future planning and action?)	Section B.12.5.1
R2-187	Details on what triggers will be used, by species, to determine whether to cease or extend monitoring at the 3-5 year mark.	Section B.12.5.2
R2-188	Details on if, and how, impacts to species with large ranges will be monitored beyond the 10 km buffer of the project area.	Section B.12.5.3

1. Requests numbers in bold and (*) were discussed at the 01 October YESAB Technical Working Group Meeting: Wildlife

B.12.2 FREEGOLD ROAD AND OTHER ACCESS ROADS

B.12.2.1 R2-150

R2-150. Initiatives that CMC will lead to monitor and address the issue of potential increased predation, mortality, and disturbance to caribou and Dall's sheep in relation to the Freegold Road.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting, specifically in regards to the initiatives of monitoring of activities and Dall's sheep. CMC re-iterated the information provided in the project proposal and SIR-A (R350) that Dall's sheep do not interact with the project, and that even indirect effects are unlikely. However, CMC agreed that there may be some activities such as overflights of sheep range that may warrant surveillance-level monitoring as an early-warning system to detect unanticipated effects on sheep.

As described in the WMMP (Appendix A.12A), CMC will lead a number of initiatives to address issues related to wildlife monitoring, including measures of increased predation, mortality, and disturbance, primarily on caribou, and incidentally on Dall's sheep. As stated in the introductory sections of the WMMP, the initiatives are classified into three categories: baseline research, surveillance, and monitoring:

- Baseline research is conducted to establish the need for, or parameters of, an environmental effects management program. Research studies could address issues such as natural variability of a measurable parameter (e.g., predation rates on ungulates) or monitoring targets, or examine the nature, extent, or duration of a potential Project-focal species interaction.
- Surveillance programs are conducted to produce information about the pattern of occurrence of focal species (e.g., caribou distribution and population monitoring within a 10-km radius buffer of project infrastructure).
- Monitoring programs are conducted to address and quantify effects mechanisms between Project activities and components of the receiving environment.

CMC identifies a number of the monitoring initiatives that will specifically monitor Project-related wildlife mortality or disturbance in the Wildlife Mitigation and Monitoring Plan (WMMP - Appendix A.12A), summarized in Table B.12.2-1.

Table B.12.2-1 Summary of initiatives related to caribou and thinhorn sheep

Species	Potential effect	Monitoring Objective	WMMP Reference
All	Wildlife Mortality (including harvest and predation)	Track Project-related mortality within and adjacent to the Project footprint	Table 5.4-3
All	Disturbance	Document use of habitat features within the LSA	Table 5.4-4
Caribou[1]	Disturbance	Evaluate trends in caribou distribution in the ZOI and within late-winter habitat	Table 5.4-8
Caribou	Disturbance	Evaluate movement patterns of caribou as they approach or cross the road and other Project infrastructure	Table 5.4-9

[1]Other wildlife, such as sheep, are recorded and reported if observed during the survey.

CMC will monitor project-related wildlife mortality (Table 5.4-3 of the WMMP), the purpose of which is to track Project-related mortality within and adjacent to the Project footprint, including the Freegold Road and Mine Site.

Any ungulate mortality due to interactions with the Project facilities, Project vehicles, predation or harvest will be recorded and reported as part of the WMMP reporting commitments.

CMC will also monitor potential caribou disturbance, as measured by habitat use and movement, through a number of monitoring initiatives (Table 5.4-4, Table 5.4-8, Table 5.4-9 of the WMMP). The purpose of disturbance monitoring is to document wildlife use of habitat features, distribution within the zone of influence (ZOI) and late winter habitat, and evaluate movement of caribou across Project infrastructure to quantify and monitor changes from baseline conditions. Disturbance monitoring for thinhorn sheep (Dall's sheep) is not proposed because the Project does not directly interact with sheep in the area.

CMC has committed to support wildlife research where significant questions related to Project effects remain, including, as outlined in Section 6 of the WMMP, to address information and knowledge gaps about wildlife, vegetation, habitat, and industrial disturbance that are not addressed by the Project-specific mitigation actions and monitoring program identified in the WMMP. There may be broader wildlife and terrestrial environmental science needs to help improve mining mitigation, First Nations knowledge, or general regional knowledge gaps. Although the information may not be specific to the Casino Project, CMC recognizes the need to develop partnerships to improve regional ecological knowledge that will help to improve understanding and future decision making.

The Executive Committee has requested information on the potential of the Project to facilitate wolf access to caribou and sheep. CMC recognizes that estimating predation (measure as predation rate or kill rate) is more in the realm of wildlife management or academic research conducted at the landscape/population scale and generally outside the scope of environmental assessment and therefore the WMMP does not specifically identify initiatives to monitor natural predation of ungulates by wolves, nor are there monitoring initiatives specifically for thinhorn sheep. However, if the Wildlife Working Group (as described in the WMMP) determines that the Project poses a significant risk of wolves affecting the local sheep or caribou population, then CMC will develop a predation baseline research initiative with input and participation from group members. Monitoring initiatives were not developed specifically for sheep because the project does not directly interact with sheep and multispecies wildlife monitoring initiatives were considered suitable for monitoring indirect effects of the project on sheep (i.e., harvest). Currently, the risk to the local sheep population is considered low (see responses to requests R2-151 and R2-177 for further information).

B.12.2.2 R2-151

R2-151. An analysis of how baseline data will be established and how predation mortality will be monitored and addressed.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting, and it was generally agreed that predation mortality data typically do not exist for most wildlife populations, even where the data are directly relevant such as where it may be most useful for population-level modelling and harvest management. To our knowledge, that level of information has never been requested for, available to, or considered relevant to, a mine project effects assessment. The discussion with the wildlife technical working group acknowledged that collection of these data are technically difficult, multi-year, and would likely require a specific and focused study. The end of that study (i.e., an estimate of predator-caused mortality with some amount of variability), while interesting from an ecological point of view, may not necessarily be relevant to the prediction of the Casino Project's effects on wildlife.

For follow-up, CMC has committed to monitoring Project-related wildlife mortality as part of the Wildlife Mitigation and Monitoring Plan (Appendix A.12A). The plan does not currently include monitoring of natural predation of ungulates for the reasons outlined in the discussion below.

Wolves are the main predator in the region capable of using human infrastructure to access ungulate prey species. CMC will initiate research programs if surveillance and monitoring programs identify unexpected changes to ungulate predation by wolves or the issue is determined to be a significant concern by the Wildlife Working Group.

Yukon thinhorn sheep populations seem independent of wolf numbers and sheep are not a target prey species for wolves in most areas of the Yukon (Hayes et al. 2003). Sheep become a more important part of wolf diet in areas where moose are less abundant (e.g., the Coast Mountains; Hayes et al. 1991). As moose are relatively abundant in the Project area, the risk of increased wolf predation on the Dawson Range thinhorn sheep population is low.

Predation by wolves on caribou is a factor limiting population growth and density of many large ungulates. The primary prey species of wolves in the majority of south and central Yukon is moose. Generally, caribou are a secondary prey species of wolves, but wolves are the primary predator of caribou. Wolves prey disproportionately on moose calves (Hayes et al. 2000) and caribou calves (Gauthier and Theberge, 1985; 1986), thereby limiting population growth of these prey. The Aishihik and Finlayson wolf control programs in Yukon have clearly shown the link between wolf predation and caribou population growth (Hayes et al. 2003); both programs occurred in areas where moose are likely the primary prey species for wolves (Hayes et al. 2000), but the caribou populations showed a clear response to wolf removal.

The Project is not expected to significantly change the wolf-prey dynamics in the region. The Project will not cause the type of land disturbance that increases the abundance of alternate prey, nor will it cause a significant change in predator access to caribou ranges; an effect that has be documented in Alberta where extensive land disturbance has increased the number of moose and deer resulting in a greater number of wolves and a change in wolf distribution, ultimately increasing wolf predation on local caribou populations (Wasser et al. 2011, James et al. 2004). The effect has not been documented along any transportation corridor in the Yukon; however, there are anecdotal observations of wolves using the Robert Campbell Highway east of Ross River. If the effect does exist in Yukon, then the magnitude of the effect is likely small and is masked by other effects from disturbance, hunting or collisions. Alternate prey and predator access mechanisms of facilitated predation are discussed further below.

Alternate prey

Deer and moose are the alternate prey species that have been suggested as supporting larger populations of wolves. Within the RSA deer are known to occupy habitats along the Yukon River and are considered relatively scarce, while moose are ubiquitous and occur at moderate densities throughout the RSA. Forestry and agriculture are examples of industries that likely result in landscape-level changes that can cause increases in alternate prey population densities that could result in increased predator abundance. The Project will not result in landscape scale disturbance that will significantly increase the quantity and quality of habitats that will result in greater number of moose. Consequently, the Project is unlikely to result in increased abundance or changes in distribution of alternate prey species that would increase the number or distribution of wolves in the area.

Predator access

During winter, wolves use areas that have hard packed or shallow snow to more easily travel in search of prey. Features that provide natural movement corridors for wolves are streams and exposed areas, such as ridges, where ice provides a solid flat surface and wind removes or hardens snow, respectively. Human infrastructure or activities that provide similar advantages include plowed or packed roads and trails. Trails, cut lines and roads provide less advantage to wolves when they are not packed (e.g., by snowmobiles) or plowed (Kiem et al., 2014).

The proposed Freegold Road upgrade and extension is currently an active transportation corridor used by placer miners, exploration companies, trappers and dog mushers to access or recreate the region during the winter. Placer mining and exploration companies mobilize equipment and supplies late in the winter when snow depths are greatest (March and April), and travel the Freegold Road to approximately the confluence of Hayes Creek and the Selwyn River. Trappers are most active earlier in the winter when animal fur is in prime condition. The extent of trapper use of the Freegold Road is currently unknown. Dog mushers use trails starting as soon a snow and ice condition permits. The extent of musher use of the Freegold Road is currently unknown, but there is a portion of the Freegold Road that is part of the Yukon Quest trail.

The Wildlife Baseline Report describes wolves currently using the entire length of the existing Freegold Road and winter road to travel. The portion of the proposed road from the Selwyn River to the Mine Site is the only segment of road that is currently not used by humans during winter as a travel route. Furthermore, vehicle traffic on the Freegold Road will be considerably more frequent than existing conditions once the project is operational, which is expected to limit wildlife use of the Freegold Road, so wolves will not be able to freely travel the road and disturbance will likely keep wolves away from the road.

B.12.2.3 R2-152

R2-152. Supporting evidence for the assertion that road design is a sufficient mitigation to the barrier effects of the Freegold Road.

Road design is only a component of mitigation (in this instance, mitigation by design) considered for reducing the barrier/filter effect of a road and road traffic through wildlife habitat. CMC did not intend to assert that road design alone was sufficient mitigation to the barrier effects of the Freegold Road. In fact, CMC described a multistage process to minimize potential effects on wildlife through route selection, road design (e.g., road design speed, embankment slope and height, construction of wildlife crossings) and road operation (e.g., road signs), which is consistent with the standard road ecology approach suggested in the Handbook of Road Ecology (van der Ree et al. 2015). Further discussion to elaborate on this approach to mitigation is provided below.

Roads can affect wildlife through mortality, loss/degradation of habitat, or barriers/filters to movement. CMC's primary objective for mitigating potential effects of the Freegold Road on wildlife is to reduce the risk of mortality through road collisions. CMC is confident that the proposed road design and mitigation measures will be sufficient to reduce mortality risk of local wildlife. The secondary objectives were to minimize effects of habitat loss and barriers to movement. The potential effects of habitat loss and barriers to movement of the proposed Freegold Road construction and use on wildlife cannot be completely mitigated. Nine years of caribou road crossing monitoring of the Misery Road in the NWT found that (Rescan, 2011):

1. The road was a semi-permeable barrier to caribou movement during winters. The road provided little restrictions to caribou movement during the snow-free season.
2. 57% of caribou groups that approached the road during winter were deflected from the crossing.
3. Snowbank height was the primary factor increasing the likelihood of caribou being deflected from crossing the road. Snowbanks greater than 1.5 m tall seemed to restrict caribou movement across the road.
4. Road use and vehicle type (including ore haul trucks) did not affect the probability of caribou crossing the road.

The study cautions that sample sizes were low and EKATI implements road closures during caribou migrations and controls vehicle activity on roads as a precautionary measure.

CMC's mitigation measures are consistent with the Misery Road monitoring results and best management practices from other jurisdictions, including:

- Roads are designed to be lower profile (i.e., flatter) minimizing the potential to act as a barrier. Lower profile roads (shallower and shorter embankments) have been used as design features in the NWT to increase the permeability of industrial roads for caribou, minimizing barrier effects. This is considered a best management practice as there is evidence that caribou are not blocked by high road embankments (Miller, 1985). Slopes in the range of 3:1 and 5:1 are generally considered acceptable to allow caribou crossing.

- Where road embankments are high or steep, wildlife crossings will be constructed to allow easier movement of wildlife. Crossing will be designed to have a shallower embankment grade, and will be built with finer materials.
- The road will be gated to control access, minimizing traffic volume thereby reducing the potential barrier effect caused by higher traffic volumes.
- Snow management will be conducted to ensure that roadside snowbanks are less than 1 m tall to allow animals to more easily move across the road surface. Evidence from caribou crossings of industrial roads in the NWT found that caribou are deflected from crossing roads when roadside snowbanks are greater than 1.5 m tall, and are undeterred when snowbanks were less than 0.5 m tall (Rescan, 2011).

The route selection details are provided in Section 4.8.4.2, with information on the alternative access road alignments provided in Appendix A.4B. Road design criteria are provided in Appendix 4B. Mitigations and monitoring are further detailed in the WMMP in Appendix A.12A.

B.12.2.4 R2-153

R2-153. A review of available data for population demographics (sex and age ratios related to surveys in the RSA). Use of demographic data for harvest and surveys will provide valuable insight into the sensitivity of regional populations to potential impacts from road maintenance and operations

A review of available population demographics were detailed in the Wildlife Baseline Report (Appendix A.12B), and for the purposes of the supplementary information request are summarized below. The available harvest data is for licensed hunting only; First Nations harvest is not reported, and data are not available. Additionally, harvest statistics for individual registered trapline concessions (RTCs) are considered private, and hence are not available to CMC.

Caribou

Data from the fall 2012 herd composition survey (Hegel, 2013) found low calf recruitment (14 calves/100 cows) and adult sex ratios (27 bulls/100 cows). These results suggest a declining population that is experiencing heavy hunting pressure, but are inconsistent with other data and the accuracy of the composition data is suspect (Hegal, 2013). Previous surveys resulted in sex ratios typically from 40–50 bulls/100 cows (Hegel, 2013).

Also, the 2012 calf recruitment is the lowest calf to cow ratio ever reported for the Klaza Caribou Herd (KCH). Past recruitment surveys averaged about 25 calves/100 cows (range 17–47). Boreal caribou recruitment rates that indicate positive population growth are 26–29 calves/100 cows (Environment Canada, 2008); however, a review of the demography of Yukon's northern mountain population (NMP) herds indicates that the threshold for positive population growth is 20–25 calves/100 cows (Hegel, 2013). The most recent data suggest that the herd has been increasing in size since 2000, and the harvest data indicates that the herd experiences little harvest pressure. The timing of the 2012 composition survey was consistent with other composition surveys, but the fall of 2012 was warmer than usual (up to 20°C), and the caribou groups may not have adequately mixed prior to the survey (Hegel, pers. Comm.). The results of the fall 2013 survey have not yet been released to provide further information on the sex and calf ratios.

Licensed harvest is only of bull animals, which averages 6.7 animals/year of the total range of the herd (Hegel, 2013). First Nations harvest is un-reported and is hence available for publication. The current harvest rate is approximately 0.6% of the 2012 population estimate, where a sustainable harvest rate is considered to be 2–3%.

Moose

Moose surveys were conducted in the Casino area by Government of Yukon in 1987, 2003, 2007 and 2011. An estimate of moose composition could not be determined in 1987 and 2003 due to low sample size (O'Donoghue et al., 2008). However, the surveys in 2007 and 2011 indicate that the number of mature bulls to adult cows (75 bulls/100 cows) was slightly higher than the Yukon average (67 bulls/100 cows) at the time of survey and above the minimum target level of 30 bulls/100 cows. In 2011 the observed number of calves in the population was low (4%), suggesting low calf survival; however, this composition index is likely biased because the survey was aimed at determining moose distribution in the survey area (O'Donoghue and Bellmore, 2011).

Licensed harvest of moose is only of bull moose. Four of the seven Game Management Subzones (GMS) around the Project are closed, with mean yearly harvest averaging 2.6 animals/year over the last ten years in the open three GMSs. First Nations harvest of moose is not published and not available to CMC.

Dall's Sheep

The current population estimates for Dall's sheep in the Yukon is 20,000 (Government of Yukon, 2013). Dall's sheep are considered a valued sport-hunting resource in the Yukon. Hunters usually target old, large trophy rams. Historically, there were few harvest reports of Dall's sheep in the Dawson Range and harvest since 1979 has been limited to GMSs 523, 524, and 526, with the majority of reports coming from guided non-resident hunts. Sheep hunting remains open across the GMSs overlapping with the RSA; however, harvest in the last ten years has been limited to GMS 523 only, with a mean yearly harvest of 0.7 animals. Licensed hunters are restricted to one full curl ram per year. First Nation harvest statistics are unknown. Demographics are not conducted for Dall's sheep surveys, however, studies suggest there are usually 40–60 rams for every hundred "nursery sheep" (Yukon Renewable Resources, 1996).

Wood Bison

A population census of the Yukon's Aishihik bison herd is typically conducted every two years, with the first survey in 1998 estimating close to 500 animals and the latest survey in 2014 estimating 1,470 animals (Jung and Egli, 2014). Two other transboundary herds occur seasonally in southeastern Yukon, known as the Nahanni and Nordquist herds (Government of Yukon, 2012). The percentage of calves in the 2014 survey was 22.7%, higher than the normal 19.9% (Jung and Egli, 2014).

Since 1998, more than 1,700 animals have been harvested, with about 60 per cent of these being male and 40 per cent being female. In the 2014–2015 season, 177 bison were taken: 119 males and 58 females (Environment Yukon, 2015).

Wood bison are expected to occur in the southern sections of the RSA only, due to limited suitable habitat. During the 2011 aerial ungulate survey, 18 bison, in two groups, were observed on the south edge of the RSA in their winter range on the edge of their core range. During the 2012 late winter survey, 23 bison in four groups were observed in the southern section of the regional study area, located in river valleys or on snow-free south-facing slopes.

Mule Deer

There is no population estimate of mule deer in the Yukon; however, their abundance is expected to be much lower than neighboring provinces and territories, but increasing. Due to their small population, mule deer harvest is by permit hunt only for all GMSs and is subject to a bag limit of one male deer per year (Environment Yukon, 2015). Between four and ten deer (mule and white-tailed deer) have been harvested each year since the hunt began, with ten being harvested in 2014 (Environment Yukon, 2015). There are no records of mule deer being harvested in the RSA.

Grizzly Bear

There is limited available information on grizzly bear distribution or abundance in the Project area. Grizzly bear densities for the project area are unknown; however, Markel and Larsen (1988) estimated densities between 10 to 16 bears/1,000 km², based on studies completed in nearby areas. 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. In the last ten years of available harvest data, a total of 11 bears were taken in GMSs 522–524 and 526. All cubs and female grizzly bears with cubs are protected from hunting (Environment Yukon, 2015).

Black Bear

The population of black bear in the Yukon is approximately 10,000 animals (Environment Yukon, 2015). Between 2010 and 2013, a total of 13 black bears were observed in the RSA during the baseline programs. Of these, six black bears were observed during the den surveys, one was photographed by a remote wildlife camera and six were observed incidentally during other baseline surveys. A total of 66 black bear observations were recorded between August 2008 and August 2013 in the Casino Project wildlife log. In the last ten years of available harvest data, a total of 19 bears were taken in GMSs 509–511, 522–524 and 526 in the RSA. Sex specific data is not available. All cubs and female grizzly bears with cubs are protected from hunting (Environment Yukon, 2015).

Furbearers

Furbearing species present in the RSA include wolf, wolverine, lynx, marten, coyote, and red fox. Other mammals considered furbearers and which are likely present in the RSA, but are not described further include red squirrel, mink, muskrat, otter, weasel, and beaver. It is unlikely that fisher or Arctic fox occur in the Project RSA. Furbearer data in the Project area are primarily limited to harvest and/or trapline data, with some incidental sightings recorded during baseline or other regional studies, though no sex specific data is provided. Snow tracking surveys were conducted to examine the distribution of furbearers in the LSA, which provided the desired presence/absence data to determine whether these species were present, but do not provide sex specific data.

B.12.3 EFFECTS ASSESSMENT FOR MAMMALS

B.12.3.1 R2-154

R2-154. A discussion of the proposed Klaza caribou model based on draft components. This should include how the model supports project effects assessment and determination of significance. The review should include available population demographic data from harvest and surveys.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting. CMC clarified at the meeting that the Klaza caribou model was a habitat-based resource selection probability function (RSF) model that does not incorporate population demographic data, nor correlate habitat effects to population demographics. It was further discussed among the technical participants that the link between habitat and population demographics is a “fundamental ecological question” that is beyond the scope and ability of this project’s effects assessment to address.

Habitat models are valuable tools for landscape management and planning. The output of habitat models is the quantification of a species’ habitat in a spatially-explicit format. The information can be visualized in maps making it accessible and interpretable to a broader audience. Habitat suitability models are particularly valuable for environmental assessment because potential effects can be communicated in terms of changes in habitat availability for the study species.

A limitation of habitat suitability models is that the availability of habitat (i.e., quantity) does not directly reflect the population demographics of the study species. For example, an abundance of high quality habitat does not necessarily directly correspond to high rates of recruitment or survival. The lack of a link between wildlife habitat and demographics is particularly true in the Yukon where populations rarely exist at the carrying capacity of the habitat because of predation and animal populations being subject to a number of stochastic variables, commonly environmental, that affect population demographics. The relationship between habitat and demographics is a fundamental ecological question and is outside the scope of environmental assessment.

The Government of Yukon completed a late winter habitat model for the Klaza caribou herd and provided a report detailing the methods and results to CMC. YESAB can request this report from the Department of Environment (Environment Yukon). Environment Yukon used a resource selection probability function (RSPF) to model late winter caribou habitat. The model uses caribou locations as the dependent variable and a number of land cover and terrain characteristics as independent variables to estimate habitat suitability as a probability of use at the scale of the habitat model input units (900 m^2).

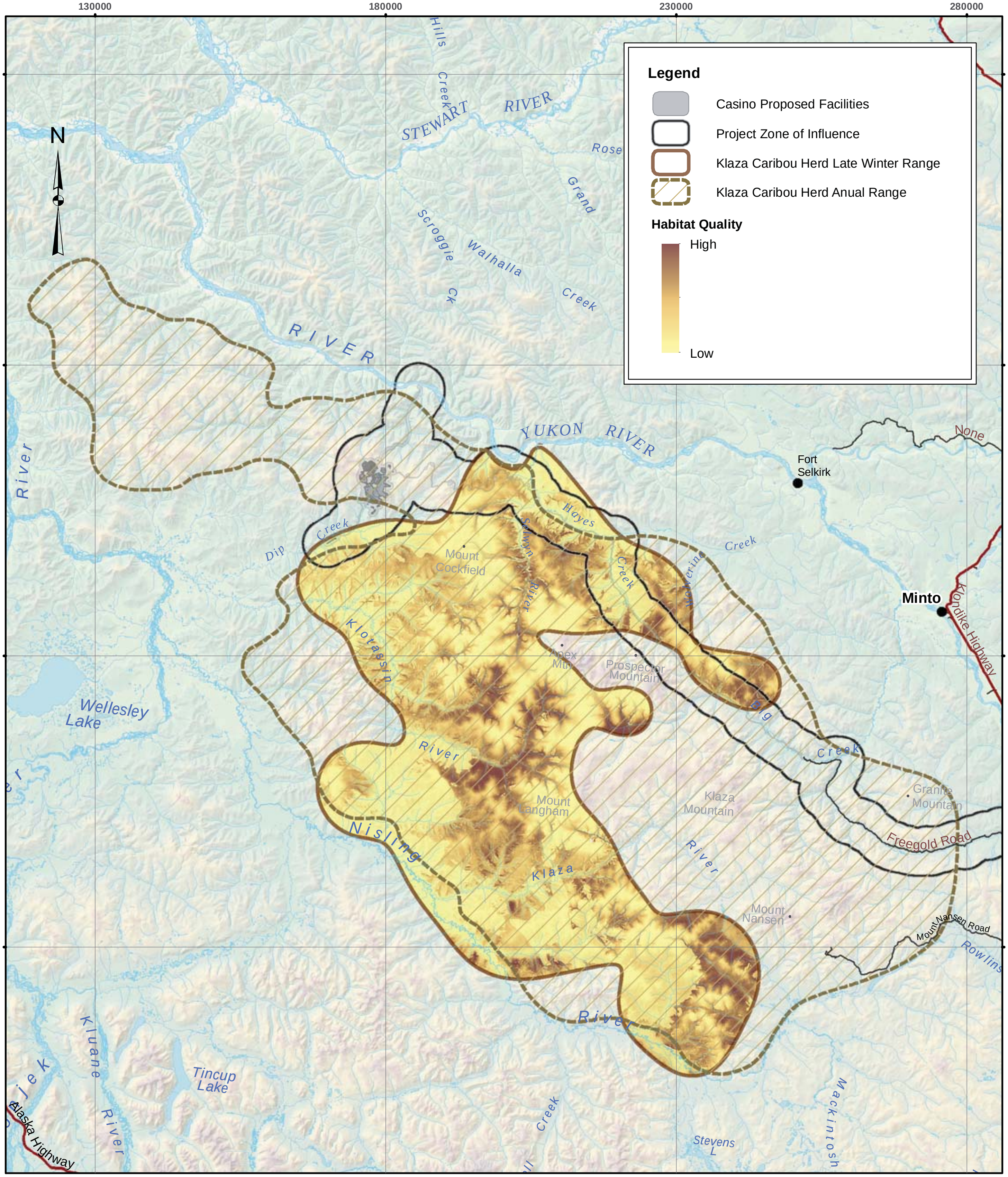
Environment Yukon’s model provides a similar output to the model used to assess Project effects on the Klaza caribou herd in Section 12.3.3. Table B.12.3-1 provides an update to the assessment of project effects on caribou habitat and Figure B.12.3-1 allows for visualization of the update, replacing Table 12.3-11 and Figure 12.3-1 in the Project proposal. The update includes an expanded herd range (Appendix A.12B, section 3.1.1) and a late winter range (Hegel, 2015). The methods used to predict potential project effects are provided in Section 12.3.3.3 of the Proposal. The zone of influence used to assess the potential Project effects on caribou habitat loss considers noise (see response to request R2-155). The updated assessment of potential Project effects indicates that the Casino Project will not have a significant adverse effect on caribou late winter habitat. The change in the availability of low, moderate and high quality winter habitat, considering loss to the footprint and zone of influence is +4.9%, -8.1% and -11.4%, respectively (Table B.12.3-1). The total effect is predicted to be -2.9% of caribou late winter habitat units.

During the October 1, 2015 technical meeting, Environment Yukon noted that the thresholds used to determine the significance of potential project effects may not be applicable to northern mountain caribou. The thresholds used to assess the project’s effect on the Klaza caribou herd’s habitat are from a detailed study of the effect of habitat changes on a number of woodland caribou herds that are part of the Boreal Population (Environment Canada, 2008). The results indicated that caribou populations have a high probability of persistence when total habitat disturbance (natural and anthropogenic) are less than 15% of a herd’s range. CMC used this as a threshold for determining the significance of the effect of the Casino Project on caribou late winter habitat — a 15% loss of habitat was assumed to be a high magnitude effect. Reid et al. (2013) reviewed the application of the Environment Canada model to the Carcross caribou herd and found that model was not applicable to the Carcross caribou herd, primarily due to the abundance of non-forested habitat types within the herd’s range. However, in the absence of other ecological or legislated thresholds for northern mountain caribou, the Environment Canada (2008) study remains the most applicable threshold currently available for woodland caribou.

Table B.12.3-1 Change in caribou late winter habitat quality due to Project effects in the RSA

Habitat Quality	Baseline	Loss to PDA (km^2)	Reduced Effectiveness in ZOI (km^2)	Maximum Disturbance	% Change
Nil	0.00	+11.8	NA	11.8	
Low	2,548	7.6	+130.0	2,678	4.9
Moderate	1,438	4.0	-108.2	1,330	-8.1
High	329	0.22	-33.7	295.5	-11.4
Sum HSI	7,125,445			6,917,201	-2.9

Update to Table 12.3-11.

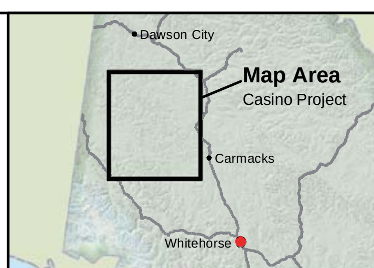


1:250,000 Topographic Spatial Data, National Road Network, Ecoregions; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Project infrastructure spatial data provided by Knight Piesold Ltd. 2014.

Klaza caribou herd late winter range provided by Yukon Government – Environment (2015).

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca



Klaza caribou herd resource selection function for late winter habitat quality

FIGURE B.12.3-1

0 5 10 15 20 25 30 35
kilometres

Main Map scale 1:900,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASINO
EDI

Path: J:\Yukon\Projects\2015\15Y0043_Casino\Mapping\Final_Mapping\450_RSF_LateWinter.mxd

B.12.3.2 R2-155

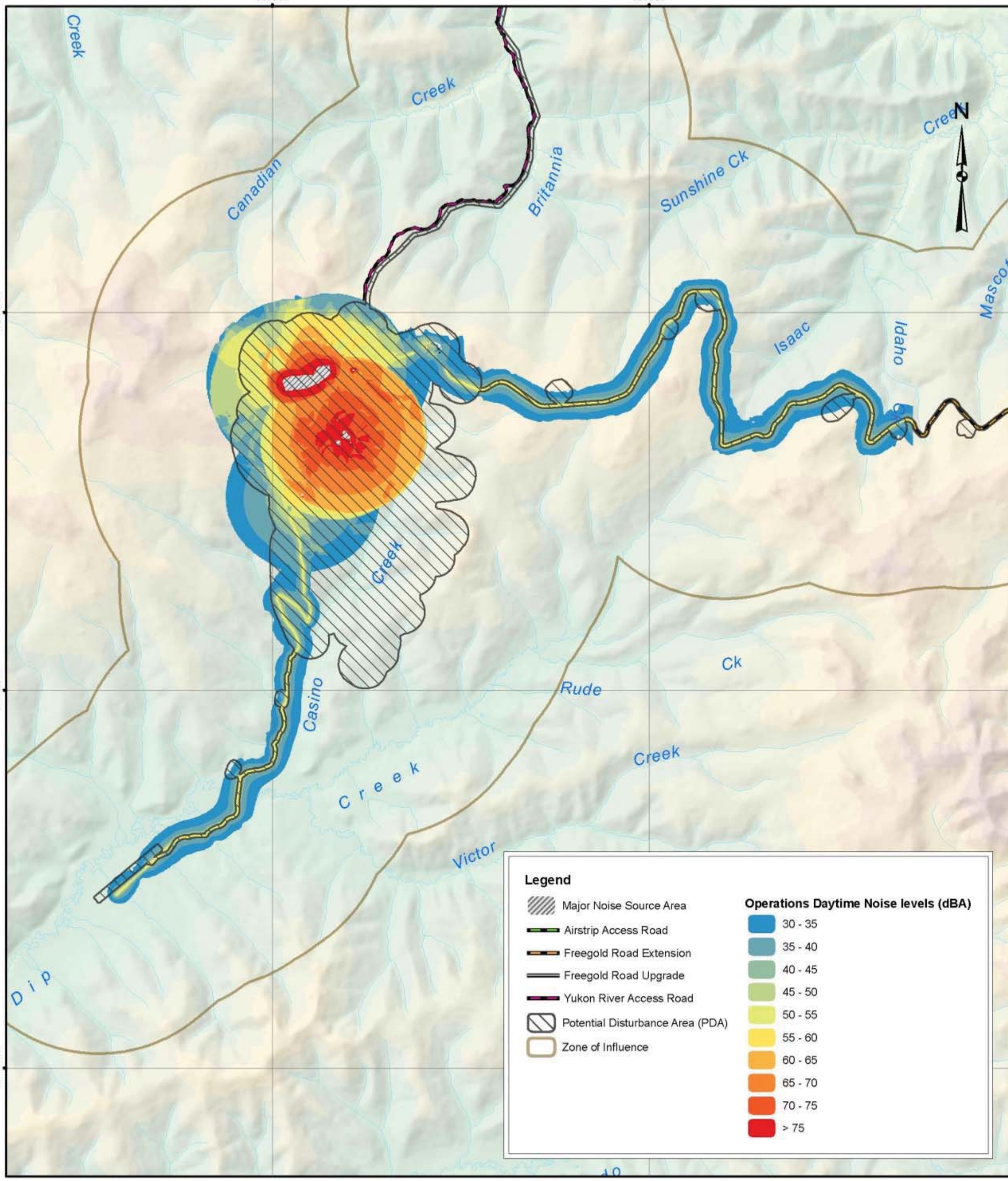
R2-155. A discussion of noise associated with the Project in relation to the habitat suitability model using the most recent reference materials available. This discussion should include consideration of noise from all project activities and baseline conditions (see R2-212, R2-213, R2-314).

Noise modelling and potential wildlife displacement was considered in the effects assessment (Section 12 of the Proposal) as a disturbance activity that could affect wildlife behaviour and distribution near Project facilities. All project disturbances and potential effects on wildlife were quantified within the various zones of influence used to quantify effects on wildlife (Figure B.12.3-2). To quantify potential behavioural changes, habitat multipliers, or "downgrading" was applied to habitat within the zone of influence (Proposal Section 12.3.3 Caribou Effects Assessment). Habitats were considered "nil" (i.e., completely avoided) within the project footprint, with varying reduced habitat uses presumed correlated with distance from Project facilities. The justification for the size and response within a zone of influence, partly determined by noise, is provided in Proposal Section 12.3.3.2 (Potential Project Interactions with the Klaza Caribou Herd). All known relevant literature on caribou response to noise was considered in that section. Mitigation measures to reduce noise levels and, consequently, reduce sensory disturbance on wildlife are listed in Proposal Section 9, Table 9.4-4, and are as follows:

- 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.
- 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 flyrock effects.
- 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.

Additionally, as summarized in the response to R359, the effects assessment on birds was conducted considering, among other disturbance features, noise within a zone of influence. It was acknowledged that there will be some reduced habitat quality within the zone of influence. This reduced habitat quality was considered 'not adversely significant' within the bird regional assessment area.

For further details on the assessment of effects from air traffic on Dall Sheep, see the response to R2-177 below.



1:50,000 Topographic Spatial Data, National Road Network, Ecoregions; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Project infrastructure (2014) and noise level (2015) data provided by Knight Piesold Ltd.

Zone of Influence data produced by EDI (2014).

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Comparison of the Wildlife Zone of Influence to the Noise Levels of the Casino Mine during Daytime Operation

FIGURE B.12.3-2

CASINO

EDI

0 0.5 1 2 3 4 5
Kilometres

Map scale 1:140,000 (printed at 8.5x11)
North American Datum 1983: UTM Zone 7

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B.12.3.3 R2-156

R2-156. A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds for actions which may mitigate adverse effects.

The objectives of the caribou monitoring identified in the WMMP are to evaluate:

- Trends in distribution within the zone of influence and late winter habitat (Table 5.4-8 of the WMMP).
- Movement patterns of caribou as they approach or cross the road and other Project infrastructure (Table 5.4-9 of the WMMP).

CMC has committed to monitor caribou winter distribution and movement adjacent to the Project footprint. The WMMP does not currently include objectives for monitoring predation of moose and caribou, for the reasons outlined in the response to request R2-151.

While the prediction of potential Project effects are generally conservative (i.e., predicted higher magnitude of effects at larger spatial extents than are likely), to account for uncertainty in the prediction of the extent and magnitude of these effects, monitoring initiatives were provided in the WMMP to increase certainty in effects prediction and inform adaptive effects management. The WMMP identifies the objectives for monitoring changes in caribou distribution and movement, and includes adaptive management thresholds. The adaptive management effect thresholds identified in the WMMP are based on the habitat effects and movement thresholds used to define the predicted effect of the Project in Table 12.1-5 and Section 12.3.3.3 of the submission. For example, the goal of the mitigation programme for caribou, outlined in Table 5.4-8 of the WMMP, is that the Project will have a 'not significant' effect on caribou distribution in the late winter, as caribou use of late winter habitat was observed in baseline studies. The threshold for action is that caribou occurrence within the ZOI is equivalent to the predictions made in the Project impact assessment. Therefore, if the distribution of caribou deviates at all from baseline, and the deviation is likely due to project disturbance, then CMC will implement corrective action measures, which will start with additional caribou movement monitoring.

Disturbance

An area of particular uncertainty is the extent and magnitude of caribou disturbance, represented by the zone of influence. The zone of influence used to assess potential Project effects assumes a reduction in habitat quality as a function of distance from the Project footprint. Figure B.12.3-3 provides a schematic of the predicted change in habitat quality as a percentage of baseline conditions at distances from the Project footprint. For example, if the modeled probability of caribou using a particular habitat unit (pixel) is 0.5 at baseline conditions and the habitat unit is 1.5 km from the project footprint, then the probability of caribou using the habitat unit drops to 0.2 (40% of 0.5), corresponding to a 60% reduction in habitat quality.

The assumption of a zone of influence is that the mechanism causing the reduction in habitat use/quality is some form of sensory disturbance (e.g., noise, smell). Zones of influence for any species are dependent on how animals (e.g., caribou) perceive their surroundings, individual experiences and other factors. Documented zones of influence come from regional caribou studies, not controlled experiments; consequently, the mechanisms causing the zone of influence will never be completely understood.

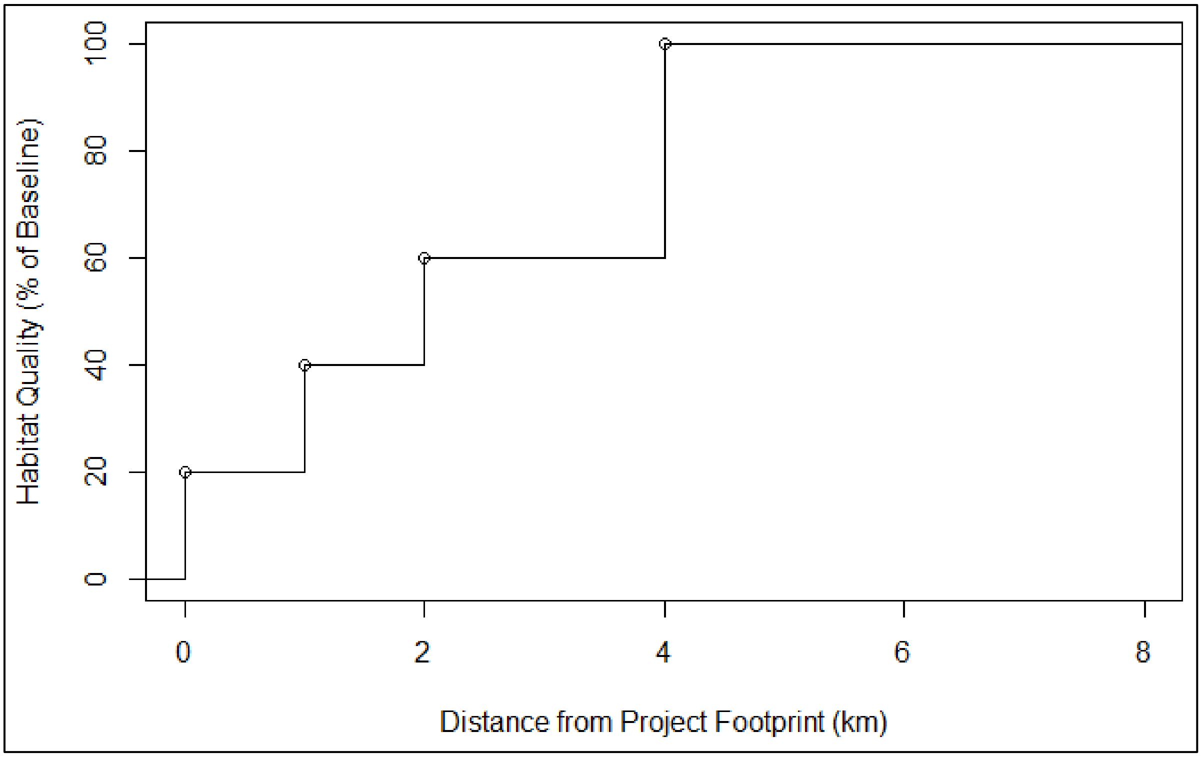


Figure B.12.3-3 Theoretical zone of influence

The caribou monitoring program will monitor the local and regional effects of road infrastructure and operations on caribou habitat use within the zone of influence through:

1. Local Monitoring: Continuous log of caribou observations from CMC personnel to document occurrence near Project facilities.
2. Regional Monitoring: Proposed annual late winter aerial surveys within a 10 km radius of Project infrastructure (as per 2013 late-winter survey; Figure 4.1, Appendix 12-A) will be implemented to document relative abundance and distribution of caribou relative to Project infrastructure. Long-term distribution patterns could be identified by a YG-sponsored caribou satellite collaring program. Collar data will inform regional late-winter habitat distribution.

Movement

There are no legislated or ecological movement thresholds for caribou. The threshold identified for monitoring effects on caribou movement is 10% of caribou that approach the road will be deflected (WMMP Table 5.4-9). This threshold is based on a change in caribou movement that is more likely to be detected using available monitoring and analytical methods. The caribou monitoring program will monitor the local and regional effects of road infrastructure and operations on caribou movements through:

1. Local Monitoring: Seasonal caribou track surveys in key movement areas where existing trails were detected within the ZOI. These can be ground-based (snow machine) to observe movement during late winter. It may also include the use of remote motion-sensing cameras and documenting fresh tracks at select trails that cross or approach the road.
2. Regional Monitoring: Long-term movement patterns as identified by a Yukon Government sponsored caribou satellite collaring program. This is a longer-term approach that requires analyses at a regional scale. These analyses are expected to be conducted by Environment Yukon.

B.12.3.4 R2-157

R2-157. Discussion on the effects to the Fortymile caribou herd in the event of overlap, including extend, duration, magnitude, and significance. The analysis should consider herd size and demographics.

The Fortymile caribou herd was estimated to include about 500,000 caribou during the early 1900s (McDonald and Cooley, 2004) and was likely one of the largest migratory caribou herds in North America. The population was nearly extirpated as it collapsed to roughly 5,000–10,000 animals by the 1970s. As the herd shrank, its annual range contracted to an area primarily in Alaska. The Project does not interact with the current range of the Fortymile caribou herd. The Fortymile Caribou Herd is a migratory herd that started to reoccupy its winter range in Yukon in 2002. The herd was estimated at approximately 51,675 animals in 2010 (Alaska Department of Fish and Game, 2012) and it is expected to grow in number and reoccupy more of its historic range in Yukon. The winter of 2013-/2014 marked the first year that the entire Forty Mile caribou herd reoccupied its historic winter range in the Yukon for the first time in several decades. The herd broke into a couple of subgroups and spread out over a fairly wide area – some animals went up into the Dempster Hwy corridor, others around the Top of the World Hwy, and others south towards White River. Approximately 10,000 Fortymile caribou were in the Dawson Range/White Gold area for the winter, mostly at higher elevations (i.e. subalpine/alpine).

In mid-October 2014, the entire herd crossed into the Yukon heading west towards the Dawson Range, but hit the White River and turned north. No collared Forty Mile Caribou were found in the Dawson Range during fall 2014 telemetry surveys conducted by Yukon Government. There have been a few reports of small numbers of Forty Mile caribou scattered through the White Gold area and Dawson Range, but the majority of the herd are wintering around 60 Mile area, Top of the World area, and along the Yukon River downstream of Dawson (western portion of the range). Reports from October 2015 indicate that the herd has returned to the Dawson region.

It is unknown how the distribution of the Fortymile herd will change in the coming years. The Project occupies none of the Fortymile Caribou Herd's current range (Figure B.12.3-4), but is part of the herd's historic winter range. If the herd continues to grow and expand its range, then the herd will likely spatially and temporally overlap with the Project during winters. If the herd increases use of the historic range, then the Project will have a greater interaction with a small portion of the herd's annual range. While there is currently no interaction or information to support an assessment, a discussion on the extent, duration, magnitude, and significance of effects on the Fortymile heard is provided below.

Extent: The Project does not spatially or temporally interact with the Fortymile caribou herd; consequently, there is no effects pathway for assessing Project effects on the herd.

Duration: The Project could overlap with the winter range of the Fortymile caribou herd, if the herd continues to extend its range into the Yukon. Migratory caribou tend to move most during the spring and fall, but also remain active during the winter. Migratory caribou do not return to the same wintering areas each year. The Fortymile herd is expected to be somewhat unpredictable in where they winter within their annual range. Caribou from the herd could interact with the Project at times during the winter, but not every winter. Consequently, the duration of the Project's interaction with Caribou will be variable among and within years, but entirely restricted to the winter months.

Magnitude: The herd was estimated at approximately 51,675 caribou in 2010 (Alaska Department of Fish and Game, 2012). Management efforts to further increase the size population, such as a hunting ban in Yukon, are currently in affect in Yukon. Alaska harvests approximately 1,000 caribou from the herd annually. The Tr'ondëk Hwëch'in First Nation will likely start to harvest caribou from the herd and the Yukon Government will start to license harvest of the herd in the near future.

Migratory herds tend be concentrated during calving season and disbursed during the winter. As the Project is within the historic winter range, it is unlikely that the entire herd would be affected by the Project during any year; however, portions of the herd could occur near the mine site or along the road during any year if the year range continues to expand.

Mitigation measures: Caribou mitigation measures identified in the WMMP (Appendix A.12B) will mitigate potential Project effects on the Fortymile caribou herd. Monitoring efforts identified in the WMMP and the Yukon Government's participation in the Wildlife Working Group will provide CMC with the information needed to determine when the herd is present in the Project area.

Significance: The significance of the Project's potential effect on the Fortymile caribou herd is currently assessed as not significant as the Project does not spatially or temporally interact with the herd. If the herd continues to expand its range into the Project area, then the tools for monitoring presence of the herd and mitigation measures are available to adaptively manage potential effects.

CMC will track Fortymile caribou presence in the RSA through communication with Environment Yukon. CMC will be a stakeholder in the conservation of the Fortymile Caribou Herd's winter habitat if the herd continues to expand its distribution into the Dawson Range. Measures identified in the Proposal for mitigating effects on the Klaza Caribou Herd will also apply to the Fortymile Caribou Herd.

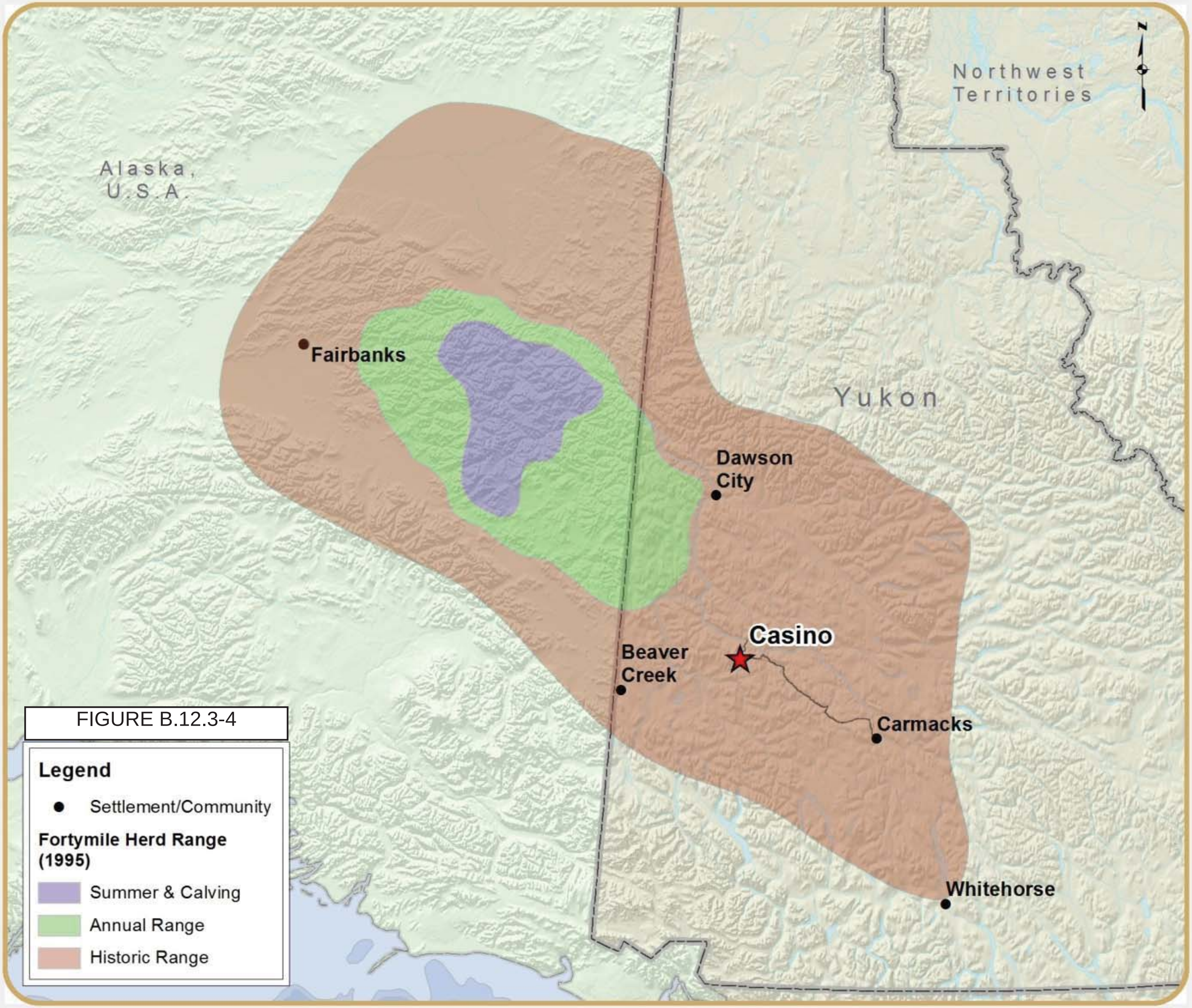


FIGURE B.12.3-4

B.12.3.5 R2-158

R2-158. Discuss how the RSF model accounts for variability in caribou distribution based on environmental conditions and among years. This should include consideration of available data on actual caribou distribution from the 1980's – present.

Yukon Government's ungulate biologist reviewed the concordance of the late winter habitat model with the aerial survey and older collar data, and determined that the caribou locations generally agree with the model (Hegel 2015).

The model inputs and methods are described by Hegel (2015). It is based on habitat use data from the recent collaring program (3 winters of data), but not survey locations or the VHF collar locations — all are actual caribou locations. The recent GPS collar location data are not compatible with survey data or older collar data because the quality (accuracy and frequency) of the spatial data acquired from the modern collars is much greater. Caribou ecology is not expected to have changed much in the past twenty-five years (habitat requirements during winter should be the same), so the results of the late-winter habitat model should be applicable. Only the land cover variables (fire history and lichen cover) have changed since the original surveys, as all other variables are unchanging terrain variables.

The model output provides an indication of caribou habitat selection based on the terrain and land cover variables included in the model. Variation in environmental conditions among years is not directly accounted for in the model; however, the use of multiple years of data allows the model to include some variation in environmental conditions. Hegel (2015) states "*Overall, the RSF indicated higher quality habitat at mid-range elevation and slope values, in more easterly and southerly areas, areas with higher lichen and ruggedness values, and unburned areas*".

B.12.3.6 R2-159

R2-159. Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.

Moose surveys were conducted in the Casino area by Government of Yukon in 1987, 2003, 2007 and 2011. An estimate of moose composition could not be determined in 1987 and 2003 due to low sample size (O'Donoghue et al., 2008). However, the surveys in 2007 and 2011 indicate that the number of mature bulls to adult cows (75 bulls/100 cows) was slightly higher than the Yukon average (67 bulls/100 cows) at the time of survey and above the minimum target level of 30 bulls/100 cows. In 2011 the observed number of calves in the population was low (4%), suggesting low calf survival; however, this composition index is likely biased because the survey was aimed at determining moose distribution in the survey area (O'Donoghue and Bellmore, 2011).

Licensed harvest of moose is only for bull moose. Four of the seven Game Management Subzones (GMS) around the Project are closed, with mean yearly harvest averaging 2.6 animals/year over the last ten years in the open three GMSs. First Nations harvest of moose is not published and not available for use by CMC.

CMC does not intend to develop a moose population demographic model for the Project area. The sensitivity of the local moose population to increased harvest pressure is already established by the Government of Yukon. Additional modeling will not inform the assessment of the Project's effect on the local population of moose because moose harvest in the region is not expected to change from baseline conditions as a result of the Project. Moose harvest is managed by the Yukon Government.

Yukon Government's annual allowable harvest (AAH) of 2% to 5% is assumed to ensure moose populations remain viable and robust to changes in harvest pressure. The sensitivity of moose population to changes in harvest pressure should be minimal if the harvest rates remain below the identified thresholds. This AAH has officially been used to manage harvest in Yukon since 1996. The highest ten year average annual harvest rate during the last ten years within a GMA that intersects the Project is 1.3% of moose the population estimate.

B.12.3.7 R2-160

R2-160. Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.

Licensed harvest of moose is only of bull moose. Four of the seven Game Management Subzones (GMS) around the Project are closed, with mean yearly harvest averaging 2.6 animals/year over the last ten years in the open three GMSs. First Nations harvest of moose is not published or available for use.

Yukon Government's annual allowable harvest (AAH) of 2% to 5% is assumed to ensure moose populations remain viable and robust to changes in harvest pressure. The sensitivity of moose population to changes in harvest pressure should be minimal the harvest rates remain below the identified thresholds. This AAH has been used to manage harvest in Yukon since 1996, and potentially earlier. All current harvest rates within GMAs within RSA are ≤1.3% of moose population estimates.

CMC does not intend to develop a moose population demographic model for the Project area. The sensitivity of the local moose population to increased harvest pressure is already established by the Government of Yukon, and they manage the harvest of moose. Additional modeling will not further inform the assessment of the Project's effect on the local population of moose because moose harvest in the region is not predicted to change from baseline conditions as a result of the Project.

Licensed harvest of moose in Yukon is restricted to males. Four of the seven Game Management Subzones (GMS) around the Project are closed. The average annual harvest is 2.6 animals/year over the last ten years in the three open GMSs. First Nations harvest of moose is not published and not available for use by CMC.

Yukon Government's annual allowable harvest (AAH) of 2% to 5% is assumed to ensure moose populations remain viable and robust to changes in harvest pressure. The sensitivity of moose population to changes in harvest pressure should be minimal if the harvest rates remain below the identified thresholds. This AAH has officially been used to manage harvest in Yukon since 1996. The highest ten year average annual harvest rate during the last ten years within a GMA that intersects the Project is 1.3% of moose the population estimate.

Given that harvest is managed as discussed above and the discussion about predation (see R2-150 and R2-151), it is CMC's position that the information necessary for assessing the Casino Project's effect on moose has been provided in the Project proposal and follow-up information requests.

B.12.3.8 R2-161

R2-161. Information on the frequency, extent, and methods for monitoring of the pipeline route including:

- **a. Prior to construction to inform the route, and**
- **b. During construction and operations**
- **c. Geotechnical and topographical information that will be used to determine which (if any) sections of the pipeline are buried.**

To establish the potential of the project's interaction with wildlife along the proposed Yukon River water pipeline, two biologists traveled the entire length of the route looking for signs of wildlife use. The proposed water pipeline occurs within the range and habitat of most animals that occur in the region, so the purpose was to document the presence of wildlife features such as mineral licks, concentration of track, trails, or other features.

Two EDI biologists travelled the current access road adjacent the pipeline route on 23 July 2014 on ATVs. The majority of the proposed pipeline alignment follows the road developed during Casino's exploration phase which accesses the proposed mine site from the Yukon River. One section of the proposed pipeline route follows the old road along Britannia Creek. The surveys drove along the route at approximately 10 km/h and watched for any sign of wildlife. The survey covered approximately 19 km between the deposit and Yukon River. Biologists travelled slowly along the route and recorded the location and description of all wildlife use. In addition, motion triggered cameras were placed at two locations where wildlife trails were observed. The cameras collected images 23 July to 22 August 2014.

In total, 62 detections of wildlife sign were made (Table B.12.3-2). Species observed included caribou, moose, bear (black and grizzly were grouped), and wolf. The most common wildlife sign observed was for bear species; a total of 23 observations of scat and tracks were made. Twenty signs of moose, 8 signs of wolf, and 5 signs of caribou scat and tracks were detected. In addition to the species specific observations, 14 wildlife trails were also observed, either crossing the proposed pipeline route, or running parallel to it.

In addition to the surveys, two wildlife cameras were set up at two sites along the proposed water pipeline route near observed wildlife trails (Figure B.12.3-5). The cameras were set up on 23 July 2014 and were active for 30 days. The camera at km 15 of the road alignment did not record any animals, while the camera at km 9 along the road adjacent to Britannia Creek recorded a black bear sow with a cub on 25 July 2014.

Table B.12.3-2 Summary of observations of wildlife sign by species along the proposed water pipeline route

Species	Tracks	Scat	Camera 1	Camera 2
Bear sp.	7	23	0	1 (+cub)
Caribou	2	3	0	0
Moose	14	6	0	0
Wolf	3	5	0	1

The frequency, extent and methods for monitoring of the pipeline route prior to construction, during construction and operations and geotechnical and topographical information to be used include:

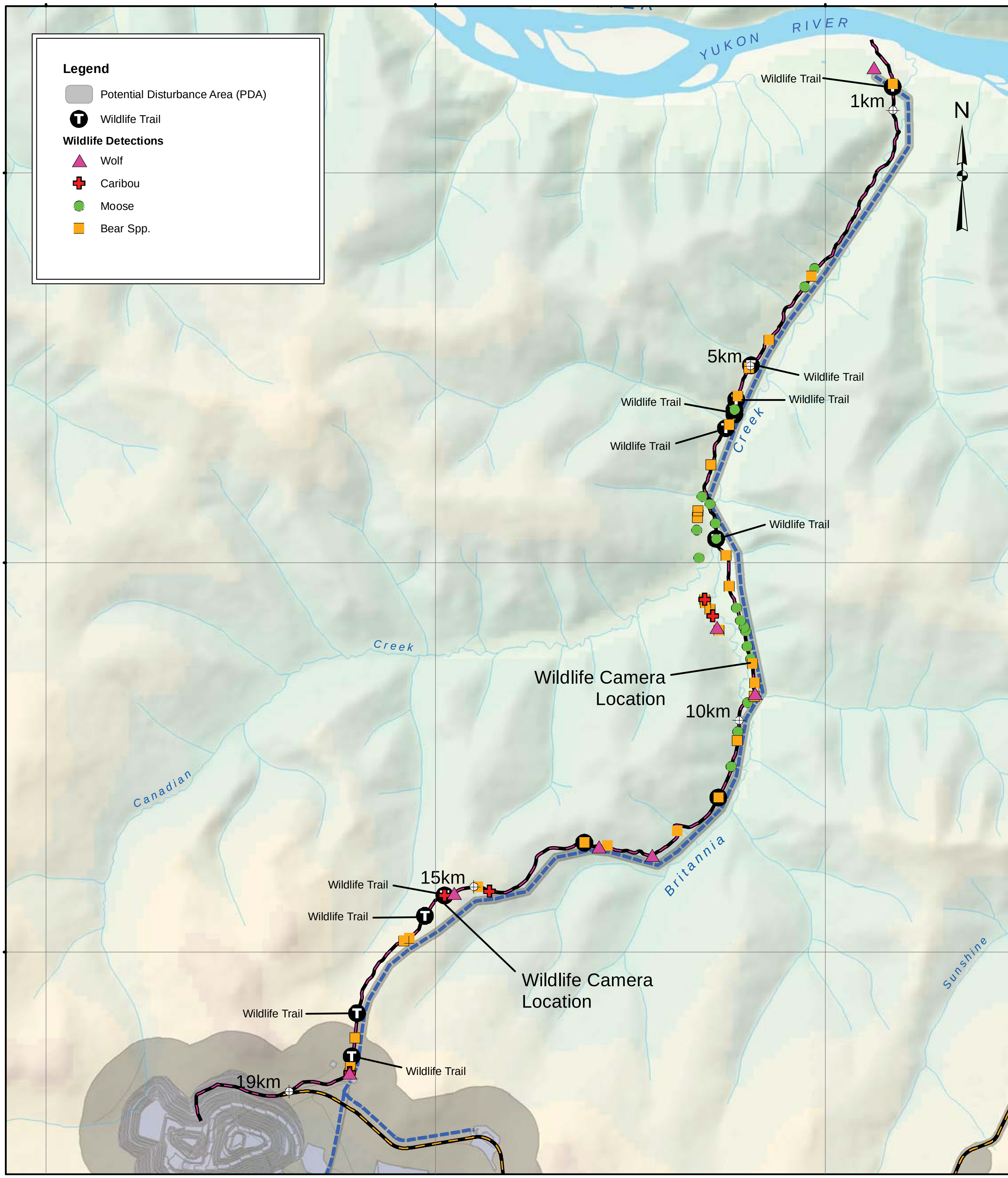
a. Prior to construction, further studies will be conducted to determine high probability wildlife crossing areas (e.g., trail surveys, snow track surveys, camera surveys) along the proposed pipeline route. These will be informed by the information collected in 2014 (summarized above) and will be conducted at a frequency required to provide the necessary data.

b. During construction and operations, the pipeline route will be monitored to determine if it is acting as a barrier to wildlife movement and to confirm the effectiveness of mitigation actions. The frequency and methods for monitoring of the Project Disturbance Area (PDA), of which the pipeline is a part, is provided in Table B.12.3-3 for all Project phases.

Table B.12.3-3 Summary of PDA Monitoring Programs by Project Phase

PDA	Construction	Operations	Closure/ Post-closure
Footprint assessment — measure the evolving Project footprint and compare the area prediction in the Project description	Annual	Annual	As needed to monitor reclamation
Building assessment — observe use of buildings for use by nest predators, nesting structures, or as a haven for potential problem wildlife.	Monthly	Monthly	n/a
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.	Ongoing	Ongoing	Ongoing to decommissioning of road
Nest monitoring			
Raptor nests adjacent to PDA	As required when adjacent nest sites are occupied	As required when adjacent nest sites are occupied	n/a
Active migratory bird nest surveys – survey areas that must be cleared 01 May to 31 July	As required prior to disturbance	n/a	n/a
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.	Ongoing	Ongoing	To coincide with TMF monitoring as required post-closure
Incidental wildlife reporting — Observation sheets placed throughout Project facilities encouraging personnel to record wildlife sightings. Data includes location, date, time, species, activity, etc.	Ongoing	Ongoing	To coincide with TMF monitoring as required post-closure

c. Ideally, the pipeline will remain on surface for as much of the route as possible. This is to enable maintenance access, and to minimize disturbance. Geotechnical and topographical information will be used to determine whether sections of the pipeline are required to be HDPE or steel, whether they need to be insulated or not and where booster stations and pressure valves are required. To minimize impact to wildlife crossings, berms can be constructed over the pipeline at appropriate intervals (to be confirmed by monitoring), or the pipeline can be raised. However, geotechnical and topographical information will *not* determine whether or not the pipeline is buried.



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Project infrastructure spatial data provided by Knight Piesold Ltd. 2014.

Wildlife observations collected by EDI (2014).

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Yukon River water pipeline alignment widlife detections and trail locations

FIGURE B.12.3-5

0 500 1,000 1,500 2,000
metres

Map scale 1:70,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASINO
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B.12.3.9 R2-162

R2-162. Initiate additional bear den surveys, utilizing suggestions by Government of Yukon, and indicate when information will be available during the screening process.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting. It was also discussed further at a meeting between the wildlife discipline lead (EDI) and Yukon Environment in a follow-up meeting on November 2, 2015. Between the parties, it was agreed another survey to locate areas consistently used by bears for denning could provide information for site-specific mitigation that may be addressed by project design. It is recognized that low snowfall in the area does lower confidence in the information provided by den emergence surveys.

The Project area receives relatively little snow, and snow in the high suitability denning habitat within the LSA is almost entirely melted by the time bears are emerging in the spring, making identification of bear dens used the previous winter difficult. Nine excavations, all possible bear dens, were documented during the 2012 den survey. The excavations were not ground-truthed and there was no snow in the area; consequently, it is not clear if these are digs or dens. If they were dens, then it is not known whether they were used the previous winter.

Environment Yukon and YESAB are requesting an additional year of surveys for bear emergence. CMC's consultants met with Environment Yukon's carnivore biologist on November 2, 2015 to discuss concerns about the survey method and potential alternative methods. Environment Yukon suggested that when survey conditions are not adequate for conducting emergence surveys, then fall surveys might be a suitable alternative.

In response to these requests and discussion, CMC will conduct a second year of bear surveys, before final engineering design and construction. CMC will further engage with Environment Yukon input before planning a second year of bear surveys.

B.12.3.10 R2-163

R2-163. A discussion of how denning may affect or be affected by project activity and suggested mitigations to prevent disturbance.

Based on discussions with Environment Yukon's carnivore biologist (November 2, 2015), the denning period for family groups can occur from the end of September to mid-June. Males and females without cubs typically den for a shorter period but denning for each bear/family group is highly dependent on local snow conditions and weather patterns.

The Project has the potential to affect denning grizzly bears by reducing the amount of available denning habitat and by disturbing denning bears, including bears that are searching for potential denning locations, primarily during the construction period.

Mitigations to reduce Project effects on grizzly bears are listed in the Project Proposal, the Wildlife Mitigation and Monitoring Plan (Appendix A.12A) and the Waste Management Plan (Appendix A.22A). The Project Proposal states that to reduce Project effects on grizzly bears, CMC will reduce the risk of increased mortality of grizzly bears by avoiding active dens, where they are known to occur, 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. CMC realizes that dealing with unknown dens on a case-by-case basis could have effects on construction schedules during the construction stage of the Project. CMC acknowledges that the range of denning could be from end of September until mid-June, beyond the dates of October to April/May described in Section 12.3.5 in the Project Proposal.

B.12.3.11 R2-164

R2-164. Updated habitat suitability and effectiveness which take into consideration the comments from Yukon government and SLR.

Below are responses to the comments by YG and SLR, as provided in Section 9.2.3.2 of the ARR-2. The consideration of these comments does not require an update to the grizzly bear habitat suitability and effectiveness models for reasons described below.

1. *Yukon Government disputes the classification of alpine habitat as unsuitable or zero, citing bear tenacity in digging through snow, presence of carcasses, and areas of little to no snow (as evidenced by the lack of snow cover during spring den surveys).*

The habitat effectiveness model defined alpine habitat as that at high elevations associated with mountainous conditions throughout Yukon. Dwarf shrubs, herb/cryptograms and low-growing and scattered krummholtz trees are the predominant vegetation condition. In very high elevation areas, bare rock, colluvium or ice/snow may be the dominant conditions. Alpine habitat provides suitable habitat for denning and includes forage species such as mountain cranberry, crowberry, Hedysarum, sedges and grasses. Alpine habitat provides habitat for prey, including thinhorn sheep, woodland caribou, marmots and ground squirrels and storage of carcasses from winter kills.

Ratings for alpine habitat were considered zero in spring (late March through May) as there is little habitat available in alpine areas until the snow melts, except for winter kills; 1.0 in summer (June to mid-August) due to the importance of alpine and subalpine zones; and 0.5 in fall (mid-August through October). The habitat rating is then used in the habitat rating component for the habitat effectiveness model.

These ratings are comparable to ratings used in other environmental assessments, for example the KSM Project, which assigned ratings of low and very low to habitats at high elevations (Rescan, 2010). The zero rating assigned for spring is a reflection of grizzly bears choices of habitat which is primarily based on availability of forage during the growing season (Gyug, et al., 2004). Alpine areas in late March through May tend to still be snow covered in Yukon. However, during summer and fall, grizzly bear habitat can include coniferous forests, subalpine willow belts, and open alpine meadows. Also for comparison, the habitat assessment conducted by Victoria Gold did not asses any habitat before May or after October (Stantec, 2011), therefore effectively assigning all habitat in March through May a value of zero.

2. *With respect to the incorporation of seasonality into the model, Yukon Environment comments that typical modelling is based around the availability of food sources (pre-berry vs. berry). How modeling considers these, and other aspects of habitat, can alter model outcomes.*

CMC chose a three season approach instead of the two season approach mentioned by YG. No analytical deficiencies were identified by any parties, and CMC considers the model adequate for effects assessment.

3. *SLR notes that road traffic modeling should not be limited to only loaded trucks. This has the potential to artificially reduce the modelled impacts of the road on bears.*

CMC assumes this comment is in relation to the effects assessment provided in Section 12, which states that the Freegold Road Extension will have a relatively low traffic volume (128 vehicles daily at peak operation). This value is inclusive of empty and loaded trucks, however, the estimate was short 12 empty vehicles. As detailed in the response to R2-11, the updated value represents 136 vehicles, empty and loaded (Table B.12.3-4 - updated Table 4.4-5 of the Proposal). This minor update does not change the impact assessment, and the conclusion of that assessment, is still relevant to the updated value.

Table B.12.3-4 Projected Traffic Volumes during the Operations Phase

Vehicle Type	FHWA Classes	Inbound (loads per day)	Outbound (loads per day)
LNG Fuel	8-13	11	11
Diesel and Lubricants etc.	8-13	4	4
Lime (as backhaul)	8-13	6	0
Grinding Media (as backhaul)	8-13	3	0
Camp and Catering Supplies	3-7	2	2
Copper Concentrate	8-13	8	17
Molybdenum Concentrate	8-13	4	4
Other (QTY: FHWA Classes)	(5:3-7), (5:8-13)	10	10
Buses, vans , light vehicles	3-7	20	20
TOTAL		**68**	**68**

1. 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

B.12.3.12 R2-165

R2-165. Detailed information on how timing of food sources has been incorporated into the models.

The timing of food sources was considered in the habitat ratings for each bioclimate zone, which defines the seasons though their importance to grizzly bear activities. The items below provide further discussion on the importance of food sources during various seasons:

- **Spring**: Boreal high and boreal low spring/early summer, over-wintered berries, sedges, roots; riparian areas important. Little habitat available in alpine until snow melts (except winter kills).
- **Summer**: Alpine and subalpine important; berries available in all bioclimate zones; spawning salmon in boreal high and low.
- **Fall**: During the early fall, subalpine and alpine used; berries important.

B.12.3.13 R2-166

R2-166. An updated security areas model using a maximum altitude of 1 900 m and incorporating low intensity disturbance.

CMC will not be updating the security areas model. The amount of area above 1,900 m within the grizzly bear study area is 1.01 km², representing 0.012% of the ~8,921 km² grizzly bear assessment area. Adjusting the model to exclude habitat above this elevation will not result in a numerical change to the model output. In the security areas model, human activity that occurred greater than 100 times per month was included. Low intensity disturbance was not included in the analysis since specific information on this type of activity is not available.

B.12.3.14 R2-167

R2-167. Additional information on Table 8.1 of the grizzly bear effects assessment, including:

a. proportion of males and females harvested;

b. a discussion of how the numbers in part a relate to the population estimate; and

c. a discussion of the population-level effects of direct mortality.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting.

a. The total harvest of female and male bears was five and three bears, respectively, during the previous ten years (Table B.12.3-5). The female to male grizzly bear harvest is approximately 60:40. When conflict bears are included, the estimate increases the female bias in mortality to 70:30.

b. The population estimate for grizzly bears in the RSA is 121 (see response to R2-168). Grizzly bear sex ratios are about 50:50 at birth (McLellan, 1989) while adult bear sex ratios are likely slightly female biased. The harvest of grizzly bears is not sex-specific like for other harvested wildlife because hunters have trouble identifying sex of bears.

c. An average of 1.1 grizzly bear is reported killed in the RSA annually. Mortality is female biased. See response to R2-168 for analysis and discussion of population-level effects.

Table B.12.3-5 Grizzly bear licensed harvest and conflict bear kills by sex in GMAs that intersect the Project (2005-2014)

	Male		Female		Total	
GMA	**Licensed Harvest**	**Conflict Bear Kills**	**Licensed Harvest**	**Conflict Bear Kills**	**Licensed Harvest**	**Conflict Bear Kills**
509		0.5[1]	1	0.5[1]	1	1
510						
511						
522			2		2	
523	2		1		3	
524	1				1	
526			1	2	1	2
Total	3	0.5	5	2.5	8	3
Mean annual mortality	0.35		0.75		1.1	

[1] Record of conflict bear kill did not include sex.

B.12.3.15 R2-168

R2-168. A discussion and analysis of the significance of mortality estimates based on population density estimate of 11 bears/1 000 km² and annual allowable mortality rate of 4 percent.

Analysis

The estimated number of grizzly bears in the grizzly bear study area is 121 bears. The bear density estimate is calculated using the appropriate bear densities (15 bears/1000 km² in Klondike Plateau and 11 bears/1000 km² in

Yukon Plateau-Central) and area of each ecoregion within the RSA (5,838 km² of Klondike Plateau and 3,016 km² of Yukon Plateau-Central).

The reported human caused grizzly bear mortality (harvest and conflict bear kills) in the RSA is 1.1 bears per year. The average annual reported human caused grizzly bear mortality of female grizzly bears is 0.75 bears per year (see R2-167). The average annual reported human caused grizzly bear mortality of male grizzly bears is 0.35 bears per year (see R2-167).

Annual allowable harvest (AAH) of grizzly bears in Yukon is 4% of the population, with one third of the mortality female (6% of male, 2% of female). Reported annual female grizzly bear mortality is below the Yukon's AAH threshold of 1.2 female bears per year (Table B.12.3-6). Reported annual male grizzly bear mortality is below the Yukon's AAH threshold of 3.6 male bears per year (Table B.12.3-6).

A more conservative estimate of 3% AAH is used to manage grizzly bear populations in British Columbia. The Yukon Government, in a meeting with CMC's wildlife consultants on November 2, 2015, suggested that the AAH used to manage bear harvest in British Columbia is a more appropriate AAH for the region. Reported annual female grizzly bear mortality is below British Columbia's AAH threshold of 0.9 female bears per year (Table B.12.3-6). Reported annual male grizzly bear mortality is below the British Columbia's AAH threshold of 2.7 male bears per year (Table B.12.3-6).

The Yukon Government suggested that the total mortality of grizzly bears from harvest and conflict bear kills should be doubled to account for unreported kills (e.g., poaching and injury from collisions with vehicles). Inflating the estimates of bear harvest and problem kills exceeds both the 3% and 4% AAH of female grizzly bears within the RSA, but not male harvest. Consequently, using this approach to estimate total grizzly bear mortality, the current mortality of female grizzly bears may already exceed the sustainable human caused mortality rates used to manage grizzly bear population.

Discussion

Humans may already be causing unsustainable mortality of grizzly bears in the RSA through harvest and conflict bear kills that seem biased toward female bears. The highest mortality rates are in GMAs 523 and 526. Mortality in GMA 523 is primarily from non-resident harvest (Table 8.1 in the Appendix A.12B), which is entirely from outfitter harvest because licensed harvesters are not permitted to special guide non-residents for grizzly bears. Bear mortality in GMA 526 is most likely from bear conflicts within or near Carmacks as the community is within GMA 526.

The Project's effect on grizzly bear mortality risk in the RSA is assumed to be extremely low (Section 12.3.5 of the Proposal) and is assessed as not significant. The mitigation measures listed in the WMMP (Appendix A.12A) and the Waste Management Plan (Appendix A.22A) will reduce the Project's potential to significant affect the regional grizzly bear population.

Management of grizzly bear mortality within the region is the responsibility of the Yukon Government. CMC does not have the tools to mitigate significant mortality that may already be occurring in the region. CMC will monitor grizzly bear mortality within the PDA (Table 5.4-3 in the WMMP) and will participate in regional population monitoring efforts with responsible governments through the Wildlife Working Group.

Table B.12.3-6 Average annual grizzly bear mortality (2005–2014) compared to 3% and 4% annual allowable harvest estimates by sex

	Male	Female[1.]	Total
Population estimate	60.5	60.5	121
4% AAH	3.6	1.2	4.8
3% AAH	2.7	0.9	3.6
Mean harvest and conflict bear mortality	0.35	0.75	1.1

1. The allowable harvest estimates assume that the sustainable proportion of female harvest is one third of the harvest.

B.12.3.16 R2-169

R2-169. Revised traffic effect analysis, including road kills, using all project traffic not just loaded vehicles.

CMC assumes this comment is in relation to the effects assessment provided in Section 12, which states that the Freegold Road Extension will have a relatively low traffic volume (128 vehicles daily at peak operation). This value is inclusive of empty and loaded trucks, however, it was short 12 empty vehicles. As detailed in the response to R2-11, the updated value represents 136 vehicles, empty and loaded (Table B.12.3-4 - updated Table 4.4-5 of the Proposal). The impact assessment is still relevant to the updated value.

Table B.12.3-7 Projected Traffic Volumes during the Operations Phase

Vehicle Type	FHWA Classes	Inbound (loads per day)	Outbound (loads per day)
LNG Fuel	8-13	11	11
Diesel and Lubricants etc.	8-13	4	4
Lime (as backhaul)	8-13	6	0
Grinding Media (as backhaul)	8-13	3	0
Camp and Catering Supplies	3-7	2	2
Copper Concentrate	8-13	8	17
Molybdenum Concentrate	8-13	4	4
Other (QTY: FHWA Classes)	(5:3-7), (5:8-13)	10	10
Buses, vans , light vehicles	3-7	20	20
TOTAL		**68**	**68**

1. 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

B.12.3.17 R2-170

R2-170. Information on how effects on known sites of collared pika occupancy will be avoided or minimized. This should include mitigation measures to ensure the health of the population.

Collared pika occur within the local study area (i.e., the immediate mine site and access road), in talus alpine slopes. All but one pika observation was within predicted suitable habitat, though not all suitable habitat was occupied by pikas. The main sites of suitable pika habitat are around the accommodation camp, and a small area between the open pit and the heap leach facility (Figure B.12.3-6). Impacts to pika are primarily through destruction of habitat. Impacts to pika habitat on either side of the accommodation camp will be relatively low, as the impact will consist primarily of the road, which will be a linear feature with relatively little destruction of habitat.

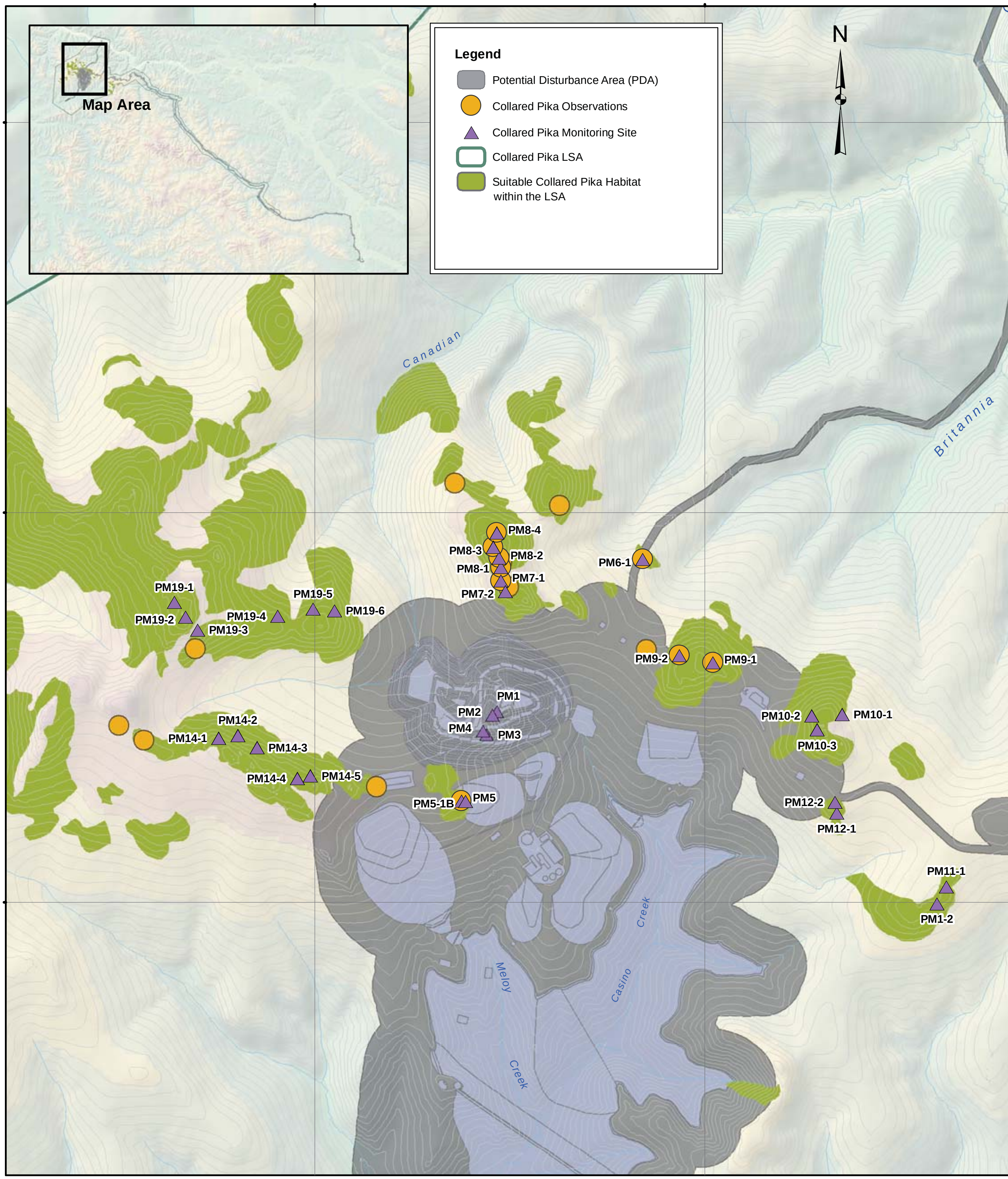
CMC has defined a threshold for disturbance of the total range of <10% to have a low magnitude effect. The habitat suitability model indicates that the LSA may contain approximately 31 km² of suitable pika habitat with a loss of 1.78 km² in the LSA. This translates to a total change of 5.73% from baseline conditions and is considered a residual effect because this habitat will not be reclaimed within a generation of pika, but with a low magnitude of effect.

The general mitigation measures outlined in the WMMP (Appendix A.12A) 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.

Monitoring of pika will involve one monitoring objective: to assess pika presence within 1 km of the PDA. Annual monitoring will occur at the local level by conducting presence/ not detected surveys for the first 3–5 years of operation, after which the data will be examined to determine future monitoring requirements.

Table B.12.3-8 Collared Pika Monitoring: Presence

Indicator	Collared pika
Monitoring category	Baseline Research and Surveillance
Design type	Observational (ground-based surveys) and opportunistic
Measurable parameter	Pika presence within 1 km of PDA
Key project interactions	Project footprint in suitable pika habitats
Goal	The Project will have a not significant effect on pika presence
Objective	Allow pika to use suitable habitat undisturbed
Threshold	Not a quantifiable threshold
Scope of monitoring work	Local monitoring: Ground-based surveys of suitable habitat within a 1 km radius of the PDA, opportunistic documentation of other sightings. These surveys will be conducted annually during the first 3–5 years of operation, after which the data will be examined to determine future monitoring frequency.
Agency/partner participation	Local monitoring: CMC
Project terms and conditions	TBD



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. 2013.

Collared pika observations collected by EDI (2012-2013) and AECOM (2010). Habitat suitability model produced by EDI, 2013.

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Collared pika observations and suitable habitat near the proposed Casino Mine Site

FIGURE B.12.3-6

0 500 1,000 1,500 2,000
metres

Map scale 1:70,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASiNO

EDI

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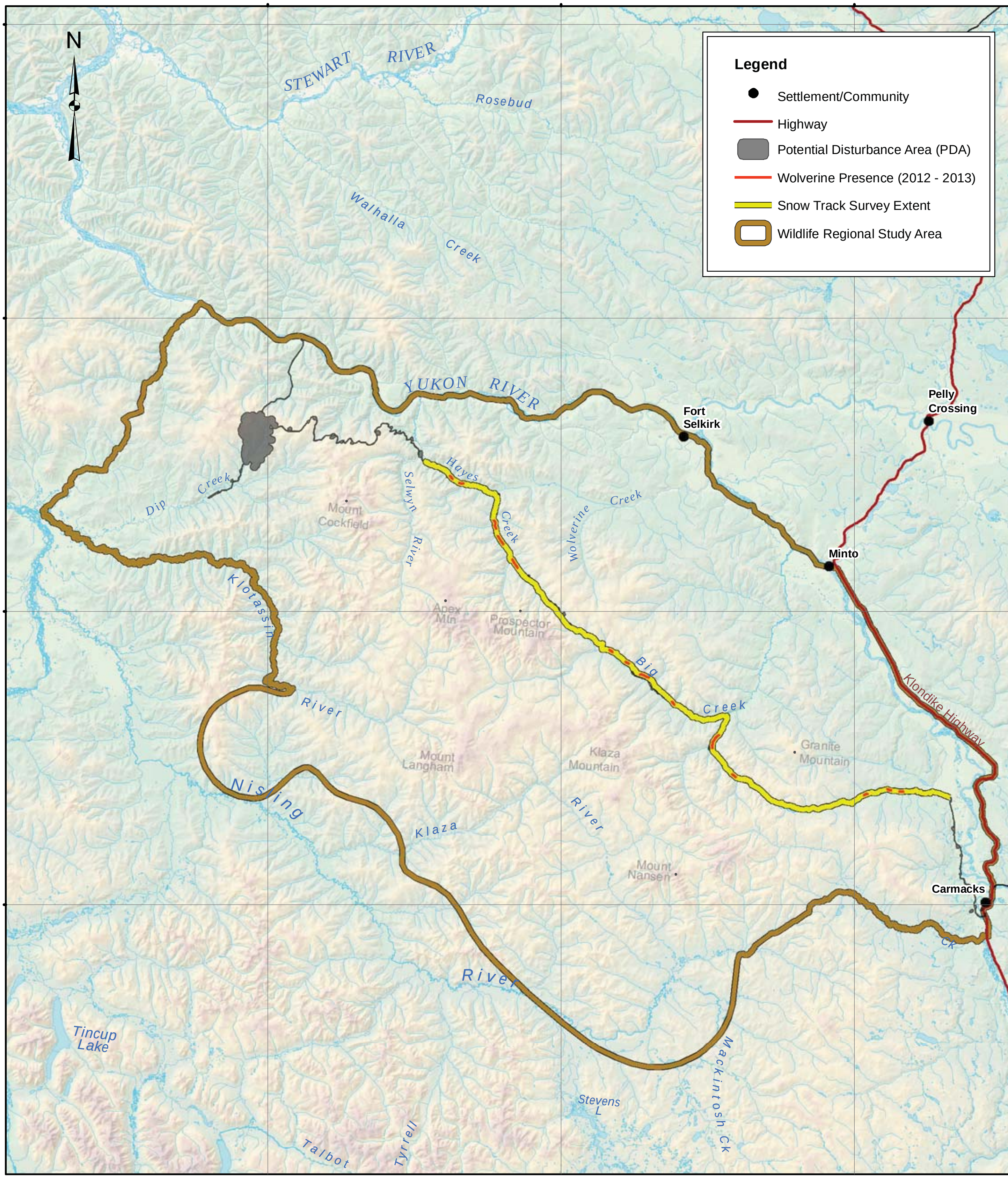
B.12.3.18 R2-171

R2-171. A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.

Only one wolverine was observed during baseline studies; it was observed on a kill in the southern section of the study area during the 2012 aerial ungulate survey. Snow tracking surveys detected wolverine tracks sporadically along the proposed Freegold Road extension and upgrade (Figure B.12.3-7). Similar to wolves, wolverine tracks were most often observed following the road/trail as opposed to crossing it. One wolverine was also recorded by Casino staff in their wildlife log (July 2009). Approximately six wolverines are harvested in trapping concessions that overlap the Project footprint each year.

Habitat suitability models for wolverine are notoriously difficult to derive as wolverine use a wide variety of forested habitats (COSEWIC, 2003), and habitat selection is strongly influenced by an adequate supply of prey, including small mammals in the summer and ungulate carcasses (e.g., moose) in winter. They have large home ranges varying from 50 to 400 km² for females and 230 to1,580 km² for males and require large tracts of wilderness ecosystems (COSEWIC, 2003). Environmental assessment of wolverine is usually not conducted, as the effects of land-use activities on wolverines are similar to those on grizzly bears (Banci 1994), and the tools used to measure mortality risk for grizzly bears are relevant for wolverine (e.g., Minto Mine (Capstone, 2013); Eagle Gold Project (Victoria Gold Corp., 2011); KSM Project (Rescan, 2013)). Wolverine are instead considered in conjunction with other furbearers (e.g., fisher, marten) and assumed protected through mitigations proposed for those species (e.g., Mt. Milligan Mine (Terrane Metals, 2008)). Additionally, mitigation measures for grizzly bears and furbearers are commonly understood to benefit wolverine, regardless of seasonal presence.

Therefore, while a habitat suitability model for wolverine is not applicable, a qualitative risk assessment for wolverine can be conducted, and is provided below in the response to R2-172.



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., Sept., 2013.

2012 – 2013 snow tracking surveys (EDI).

Wildlife Key Areas, Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Wolverine detections during the snow tracking surveys

FIGURE B.12.3-7

0 5 10 15 20 25
kilometres

Map scale 1:800,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASINO
EDI

Path: J:\Yukon\Projects\2014\14_Y_0285_Casino_EIS\Mapping\Baseline_Dec2014\Final_Mapping\450_Fig_11_2_Wolverine.mxd

B.12.3.19 R2-172

R2-172. A risk assessment for wolverines which considers the habitat suitability model. The assessment should identify potential effects to natal and maternal den sites and proposed measures for avoiding disturbance of females with kits.

Potential effects

Potential effects on wolverine can be considered under five key issues:

- Change in habitat availability;
- Degradation of habitat;
- Displacement;
- Mine features acting as attractants; and
- Mortality.

Change in habitat availability and degradation of habitat are more likely to occur during construction, whereas displacement, features acting as attractants and mortality are equally as likely to occur during operations and closure. All five effects are unlikely to occur during post-closure.

Wolverine use a wide variety of forested habitats (COSEWIC, 2003), and habitat selection is strongly influenced by an adequate supply of prey, including small mammals in the summer and ungulate carcasses, e.g., moose in winter. They have large home ranges varying from 50 to 400 km² for females and 230 to1,580 km² for males and require large tracts of wilderness ecosystems (COSEWIC, 2003).

Wolverines are sensitive to the presence of humans and are likely to be affected by the effects of road noise. Wolverines are curious, and will investigate campsites, food caches and cabins when humans are not present (COSEWIC 2003). Thus, despite their innate curiosity, the presence of a permanent workforce and waste management handling procedures will make wolverine visits to the area of mine operations unlikely.

There is an increased risk for vehicle collisions with wolverine, though it is unlikely to have a large effect on the population because wolverines tend to avoid open areas. Though major high traffic volume highways have been reported to be a significant source of mortality for wolverines (COSEWIC, 2003), the traffic on the Freegold Road extension is not expected to have a low to nil magnitude scale of effect.

Mitigation

Wolverines use a wide variety of habitat and effects on them are likely to result from disturbance and the presence of humans in the LSA. The increase in traffic associated with project is not expected to affect current wolverine use of the LSA. Measures to mitigate against the effect of noise from construction activities, equipment operations, mine activities and traffic on wildlife in the LSA, as described in the WMMP, will minimize displacement of wolverine in adjacent 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), thereby reducing the potential for human-wildlife conflict, as outlined in the Waste and Hazardous Materials Management Plan provided in Appendix A.22A and in the WMMP (Appendix A.12A). Both documents provide mitigation measures that aim to reduce Project effects and summarize monitoring that could trigger adaptive management if unanticipated effects are detected. The Waste and Hazardous Materials Management Plan (Appendix A.22A) includes year round waste management which will reduce attractants throughout all seasons. This plan will be implemented year round and includes a number of mitigations that will reduce the potential for attracting all wildlife, including grizzly bears and wolverine. Section 5.4.6 in the updated WMMP (Appendix A.12A) includes den site monitoring for wolverine. If it becomes apparent that mitigation specific to reducing encounters with wolverine are necessary, this can be readily accommodated through the adaptive management approach described in the WMMP.

Residual Effects

Project development will cause changes in habitat availability for furbearers and will likely result in displacement and mortality for some individuals within the project footprint. There will be a temporary loss of habitat for the construction and operations phases of the Project, though some habitat will be restored during reclamation, there will be a net loss of habitat around the mine site and therefore there is a residual effect. However, as wolverine use a large and varied habitat, the overall effects on wolverine associated with changes in habitat availability are minor.

While there is a small possibility that individuals may be displaced from habitat directly affected by the project, reclamation at mine closure is intended to restore habitat comparable to pre-mine conditions and will provide habitat connectivity through revegetation. Some suitable habitat will be permanently lost to the open pit and TMF. The effects on wolverine directly associated with displacement are expected to be minor. Given the above mitigation measures, mortalities could still occur, however, the overall effect of incidental mortality on wolverine populations is predicted to be minor and not significant.

B.12.3.20 R2-173

R2-173. Detailed information on study methodology for the July, 2014, bat survey.

Surveys to assess the presence of the little brown bat at the proposed mine site were conducted during July 2014. Two EDI biologists surveyed potential roosting habitat at the proposed Casino mine site for signs of bat use. Since most of the area is above treeline, the only potential habitat identified was the camp buildings. Each building was visually assessed for bat presence. No signs of bats were found in the camp buildings.

A bat detector was also set up to monitor and record any ultrasonic echolocation calls of bats. The bat detector was an Anabat SD1 system, made by Titley Scientific, and is based on frequency division (Corben, 2004). The detectors were attached to a cable microphone with the microphone set in a protective PVC tube sleeve. The microphones were angled down over a reflective plexi-glass plate, mounted at 45° to horizontal, resulting in the microphone sampling an area parallel to the ground. The Anabat detector was installed on the top of a silo approximately 10 m above the ground. This site was chosen since it is slightly lower in elevation then the camp, and closer to treeline and wetter habitat. It was also the only free standing infrastructure suitable for unobstructed bat monitoring. The anabat detector recorded ultrasonic acoustic detections for a total of six days. No bat calls where recorded in this time.

B.12.3.21 R2-174

R2-174. Results and discussion of additional field work needed to determine the presence of little brown myotis and its roosts and hibernacula.

During the construction phase, pre-clearing surveys will be conducted by a qualified biologist. Preclearing surveys will include searching for potential roost sites. If bat roosts are detected, site-specific avoidance measures and a mitigation plan will be developed.

B.12.3.22 R2-175

R2-175. Monitoring and mitigation measures that will be undertaken for this species if their presence is determined. This will require more detailed information in the Wildlife Mitigation and Monitoring Plan.

During the construction phase, pre-clearing surveys will be conducted by a qualified biologist. Preclearing surveys will include searching for potential roost sites. If bat roosts are detected, site-specific avoidance measures and a mitigation plan will be developed.

B.12.3.23 R2-176

R2-176. Additional baseline information on Dall sheep that will allow for population and demographic monitoring in the future.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting. CMC reiterated that Dall's sheep did not interact with the project, but the group discussed the potential for indirect interaction. There was no consensus among the group of whether or not there would be indirect interaction given the distance (>~4 km) of known occupied range from the proposed Freegold Road extension. CMC was referred to a draft range assessment by Yukon Government that could have additional demographic data. There was some suggestion about the potential disturbances from aircraft overflights were not adequately addressed in the effects assessment, and that issue was not explicitly brought forward in this information request. The group did agree overall that more discussion on the issue, as requested by YESAB, may better inform the effects assessment. That discussion is provided below.

CMC provided substantial details of Dall's sheep in Section 5 of the Wildlife Baseline Report (Appendix A.12B), including data on all sheep surveys conducted since 1974, and a discussion of distribution, abundance and harvest in the Dawson Range area. The Government of Yukon has since conducted a range assessment for thinhorn sheep in the Dawson Range (Hayes, 2015), which considers the same data used by CMC, and provides further details on the relationship between human and natural disturbance types, population trends, predator/prey dynamics, forest succession trajectories and how all these factors may affect the population's range.

The following demographic data was provided by Hayes (2015) for the Dawson Range sheep population based primarily on a 2013 sheep survey:

- Current population is at minimum 70 sheep (maximum count in 2013, but considered incomplete);
- The sex ratio is approximately 54 rams per 100 nursery sheep; and
- Recruitment is approximately 20 lambs per 100 nursery sheep.

As studies of the Dall sheep in the Dawson range have occurred over 40 years, and the range has been constrained in the area south east of the Project, direct project interactions with the Dall's sheep are not predicted. However, CMC will continue to support Yukon based wildlife research, primarily conducted by Environment Yukon. Territorial sheep range assessments may be conducted at intervals by Environment Yukon, and CMC will support this research to continue to provide information on the health of the sheep in the Dawson Range.

The Project does not directly interact with the Dawson Range sheep population, however, there may be indirect interactions through possible increased predator access and disturbance from aircraft. These indirect interactions are discussed further in the response to R2-177 below.

Suggestions provided by Hayes (2015) to reduce effects of potential aerial disturbance (e.g., locating ground and aerial activities to lower elevations and away from the alpine) will be implemented to mitigate the potential interactions of the Project with the Dawson Range thinhorn sheep population. Wildlife monitoring initiatives will further reduce the risk of the Project indirectly affecting thinhorn sheep (see response to R2-150 and R2-151). CMC will provide monitoring of the sheep population, if determined necessary by the Wildlife Working Group.

B.12.3.24 R2-177

R2-177. A discussion of the indirect effects to Dall sheep based on:

- **a. Increased hunter access;**
- **b. Disturbance related to land and air traffic; and**
- **c. Changes in predator-prey dynamics.**
- **d. The discussion should include seasonal variation as well as proposed mitigation and monitoring measures.**

The proposed Project does not directly interact with thinhorn (Dall's) sheep in the region. However, indirect interactions of the Project with thinhorn sheep could occur through three mechanisms:

1. Increased hunter access,
2. Increased predator access, and
3. Disturbance from aircraft.

These mechanisms are discussed further below.

Hunter Access

CMC intends to operate the Freegold Road extension as a private industrial road with policies that limit the public's ability to travel the proposed road. A manned gate will be installed at the Big Creek crossing to manage access. The gate will prohibit public access of the Freegold Road beyond KM 83, mitigating the potential adverse effect of increased mortality risk due to harvest. Users of the Freegold Road extension will be granted access by the Casino Project Road Use Plan, and associated Traffic Management Plan (draft provided in Appendix A.22E).

The following commitments outline how CMC will mitigate the potential harvest effects on wildlife (including thinhorn sheep):

Commitment no.	Commitment
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.
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.
88	To mitigate potential effects on wildlife from construction, operation and closure and

Commitment no.	Commitment
	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 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.
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.
123	Access Mitigation - A Road Use 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 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 ensure concerns are identified and addressed.
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.

Predation

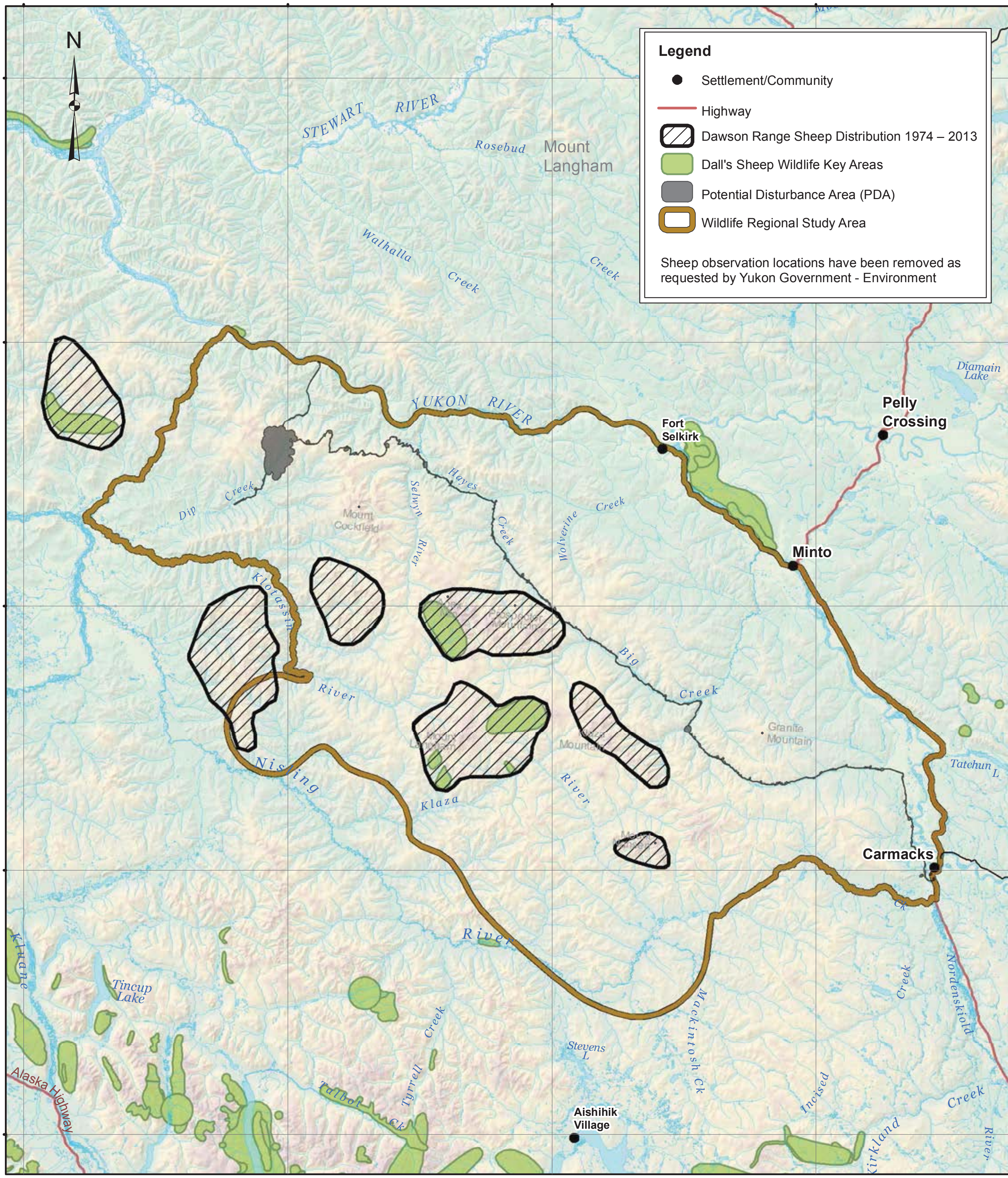
The local thinhorn sheep population could experience higher predation rates indirectly from human infrastructure via two mechanisms:

1. Landscape changes increasing the availability of suitable habitat for alternate prey resulting in a larger prey density in the region, thus creating a larger predator population and increased predation on sheep.
2. Predators, primarily wolves, increasing the use of linear features (roads and trails) as corridors for foraging during winter because of easier travel on packed or cleared snow, resulting in higher sheep mortality closer to linear features.

In response to 1. CMC had conducted an assessment on the possibility of increasing the abundance of alternate prey species, which was provided in the response to R315 (section A.12.3.1.1). The assessment indicates that the project will not result in landscape changes that will increase the abundance of alternate prey species.

In response to 2, as the proposed mine site and entire length of the Freegold Road do not intersect thinhorn sheep habitat, the infrastructure is not likely to increase predator access to the sheep in their known range. The Freegold Road extension is approximately 14 km from the nearest thinhorn sheep wildlife key area and although it is shown to intersect the Dawson Range Sheep Distribution 1974–2013 polygon (Figure B.12.3-8), this polygon is generated from a buffer of known sheep locations, but does not indicate that sheep occupy the area.

Prospector Mountain is the closest known occupied sheep habitat to the proposed Freegold Road extension. One group of eleven sheep was observed on Prospector Mountain during baseline late winter ungulate surveys. Sheep were observed on Prospector Mountain once during seven sheep surveys of the Dawson Range between 1974 and 2014 (Hayes, 2015). Wolves were detected travelling most of the Freegold Road, including the portion of the proposed Freegold Road extension adjacent to Prospector Mountain, during baseline surveys. Therefore an increase in predation of sheep from wolves could only occur if the proposed Freegold Road extension increases the frequency or intensity of wolf use near Prospector Mountain during the winter. An intensive study of wolf predation on ungulates in the Aishihik area found that changes in wolf abundance had no detectable effect on sheep population growth (measured as lamb survival; Hayes et al., 2003). Consequently, the risk of the Project providing new access for wolves to sheep is low; therefore, the indirect effect of increased mortality on local sheep population as a result of wolf predation is likely low.

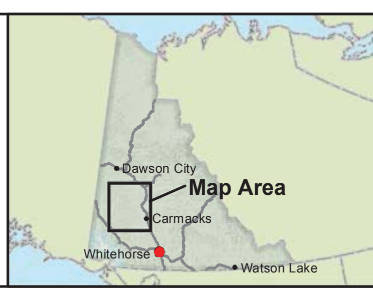


1:250,000 Topographic Spatial Data, National Road Network; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Potential Disturbance Area (PDA) provided by Knight Piesold Ltd. Sept., 2013.

Wildlife key areas (updated 2012) and Dawson Range Sheep Distribution (2014) provided by YT - Environment.

Digital Elevation Models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca



Dall's sheep regional distribution

FIGURE B.12.3-8

0 5 10 15 20 25 30 35
kilometres

Map scale 1:900,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

CASINO

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Aircraft Disturbance

Sheep are sensitive to low flying aircraft, particularly helicopters. Aircraft, including helicopters, will be used during all phases of the proposed project. Regular aircraft charter flights between Whitehorse and the proposed Project airstrip will occur over areas occupied by sheep within the Dawson Range. Although Canadian Aviation Regulations will prevail, where possible, CMC will follow the guidance document for flying in sheep country developed by the Government of Yukon (Laberge Environmental Services, 2002). Also, when possible, CMC will also comply with new draft documentation provided by Environment Yukon specifically for mitigating disturbances to sheep in the Dawson Range, which suggests aircraft minimum elevations and routing (Hayes, 2015). CMC commits to the following suggestions listed in the new guidance document:

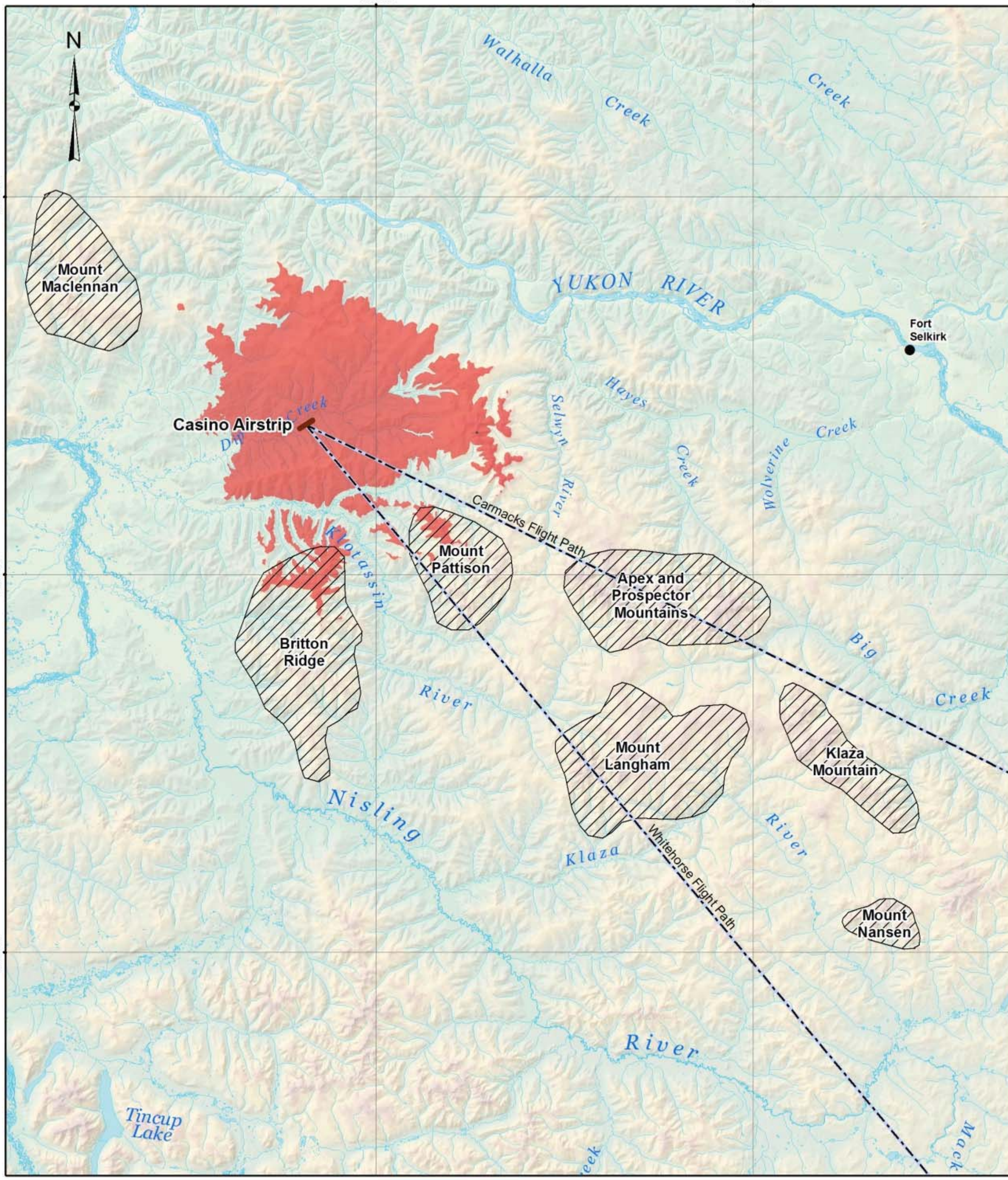
- Locate flight paths at least 1,000 meters away from treeline wherever possible.
- Restrict helicopters from horizontally flying closer than 3,500 meters and fixed-wing aircraft from flying closer than 1000 meters from known lambing, post-lambing and winter ranges, from November 1 through July 1.
- Restrict helicopters and fixed-wing aircraft from flying lower than 500 meters above known lambing, post-lambing and winter ranges, from November through July 1.
- Restrict helicopters from horizontally flying closer than 3,500 meters and fixed-wing aircraft from flying closer than 1000 meters from known mineral licks [used by sheep].
- Restrict helicopters and fixed-wing aircraft from flying lower than 500 meters above known mineral licks [used by sheep], year-round.
- Restrict helicopters and fixed-wing aircraft from flying lower than 500 meters above alpine movement corridors year-round.

CMC will follow these recommendations when possible, when recommendations do not conflict with Canadian Aviation Regulations. For example, aircraft travelling to the proposed project site will be required to adjust flight altitude to avoid conflicts with other passenger or private planes. Weather condition may also require deviation from flight paths or preferred elevation.

The Hayes (2015) guidelines detail the elevation of terrain within the sheep polygons to above which impacts should be avoided. The mean and maximum elevation is 1,310 m and 2,012 m, respectively. Using the maximum elevation as the threshold, the minimum cruising altitude of aircraft flying between the Mine Site and Whitehorse is 8,250 feet (2,512 m) when flying above sheep range between November 1 and July 1; above known mineral licks used by sheep; and above movement corridors. CMC will fly above 8,250 feet (2,512 m) while in transit between the Casino Mine Site and Whitehorse when no conflicts with Canadian Aviation Regulations exist. Other aircraft, such as helicopters or small aircraft, will also fly above 8,250 feet when in transit between the Casino Mine Site and Whitehorse.

The lowest elevations and, consequently, greatest disturbance to wildlife will be during takeoffs and landings at the proposed airstrip. The areas where aircraft could be below the 500 ma above ground level (m agl) guideline are shown in Figure B.12.3-9. Takeoffs generally have a steeper climb angle than landing, so characteristics of landing are shown in Figure B.12.3-9. The nearest sheep polygon to the proposed airstrip is 16 km directly south.

Wildlife monitoring initiatives will further reduce the risk of the Project indirectly affecting thinhorn sheep (see response to R2-150 and R2-151). CMC will provide monitoring of the sheep population, if determined necessary by the Wildlife Working Group.



1:250,000 Topographic Spatial Data, National Road Network; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital elevation models (30 m and 90 m) provided by Yukon Government - Geomatics Yukon; online Corporate Spatial Warehouse. www.geomaticsyukon.ca

Flight Path below 500 m agl

FIGURE B.12.3-9

0 5 10 15 20 25
kilometres

Map scale 1:900,000 (printed at 8.5x11)
North American Datum 1983 CSRS Yukon Albers

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B.12.4 EFFECTS ASSESSMENT FOR BIRDS

B.12.4.1 R2-178

R2-178. Rationale on the exclusion of the identified species (rock ptarmigan, white-tailed ptarmigan, and short-eared owl) as key indicators as compared against other species of concern, including available baseline information, or the inclusion of these species as key indicator species (either as a group or individually).

Four key indicators were selected to assess potential Project effects on birds, which included assessments of nine focal bird species and two bird communities. The key indicators were selected to be representative of the diversity of bird species in the area and based on likely project interactions. Key indicators specific for birds are:

- Cliff-nesting raptors;
- Bird species at risk;
- Passerine birds; and
- Waterfowl.

The short-eared owl was assessed with other species at risk (horned grebe, olive-sided flycatcher and rusty blackbird), and a habitat assessment was conducted to assess impacts, and presented in Section 12.3.7 Passerine and Bird Species at Risk Effects Assessment of the Project Proposal.

White-tailed and rock ptarmigan are two of the 77 priority species identified for Bird Conservation Region 4 (BCR4; Environment Canada, 2013). There are 211 regularly-occurring bird species in BCR4. The majority of the BCR4 priority species are known or likely to occur in the Project area. The identification of a bird species as a priority species for BCR4 is not a criteria for selection of key indicators for the environment assessment of Project effects on birds. Environment Canada (2013) identifies:

> *"priority species" from all regularly occurring bird species in each BCR subregion. Species that are vulnerable due to population size, distribution, population trend, abundance and threats are included because of their "conservation concern." Some widely distributed and abundant "stewardship" species are also included. Stewardship species are included because they typify the national or regional avifauna and/or because they have a large proportion of their range and/or continental population in the subregion (i.e. BCR 4 in Canada); many of these species have some conservation concern, while others may not require specific conservation effort at this time. Species of management concern are also included as priority species when they are at (or above) their desired population objectives but require ongoing management because of their socio-economic importance as game species or because of their impacts on other species or habitats.*

The diverse rationale for identification of priority species and the large number of species makes inclusion of BCR4 priority species impractical for environmental assessment; consequently, the identification of a bird species as a priority species was not a criteria of inclusion as a focal species. Species of conservation concern, defined as listed on the SARA or as assessed by COSEWIC, was the primary criteria for inclusion of particular species (e.g., short-eared owls). An assessment of environmental effects is required by the SARA for listed species (section 79 [2]). The BCR4 priority species and national conservation status of each species assessed in the Project Proposal are summarized in Table B.12.4-1.

Rationale for excluding species as key indicators, even when there is a known potential Project interaction (e.g., white-tailed and rock ptarmigan) includes:

- are unlikely to interact with the Project in substantial numbers;
- are found only in very low densities and effects may be addressed by a species that is a KI;
- are not species at risk;
- were not identified as of concern to stakeholders or regulators; or
- are generally numerous and not susceptible to anthropogenic disturbances.

While most bird species are not assessed individually, one or more bird species or communities were selected to be representative of a particular habitat type, which is then used to quantify effects. For example, short-eared owl was used as a representative species for potential project effects on alpine birds.

Table B.12.4-1 Summary of key indicators and species/communities used to assess the effects of the proposed Project on birds, including BCR4 priority designation and national conservation status

Key indicator	Species/community	BCR4 priority species designation	BCR4 population objective	National Conservation status
Cliff nesting raptor	Golden eagle	Yes	Assess/Maintain	None
Cliff nesting raptor	Gyrfalcon	No	None	None
Cliff nesting raptor	Peregrine falcon	Yes	Assess/Maintain	SARA schedule 1, special concern
Bird species at risk	Horned grebe	Yes	Assess/Maintain	COSEWIC, special concern
Bird species at risk	Olive-sided flycatcher	Yes	Increase 50%	COSEWIC, threatened
Bird species at risk	Rusty blackbird	Yes	Increase 50%	COSEWIC, special concern
Bird species at risk	Barn swallow	Yes	Assess/Maintain	COSEWIC, threatened
Bird species at risk	Bank swallow	No	None	COSEWIC, threatened
Bird species at risk	Short-eared owl	Yes	Assess/Maintain	COSEWIC, special concern
Passerine birds	All passerine birds as a group	Some	Various	Various
Waterfowl	Ducks, geese, swans, waterbirds as a group	Some	Various	Various

B.12.4.2 R2-179

R2-179. Baseline data and assessment of effects in relation to red-necked phalarope.

The red-necked phalarope is a small wading bird that occurs throughout Yukon. It typically breeds in areas with wet sedge tundra scattered with small ponds. In the southern Yukon, it has been observed breeding on the marshy edges of small lakes. When migrating, it uses wetlands, ponds, lakes, tundra ponds and then nearshore marine environment (Alexander et al., 2003).

CMC is not proposing to collect baseline data and assess Project effects on the red-necked phalarope as it was not included as a Key Indicator.

The Project has the potential to affect the red-necked phalarope through direct and indirect loss of habitat. Concerns related to loss of wetland habitat have been addressed by other indicators for wetland habitats — rusty blackbird and horned grebe (Section 12.3.7). Table B.12.4-2 identifies the change/loss in suitable habitat for the rusty blackbird and horned grebe which is applicable to the red-necked phalarope.

Mitigations to address potential effects to habitat availability applicable to the red-necked phalarope includes that where possible given the terrain and other site-specific features, Project design will incorporate a minimum 100 m between Project infrastructure and any ponds or open-water wetlands (e.g. marsh, fen, etc.).

Table B.12.4-2 Change in Rusty Blackbird Habitat Quality Due to Project Effects in the LSA

Habitat Quality	Baseline Conditions	Conditions at Maximum Disturbance			
	Available Habitat (km^2)[a]	**Loss to PDA (km^2)**	**Reduced effectiveness in ZOI (km^2)**	**Available habitat (km^2)[b]**	**% change[c]**
Horned Grebe					
Not Suitable	886.02	+0.01	+0.10	886.13	--
Suitable	0.27	-0.01	-0.10	0.16	-41%
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%

a. The total area of the LSA is approximately 886 km2
b. Available habitat at maximum disturbance is a combination of the habitat loss to PDA and reduced effectiveness in the ZOI
c. % change is the difference in habitat conditions at maximum disturbance from baseline conditions.

B.12.4.3 R2-180

R2-180. Spatial information on the presence of alpine meadows or alpine open areas.

This Information request was discussed at the October 1, 2015 YESAB Wildlife Technical Working Group Meeting. CMC reiterated that there are no “alpine meadows” identified in the study area. Alpine meadows, as defined by ecological land classification mapping, are not present in the local study area (LSA). A number of alpine land cover type are present in the LSA. Alpine land cover types are summarized in Table B.12.4-3. The methods used to map land covers did not detect any alpine meadows within the LSA.

Currently, there is no standardized system for ecological land classification mapping in the Yukon. The ecological land classification mapping submitted in the Project proposal was guided by the B.C. Terrestrial Ecosystem Mapping inventory standard for 1:20,000 scale mapping (Resource Inventory Committee (RIC), 1998). Further details are provided in Appendix 11A.

Table B.12.4-3 Summary of alpine ecosites within the Casino Project local study area (LSA)

Ecosystem name	Site Description	Area (km²) in LSA	% of LSA
Tors	Protruding bedrock outcrops on mountain crests. Plant growth is mainly restricted to fractures and crevices where soil has accumulated.	2.7	0.3
Dryas/Sparse Herb	Occurs on plateaus and gentle slopes at high elevations. Structural development is limited by environmental conditions, and vegetation communities are mainly composed of mountain-avens, bryophytes and lichens.	15.1	1.7
Felsenmeer	Veneer of angular rock fragments/boulder fields over gently to moderately sloping ground. Vegetative cover is typically <40%, and includes dwarf shrubs, grasses, bryophytes, and lichens.	35.0	3.9
Total	**Alpine Bioclimate Zone**	**52.8**	**6.0**

B.12.4.4 R2-181

R2-181. Description of how the WMMP will address and protect the identified species (e.g. olive sided fly catcher, rusty blackbird, common nighthawk, short-eared owl, horned grebe, and other human intolerant species of concern.)

The WWMP is designed to mitigate Project effects on all terrestrial wildlife. Potential Project effects on identified bird species, including the olive sided fly catcher, rusty blackbird, common nighthawk, short-eared owl, horned grebe are:

1. the risk of mortality to nesting birds and the destruction of bird nests; and
2. habitat loss.

Mitigations listed in the WMMP specific to identified bird species and species at risk are summarized in Table B.12.4-4.

Table B.12.4-4 Mitigations for identified bird species

Identified Species	Mitigation Summary
Olive-sided flycatcher	• Minimize footprint: To minimize loss of habitat, the Project footprint (~23.5 km²) is designed to be as small as possible. • Avoid construction in sensitive habitats and/or during sensitive times, which will include: ○ Avoidance of new clearing during the breeding bird nesting season (1 May to 31 July in Yukon), or conducting nest surveys immediately prior to clearing activities. • If clearing must occur during the bird nesting season, conduct active migratory bird nest surveys prior to clearing. • Apply dust suppression methods 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).

<table>
<tr><th>Identified Species</th><th>Mitigation Summary</th></tr>
<tr><td>Rusty blackbird
Horned grebe
Red-necked Phalarope</td><td>• Minimize footprint: To minimize loss of habitat, the Project footprint (~23.5 km²) is designed to be as small as possible.
• Avoid construction in sensitive habitats and/or during sensitive times, which will include:
o Avoidance of new clearing during the breeding bird nesting season (1 May to 31 July in Yukon), or conducting nest surveys immediately prior to clearing activities.
• If clearing must occur during the bird nesting season, conduct active migratory bird nest surveys prior to clearing.
• 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.).
o 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.
• Apply dust suppression methods 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).</td></tr>
</table>

B.12.4.5 R2-182

R2-182. A description of how the WMMP will address and protect wetland habitats and their occupants.

Wetlands in the LSA have been identified in the Bird Baseline Report as high quality habitat for the Key Indicator species rusty blackbird. Wetlands are identified as sensitive habitat features and clearing in these areas will be avoided where possible. All wetlands located outside of the Project footprint will remain undisturbed.

Although not specifically listed in the WMMP, Section 12.3.7.4 of the Project Proposal includes the following mitigation that will reduce the effects on wetland habitats and their occupants:

- 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.

In addition, Section 4.2 Construction Mitigation of the WMMP states:

- Construction mitigation actions aim to reduce or remove potential effects to wildlife and wildlife habitat during this time, and will include:
  - Avoid construction in sensitive habitats and/or during sensitive times, which will include:
  - Avoidance of new clearing during the breeding bird nesting season (1 May to 31 July in Yukon), or conducting nest surveys immediately prior to clearing activities.
  - If clearing must occur during the bird nesting season, CMC commits to conducting active migratory bird nest surveys prior to clearing.

B.12.4.6 R2-183

R2-183. Effects assessment of the TMF wetland on waterfowl. This should include:

- **a. Discussion of pathways by which waterfowl accumulate detrimental levels of metals and negative effects of trace metals, particularly with respect to bioaccumulation;**
- **b. Inclusion of other trace metals found in elevated levels according to baseline surveys; and**
- **c. Consideration of the availability of open water bodies in the LSA relative to the RSA (i.e. likelihood of waterfowl staging in the project footprint.)**

Constructed wetland treatment systems (CWTS) are distinctly different from wetlands that provide habitat for wildlife, or are intended to compensate or reclaim/restore impacted wetlands. Instead, a treatment wetland is designed to remove compounds from water, using natural processes to either degrade the compounds into benign forms, or sequester them into the soils rendering them less bioavailable.

Pathways that constituents of concern may reach wildlife include the water, vegetation, sediments, and invertebrates living in the wetland (e.g., benthic invertebrates). However, in a treatment wetland, the constituents of concern are systematically rendered lower in bioavailability, thereby decreasing these pathways for exposure. For example, plant uptake of metals and metalloids is minimized by mineralization of these elements through coupled biogeochemical processes (catalyzed by beneficial microbes), which turns these elements into compounds that cannot be uptaken into plants, and even if the sediments are ingested, the elements are in a low- or non-bioavailable form.

Another important aspect of the design of treatment wetlands is that in contrast to habitat wetlands, treatment wetlands should be designed to deter wildlife. In many cases, wildlife including waterfowl can be deterred from treatment wetlands by doing the opposite of what is recommended for design or restoration of habitat wetlands. For example: steep inclines on the shores and armouring with riprap; no open water; monocultures of plants (no diversity); and even fences. Where appropriate, wildlife-attracting wetlands can also be built downstream of or nearby the treatment wetland to provide a preferential habitat and attract the wildlife away from the water requiring treatment.

These design aspects that deter wildlife are also important features that positively influence the treatment capacity of the wetland. Specifically, the steep banks allow for consistent hydraulic retention time as accretion progresses; armouring prevents erosion; open water is often counterproductive for treatment; and monocultures provide consistency and predictability of treatment.

a. Pathways of effects

Constructed wetlands are a complex ecosystem of plants microbes, and sediment that together act as a biogechemical filter, efficiently removing dilute contaminants from very large volumes of wastewater (LeDuc and Terry, 2005), as shown in Figure B.12.4-1. Depending on the exact structure of the constructed wetlands at the North and South TMF, 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.

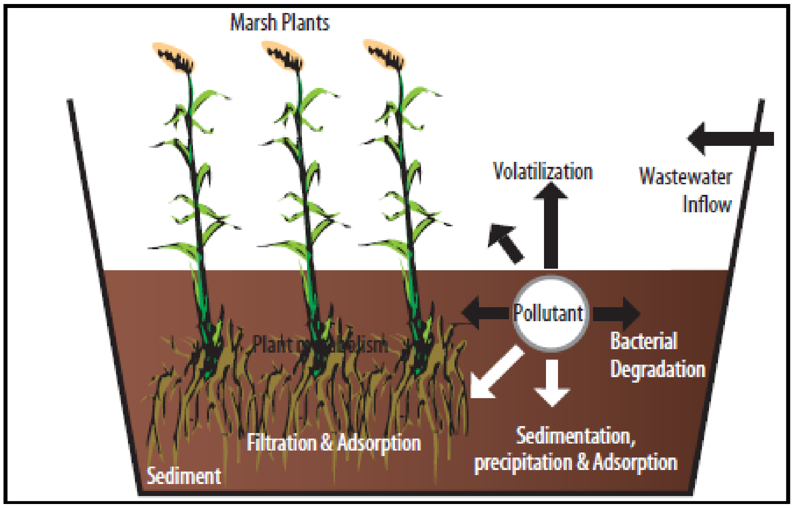

Figure B.12.4-1 Pollutant Removal Mechanisms in Constructed Wetlands (UN-HABITAT, 2008)

Most of the contaminants removed from the waste-stream are immobilized in the sediment (LeDuc and Terry, 2005) or in below ground tissue of wetland plants (Alhashemi et. al., 2011). Most wetlands plants are not accumulators so the attractive nuisance aspect is muted; however, research indicates that some edible wetlands plants, such as duckweed, concentrate metals and are attractive food for waterfowl such as coot (Terry and Banuelos, 2000). Aquatic invertebrates, particularly insects are important in the diets of ducks and many other bird species (Nelson et. al., 2000). Likely key pathways for waterfowl to accumulate contaminants from constructed wetlands are:

1. Ingestion of water;
2. Ingestion of invertebrates and insects; and
3. Ingestion of plants.

Further discussion of the key pathways of effects is provided below.

Ingestion of contaminated water

Generally, the anoxic environment and organic matter production in wetlands promote biological and chemical processes that transform contaminants to immobile or less toxic forms (LeDuc and Terry, 2005) removing contaminants from the water and depositing them in the sediments. However, some metals will remain in the water in the constructed wetlands.

Water quality modeling for the Pit Lake, TMF Pond and TMF Spillway was conducted for the Project Proposal, and updated in Appendix A.7B, and water quality results are summarized in Table B.12.4-5 for parameters above the Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines for the Protection of Aquatic life (WQG). The results for all other parameters are summarized in Appendix A.7B, and are either not limited by the CCME WQGs, or the predicted values are less than the CCME WQGs.

During the TMF Discharge (approximately Years 31 – 112) and Pit Discharge (Years >113) phases, when the constructed wetlands will be operational, concentrations of sulphate, fluoride, aluminum, cadmium, copper, molybdenum, selenium and uranium exceed the CCME WQGs (bold values in Table B.12.4-5). While metal concentrations for the constructed wetlands are not specifically modeled, they can be assumed to be within the range of those predicted for the Open Pit, TMF pond and TMF Spillway, in order of decreasing concentrations (Table B.12.4-5).

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. CCME WQGs are generally derived from the most sensitive species likely to be exposed to the specific pathway, often freshwater biota, which are sensitive to elevated metal concentrations; whereas birds and mammals are comparatively less sensitive (Kadlec and Wallace, 2009).

Of the elements predicted to be present in elevated levels within the constructed wetlands, 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 (2000) 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., 2000), 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).

Post-closure selenium concentrations in the constructed wetlands range from 4.3 – 5.2 µg/L, which is comparable to the selenium continuous concentration criterion of 5 µg/L set by the US EPA (2004). 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).

Table B.12.4-5 Open Pit, TMF Pond and TMF Spillway Water Quality during TMF Discharge and Pit Discharge phases

Parameter	CCME Water Quality Guidelines for the Protection of Aquatic Life (mg/L)	Water Quality (mg/L)				
		Open Pit	TMF Pond		TMF Spillway	
		Long-term Discharge	TMF Discharge Phase	Pit Discharge Phase	TMF Discharge Phase	Pit Discharge Phase
pH	6.5 – 9.0	6.2	6.9	6.9	6.9	6.9
Hardness	-	378	453	381	452	381
Sulphate	309	368	**335**	266	283	225
Fluoride	0.120	**0.88**	**0.65**	**0.63**	**0.65**	**0.63**
Aluminum	0.005 if pH<6.5 0.100 if pH≥6.5	**0.19**	0.096	**0.12**	0.096	**0.12**
Cadmium	0.001 (short-term) 0.0009 (long-term)	**0.0035**	0.00034	0.00016	0.00008	0.00008
Copper	0.004 (for hardness >180 mg/L)	**4.9**	**0.11**	**0.073**	0.004	0.004
Molybdenum	0.073 (long-term)	**0.10**	**0.85**	0.066	**0.085**	0.066
Selenium	0.001 (long-term)	**0.0052**	**0.0043**	**0.0043**	**0.0043**	**0.0043**
Uranium	0.033 (short-term) 0.015 (long-term)	**0.054**	**0.048**	**0.042**	0.015	0.015

Ingestion of invertebrates and insects

Generally, contaminants removed by the wetlands will be retained in wetland sediments and will be biologically unavailable. A study by Wood and Shelley (1999) found that bioavailability of metals in sediments to benthic or aquatic organisms are directly linked to pore water metal activity and that the amount of organic carbon in the sediment is the largest driver of metal bioavailability. Wetlands have large amounts of available organic carbon due to the biogeochemical cycling occurring as wetlands plants grow and senesce annually.

Similarly to the assessment of the effect of metal concentrations in water, studies of invertebrate assemblages associated with constructed wetlands indicate that while concentrations of most metals (e.g., aluminum, arsenic, mercury, silver) remain below harmful concentrations, selenium may accumulate to harmful concentrations (Nelson et. al., 2000). As modeled selenium concentrations in the constructed wetlands are below the selenium continuous concentration criterion of 5 µg/L set by the US EPA (2004), selenium bioaccumulation is not of concern for the constructed wetlands.

Organic mercury is also typically of concern, as organic mercury compounds are the principle source of environmental mercury poisoning because these compounds bioaccumulate in aquatic food chains, and both predator birds and mammals are poisoned (Terry and Banuelos, 2000). However, modeled mercury concentrations in the open pit, TMF pond and TMF spillway (0.000015 – 0.000022 mg/L) are well below the CCME WQG of 0.00026 mg/L, and hence do not occur at concentrations likely to cause effects.

Ingestion of wetland plants

While wetland sediments are known to act as a sink for heavy metals (Sheoran and Sheoran, 2006; Baldwin and Hodaly, 2003; August et al., 2002), wetland plants support microbially mediated transformations of contaminants by supplying fixed-carbon as an energy source for bacteria and by altering the chemical environment in their rhizosphere (LeDuc and Terry, 2005). Bioaccumulation in plants is also considered to some extent a metal removal pathway. Most wetlands plants are not accumulators so the attractive nuisance aspect is muted; however, research indicates that some edible wetlands plants, such as duckweed, concentrate metals and are attractive food for waterfowl such as coot (Terry and Banuelos, 2000). Metal uptake by plants growing in wetlands treating mine-impacted waters has been sparsely studied with records of metal uptake by *Carex aquatilis* and *C. rostrata* (August et al., 2002; Stoltz and Greger, 2002; Nyquist and Greger. 2009), *Juncus maritimus* and *J. effuses* (Conesa et al., 2011; Rahman et al., 2011), *Typha latifolia* and *T. domingensis* (Mitsh and Wise, 1998; Taylor and Crowder, 1983; Maine et al., 2006), *Phragmites australis* (Batty and Younger, 2004; Stoltz and Greger, 2002; Nyquist and Greger, 2009) *Eichhornia crassipes* (Maine et al 2006) and *Salix Sp*. (Stoltz and Greger, 2002). In most of these cases heavy metals were reported to be largely found in plant roots with minimal or no uptake into shoots. Uptake by wetlands plants can be strongly affected by the water chemistry, the plant species (Deng et al., 2004, Sheoran, 2006), as well as the redox conditions and geochemistry in the wetland substrate (Sobolewski, 2010).

To assess the potential for metal accumulation in constructed wetlands and to determine the best plants for use in the TMF wetland, CMC has initiated studies with both the Yukon College and Contango Strategies Limited. The results of the initial study conducted at the Yukon College was provided in Appendix A.4K, and included a discussion of the availability of contaminants to wildlife in constructed wetlands. The review concluded that metal uptake potential in aboveground shoots should be well characterized in constructed wetlands that are used for mine closure.

b. Baseline water quality studies indicate that 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 (cadmium, copper, 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 related to hydrological factors such as snow melt and stream flow. The predicted water quality in the TMF wetlands (as inferred by modeled water quality for the Open Pit, TMF pond and TMF Spillway) for parameters that are predicted to exceed CCME WQGs are summarized in Table B.12.4-5.

c. The LSA contains no lakes and open-water wetlands and pond habitats are generally infrequent and small. The RSA, as defined in the Bird Baseline Report (Appendix 12B), is the entire LSA plus a 5 km buffer on all Project components including the mine site, Yukon River access road and the Freegold Road extension. Within the RSA <0.1% contains lakes or ponds 0.5 to 10 ha in size.

   As a result, the study area does not contain a high density or diversity of waterfowl (i.e. ducks, swans, and geese) and other waterbirds (e.g. loons, grebes, gulls). Species such as Canada goose, mallard, green-winged teal, bufflehead, and goldeneye can be expected in small wetlands within the study area, 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; while herring gull can be found along the portion of the study area which is adjacent to the Yukon River. In total, 17 species of waterfowl and other waterbirds are expected within the LSA, seven of which were confirmed present, however, numbers are very low. The 2013 bird surveys located only three mallards, three American green-winged teal, and one herring gull over more than 80 hours of field surveys throughout the entire LSA.

   Shorebirds within the study area are separated into two broad groups based on their habitat requirements: (1) those which breed in wetlands and along stream margins, and (2) those which breed in upland tundra habitats. The most common shorebirds in the LSA are spotted sandpiper that occurs regularly along the large streams and rivers, and solitary sandpiper, which is typically found at small ponds and wetlands. Other wetland and stream-oriented species that may occur at low densities in the LSA include semipalmated plover, wandering tattler, lesser yellowlegs, least sandpiper, and Wilson’s snipe, although only Wilson’s snipe was confirmed present. Tundra-related species such as American golden-plover, whimbrel, and upland sandpiper occur in low densities within high elevation tundra plateaus within the region (Frisch 1983). Intensive surveys of the tundra habitats near Prospector Mountain, Apex Mountain, and Magpie Creek by Frisch (1983) also revealed a number of surfbirds within this area which is a unique observation for the central Yukon as this species is typically found further north. The 2013 breeding bird surveys confirmed the presence of upland sandpiper within the LSA. Surveyors also recorded a surfbird calling on the northeast slopes of Prospector Mountain, just outside of the LSA. In total, 11 shorebird species have the potential to be found within the LSA.

   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 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.

B.12.4.7 R2-184

R2-184. Thresholds for trace metal (e.g. selenium, arsenic, lead) concentrations at which waterfowl/TMF wetland monitoring would occur during the construction, operation, and decommissioning phases and a discussion of how this information will be factored into mitigation measures. This should include a discussion of additional deterrence measures that would be utilized if thresholds are crossed and an analysis of their effectiveness.

Two types of waterfowl may interact with waterbodies with high concentrations of metals: 1) transient migratory birds, which may only spend one or two days in waterbodies in the RSA during spring and fall migration, and 2) resident wetland birds which will spend several months in the RSA during the breeding season. During operations, mitigations will be implemented to prevent birds from spending any significant time in the TMF pond. 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). Other Deterrence measures can include wildlife fencing to keep wildlife out, scare crows, cannons, or any other proven methods at the time the risk is identified.

During closure, when activities at the site will be minimal, it is expected that wetland-associated wildlife will be attracted to and use the area after the mine has closed and the wetland has become established. There are no toxicological effects expected from use of the wetland and no further mitigation for wildlife is expected; however, if water quality monitoring results exceed acceptable standards (i.e., those predicted in the water quality model, as detailed in the response to R2-183 above), wildlife monitoring in the vicinity of TMF will be conducted.

B.12.4.8 R2-185

R2-185. A discussion of amending the Wildlife Mitigation and Monitoring Plan to include a vegetation monitoring and management plan aimed at removing/minimizing plant growth around the TMF and Pit pond.

The intent of the closure plan for the Casino Project is to return the landscape back to landforms that are self-sustaining and ecologically appropriate. Removing plant growth around the TMF and pit pond are not viable closure techniques as they require on-going maintenance. Monitoring of the TMF and open pit lake (throughout operations and post-closure) and open pit lake (post-closure) will be conducted as part of the PDA/Facility-Specific Monitoring, and will include determination of any wildlife attraction, an assessment of the risks if wildlife are using it, and the need for deterrence measures, if required. Further details are provided in the WMMP in Appendix A.12A

B.12.5 WILDLIFE MITIGATION AND MONITORING PLAN

B.12.5.1 R2-186

R2-186. Information on the authority of the Wildlife Working Group (i.e. how are recommendations from the group incorporated into future planning and action?)

Once established, CMC intends for the Wildlife Working Group to participate in the following:

- Review of wildlife baseline data collected to date;
- Review of Wildlife Mitigation and Monitoring Plan;
- Finalization of Wildlife Mitigation and Monitoring Plan, in advance of submission to the Yukon Government as part of the Wildlife Protection Plan to be submitted as part of the Quartz Mining Licence application;

- During construction and operations, conduct annual tours with the Wildlife Working Group to oversee ongoing monitoring, discuss monitoring results, assess mitigation effectiveness and plan work for the following year;
- Review of annual Wildlife Mitigation and Monitoring Plan Annual Reports.

The intent is to involve the Wildlife Working Group in all aspects of wildlife protection, mitigation and monitoring through involvement in the development of the Wildlife Mitigation and Monitoring Plan once the Project has been approved.

B.12.5.2 R2-187

R2-187. Details on what triggers will be used, by species, to determine whether to cease or extend monitoring at the 3-5 year mark.

CMC will review the results of annual monitoring every three to five years and include in a detailed report the following information:

- An examination of trends in variability of wildlife distribution and abundance relative to natural trends;
- An analysis of measured wildlife responses to Project-related disturbances, including habitat use and measures of barriers/filters to wildlife movement;
- A description of how Project effects monitoring contributes to cumulative effects monitoring in the region;
- Detailed analyses of other variables as identified in individual monitoring programs as the Project evolves; and
- Description of changes to monitoring programs, statistical procedures, and proposed changes to mitigation activities to adaptively manage for unforeseen effects.

To address environmental and Project changes through time, an adaptive management approach is adopted for this mitigation and monitoring plan. It is anticipated 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. The changes may be a result of inadequacies in the sampling methods or from increased awareness of environmental personnel, regulators, First Nations, or other public concerns. An adaptive approach means that increasing monitoring or changes to the monitoring program can occur if unanticipated adverse 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 so that the resources may be applied elsewhere. To facilitate adaptive management and react to changing environmental and Project conditions, a process needs to be established to ensure regular review of the WMMP that includes regular and transparent reporting (Figure B.12.5-1).

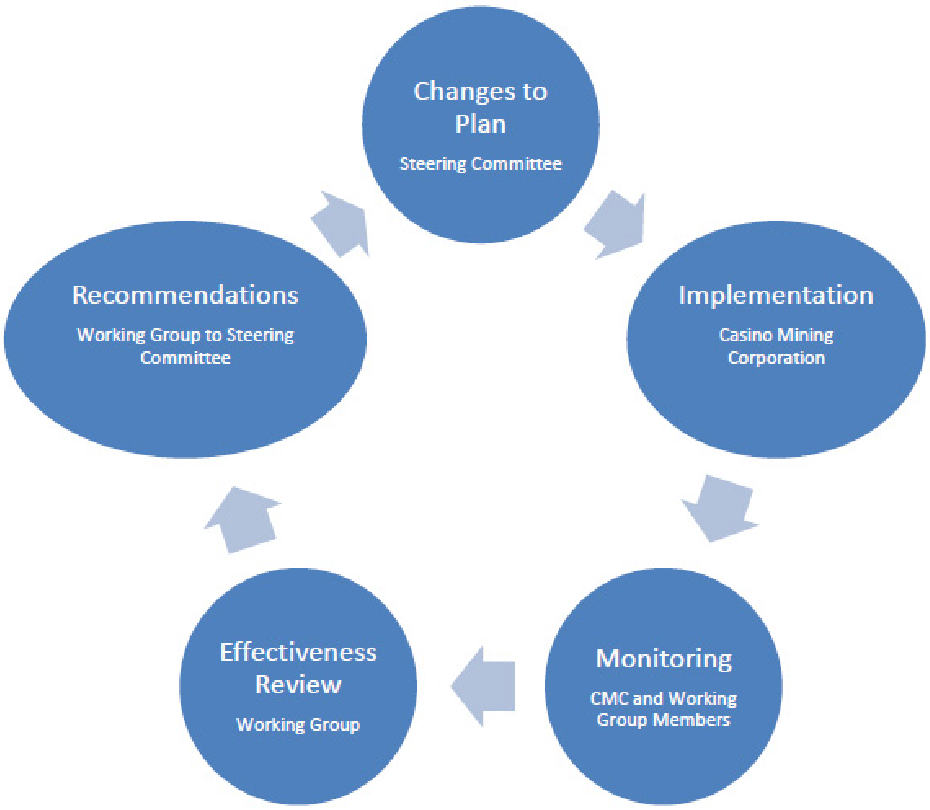

Figure B.12.5-1Schematic of the Adaptive Wildlife Mitigation and Monitoring Process

B.12.5.3 R2-188

R2-188. Details on if, and how, impacts to species with large ranges will be monitored beyond the 10 km buffer of the project area.

CMC is committed to actively supporting regional wildlife management initiatives. CMC will continue to Support YG Environment and affected First Nations wildlife harvest management initiatives in the Project area. Impacts to species with larges ranges will be monitoring through regional monitoring, including:

- Monitoring of both indirect habitat loss and habitat use during the late-winter season will occur at the local level by tracking incidental observations of caribou by Project employees, and at the regional level through aerial surveys.
- Long-term distribution patterns will also be identified by a YG-sponsored caribou satellite collaring program(s). Collar data from the YG-sponsored caribou satellite collaring program will inform regional late-winter distribution patterns.
- Periodic consultation will be conducted with local RRCs to provide information on the relative abundance of caribou in and around the RSA.
- Maintain/add to long-term regional den site database in cooperation with YG Environment and support any regional programs targeting bears or wolves.

- If stakeholders are interested or concerned about broader regional-level wildlife issues, a collaborative approach and participation by CMC can be considered for monitoring outside of the RSA.

CMC recognizes that there are information and knowledge gaps about wildlife, vegetation, habitat, and industrial disturbance that are not addressed by the Project-specific mitigation actions and monitoring program identified in the WMMP. There may be broader wildlife and terrestrial environmental science needs to help improve mining mitigation, First Nations knowledge, or general regional knowledge gaps. Although the information may not be specific to the Casino Project, CMC recognizes the need to develop partnerships to improve regional ecological knowledge that will help to improve understanding and future decision making.

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B.14 – EMPLOYABILITY

B.14.1 INTRODUCTION

Employability was selected as a Valued Component (VC) for the Casino Project (the Project) by Casino Mining Corporation (CMC) because changes in an individual's ability to obtain employment will affect the well-being of the individual, as well as the family of the individual and the community in which he or she lives. The Project will require a large labour force with a wide range of skills and skill levels during the construction and operations phases.

The Proposal concluded that all potential effects of the Project on employability are beneficial and not adverse. In addition, CMC committed to implementing enhancement measures to maximize potential beneficial effects and improve long-term employability of local and regional workforces. Substantial investments in training and capacity-development in the region will help CMC to meet the company's target for employment.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review.

Responses to the four requests for supplementary information related to Section 14 and Section A.14 of the Project Proposal and SIR are provided below, as outlined in Table B.14.1-1. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

Table B.14.1-1 Requests for Supplementary Information Related to Employability

Request #	Request for Supplementary Information	Response
R2-191	Details on implementation of the hiring policy	Section B.14.2.1.1
R2-192	Projected direct Project employment for affected communities based on actual employment information from mines in neighbouring jurisdictions and/or Minto mine. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.	Section B.14.3.1.1
R2-193	Details on the proposed mitigation strategies (flexible rotations, counselling services, and adaptive management) for the shift structure identified in the proposal.	Section B.14.4.1.1
R2-194	Details on how unscheduled community/cultural events will be accommodated in the shift structure. This should include references to experiences in Yukon and neighbouring jurisdictions.	Section B.14.4.1.2

B.14.2 BOOM AND BUST CYCLES

B.14.2.1.1 R2-191

R2-191. Details on implementation of the hiring policy

CMC will recruit and hire as many Yukoners as possible during the construction and operation phases of the Project. CMC will implement the following measures to meet its recruitment commitments and assist employees who reside in the North:

- Establish a minimum Grade school level as a standard for trainable positions.
- Develop work schedules compatible with the traditional pursuits of First Nations.
- Fund and co-fund community research projects directed at gathering information and addressing barriers to successful employment.
- Actively promote and encourage careers in the mining industry to the youths in the Yukon.
- Promote and encourage partnerships with local schools for work experience and job placement programs as well as summer employment opportunities that allow students to gain experience while continuing to complete their education.
- Provide opportunities for summer employment to Yukon post-secondary students during project operation.

CMC will monitor the socio-economic effects of the project during construction, operations, and closure phases as outlined in the Conceptual Socioeconomic Management Plan (Appendix A22F). This will include monitoring direct employment (including employment among contractors) during construction and operation to measure the effectiveness of hiring policies and make adjustments to recruitment activities to ensure hiring priorities are met.

CMC also commits to the following initiatives regarding the implementation of its hiring policy:

- During the hiring process, consider the life experiences of candidates from local communities whereby transferrable skills from experiences gained outside the mining industry may substitute for formal educational requirements.
- Provide a reasonable second chance to local employees that experience difficulties adapting to an industrial work setting and rotational schedule.
- Increase retention rates by monitoring employee satisfaction and conducting exit interviews with those employees that withdraw from Project employment in order to understand their reason(s) for leaving and make necessary adjustments.

CMC will focus its recruitment and pre-employment efforts for non-Yukon employees in northern British Columbia and the Northwest Territories since these employees are likely to adapt quickly to living conditions in the Yukon. Northern British Columbia and the Northwest Territories are important labour markets as many northern residents have experience working in other northern mines such as the diamond mines in the Northwest Territories and the various open-pit mines in British Columbia.

These concepts will be subject to any provisions that are agreed to in Impact Benefit Agreements with affected First Nations.

B.14.3 EMPLOYMENT AND MIGRATION

B.14.3.1.1 R2-192

R2-192. Projected direct Project employment for affected communities based on actual employment information from mines in neighbouring jurisdictions and/or Minto mine. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.

Direct project employment is defined as those individuals employed directly by CMC, and any contractor operating directly at site. Direct project employment does not consider those migrants who are expected to come to the Yukon as a result of indirect Project effects (e.g., changes to employment rates, household incomes, etc.).

CMC will work to achieve their Yukon hiring targets through such strategies as prioritizing local hiring and recognizes that there are many factors that influence direct Project employment including personal circumstances, socio-economic context, community investment and development by governments, and local labour supply. Projected direct employment and subsequent net migration of individuals expected to move to the Yukon to work directly for CMC is detailed below. Also provided is a discussion of available data from other operating mines in the Yukon, with community and First Nation distribution data from the Minto Mine summarized.

Projected Direct Employment of Residents in Affected Communities

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 B.14.3-1, 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 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 B.14.3-1 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

*Values for Carmacks are for 2006; Sources: 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 the Mining Industry Human Resources Council (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. 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.

Projected Net Migration due to Direct Employment by CMC

As a result of direct employment by CMC during the Project's Construction and Operations phase, an estimated net total of 335 individuals are expected to migrate to the Yukon (Table B.14.3-2 – adapted from Table 16.4-2). The majority of these migrants are expected to settle in the communities of Whitehorse (95.9%), Carmacks (2.4%), and Pelly Crossing (1.7%). This translates into an estimated net increase of approximately 320 individuals in Whitehorse, 8 individuals in Carmacks and 6 in Pelly Crossing, due to direct Project employment.

Table B.14.3-2 Estimated Population Changes

Phase	Year	Total Yukon-Resident Staff	Share of Migrants in Resident Staff	Annual Net Migration From Staffing	Cumulative Migration from Staffing
Construction	-4	0	0	0	0
	-3	68	28	73	73
	-2	155	54	66	140
	-1	196	61	20	160
Operations	1	353	85	62	222
	2	442	126	105	327
	3	489	129	8	335
	4	525	134	12	335
	5	536	129	-12	335

Adapted from Table 16.4-2 in the 'A-16, Community Vitality' Section of Casino Project Proposal, p.16-9

Pelly Crossing

As stated in Section 17, the majority of individuals employed directly by CMC who migrate to Pelly Crossing are expected to be returning residents. In Pelly Crossing, this is due to the limited amount of privately owned homes available and the high demand for SFN residential housing. The majority of housing in Pelly Crossing is only available to SFN citizens, as SFN residential housing comprises the majority of residential housing units. More specifically this included 133 SFN residential housing units, four privately owned houses, and 11 YG staff houses in 2012 (Klohn Crippen Berger (KCB), 2013). In 2012, it took an average of five years for an SFN citizen to be assigned a home once their housing application was complete (KCB, 2013). Pelly Crossing is home to SFN people which includes 336 people (2011 census) 305 which are first nation (Capstone, 2015). The median population age of Pelly Crossing is 38 years of age (2011 census).

Carmacks

Similarly to Pelly Crossing, the majority of individuals employed directly by CMC who migrate to Carmacks are expected to be returning residents. The development of new residential housing is currently limited in Carmacks due to the high cost of building new homes (personal communication 2013). Other identified costs which may be limiting the availability of housing are the lack of suitable land and CMHC lending regulations. LSCFN housing is also reported as being limited for its citizens.

Yukon Mining Employment Data

A 2013 email survey of employees working at one of the three mines operating in 2013 (Minto, Wolverine, and Alexco/Bellekeno) revealed that of the total 624 individuals employed at the Minto, Wolverine and Alexco/Bellekeno Mines (includes contractors) approximately 417 or 67% resided outside of Yukon (Ecofor, 2013), or, approximately 33% of the workforce directly employed by operating Yukon mines were Yukoners. Another survey of employees working at operating mines in the Yukon found that 59.5% of employees resided outside of the Yukon, or 40.5% of employees were Yukoners (Ecofor, 2013).

In summary, based on the results of the two surveys listed above, the proportion of Yukoners employed by one of the three Yukon mines in 2013 ranged between approximately 33% to 40.5%. For context, in 2013, the Minto Mine had been operating for 6 years, the Wolverine Mine had been operating for 4 years and Bellekeno had been operating for 2 years.

Minto Mine

The Executive Committee has suggested that CMC use data from the Minto Mine to support employment projections. CMC has examined the data from the Minto Phase V/VI Socio-economic Study (KCB, 2013) and the 2014 Socio-Economic Monitoring Report. A detailed Socio-Economic Monitoring Program was developed by the Minto Mine Tri-Partite Working Group, consisting of Selkirk First Nation, Minto Explorations Ltd. and Yukon Government in September 2013. Results of data collection and analysis from 2007 to 2014 are currently being compiled, and the report expected at the end of 2015. Once the data from the Minto Socio-economic Monitoring Survey is public, CMC will incorporate those findings into its conceptual socio-economic monitoring plan and use it to compare to CMC's employment projections. Note also that employment cited in the study is for Minto employees only, and does not include contracted employees, which is significant.

B.14.4 FLY-IN-FLY OUT AND SHIFT STRUCTURE

B.14.4.1.1 R2-193

R2-193. Details on the proposed mitigation strategies (flexible rotations, counselling services, and adaptive management) for the shift structure identified in the proposal.

CMC will implement its Socioeconomic Management Plan to mitigate for, and to monitor and adaptively manage potential adverse residual effects of the Project on employees, their families and communities. The Socioeconomic Management Plan outlines commitments to work with agencies and parties to address potential adverse effects of the proposed shift structure:

- Provide employees with free work-related round-trip transportation to the mine site from the communities of Pelly Crossing, Carmacks, and Whitehorse.
- Introduce and maintain measures to assist employees to perform well in their jobs and to help their local communities with any potential effect of the Project.
- Provide shifts to accommodate subsistence harvesting and participation in cultural activities/events;
- Provide flexible work rotation schedules, where practical, that could accommodate the needs of local hires and industry practices.
- Work with Yukon Government, and community-based agencies to ensure there are services in the field of counselling, addiction and rehabilitation, family adjustment, and money management for all employees and their families.

In addition CMC will implement several mitigation measures to provide support to its workforce, several of which were identified by Barclay et al. (2013) for improving the health and well-being of fly-in fly-out workers and increasing employee retention:

- Increase awareness among employees of the common mental health and well-being challenges that fly-in-fly-out workers face by providing them with informational booklets and materials upon their hire.
- Provide workers with access to a website that enables them to complete a self-assessment of their mental health using online diagnostic tools.
- Provide employees with the contact information of doctors and counselors.
- Foster a workplace culture that promotes discussion among employees by appointing a trusted and well-respected employee to organize and facilitate group meetings for employees to discuss any mental health issues or well-being considerations in a private, confidential setting.
- Consider a “buddy-system” for pairing new employees with more seasoned shift rotation employees to assist during the transition phase.
- Schedule regular meetings with the community liaison to provide updates and information on the overall satisfaction of First Nation employees and any concerns related to their mental health and well-being.
- Consider modified shift rotations for those employees that have unique circumstances requiring more frequent trips home.
- Maintain an on-call list that can be used to meet staffing shortfalls in the event that First Nation and non-First Nation employees need to return home for planned and unplanned family and community events or emergencies.
- Allocate a certain number of days per year that First Nation and non-First Nation employees can use as unaccountable days off.
- Ensure that employees have direct access to the Internet and telephones that will enable them to stay connected with friends and family on a regular basis.

Experience from the Minto Mine indicates that employees expect a fly-in, fly-out camp model, as it is attractive to employees who can stay in their hometown and not move to the Yukon (Capstone, 2015).

B.14.4.1.2 R2-194

R2-194. Details on how unscheduled community/cultural events will be accommodated in the shift structure. This should include references to experiences in Yukon and neighbouring jurisdictions.

CMC will support and encourage its employees to return home when an unscheduled community/cultural event occurs. Regular flights from the mine site will be available, and the road will also be accessible for employees who live within driving distance. With over 600 employees during operations, there is opportunity to bring in the employees cross-shift, if available, or cover the workload using existing employees. Ideally, community and cultural events will be identified well in advance, and employees will make accommodations with their supervisor to attend those events. Obviously, some events cannot be planned for (i.e., deaths in the community), and accommodations will be made to facilitate any needs the employee has to connect with family and friends.

The Socio-economic Management Plan will be finalized in discussions with First Nations, and affected communities, and will be subject to any provisions agreed to in Impact Benefit Agreements with affected First Nations. Commitments in the Socio-economic Management Plan relevant to unscheduled community/cultural events include:

- Developing and implementing a policy that provides family leave for those employees responsible for providing child care or elder care in an emergency situation.
- Providing First Nation and non-First Nation employees with a specified number of days for unaccountable leave.
- Arranging for emergency travel in the event that employees must leave the Project site and return to their home community to attend unscheduled community/cultural events.
- Providing communication links to home communities that enable First Nation and Non-First Nation employees to easily contact community and family members.
- Hiring a community liaison that is a member of a First Nations community who will work with local communities to gather information on community and cultural events (including funerals and potlatches) and relay this information to affected employees and CMC.

CMC will address staffing shortfalls by maintaining an on-call list to ensure that its employees have the opportunity to return to their communities in the case of unscheduled events.

The community liaison will play an important role in developing and maintaining positive relationships between CMC and First Nations. The specific duties of the community liaison will be determined prior to hiring. Anticipated responsibilities of the community liaison could include:

- Building trust and relationships with First Nation employees.
- Understanding the unique culture and traditions of all First Nation groups represented among Casino employees.
- Providing and facilitating communication among CMC, its employees, and First Nations.
- Working closely with First Nation employees to monitor their satisfaction and understand sources of stress that affect their mental health and well-being.
- Facilitating travel between the mine site and FN communities.

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B.15 – ECONOMIC DEVELOPMENT AND BUSINESS SECTOR

B.15.1 INTRODUCTION

The Proposal defines Economic Development and Business Sector as economic growth, government revenues, and business opportunities in the Yukon economy. Economic development and the business sector was assessed as a Valued Component (VC) in the Proposal because the Casino Project (the Project) would generate employment, income and business opportunities throughout Yukon.

The construction of the Project is expected to require capital expenditures that will have direct, indirect, and induced effects on the regional economy. Direct effects on Yukon's GDP include direct anticipated expenditures of $261 million, leading to a projected $363 million increase in Yukon's GDP over a 4-year period. Casino Mining Corporation estimates that approximately 69% of operational spending will occur in Yukon. Indirect effects are related to the purchase of goods and services needed to construct and operate the Project, while induced effects result from expenditures of direct and indirect labour income on consumer goods and services.

The Proposal identified socio-economic enhancement measures including cultural awareness training for employees and contractors; partnering with First Nation communities and their development corporations to access additional funding for training; providing support for non-mining training and entrepreneurial initiatives; and monitoring socio-economic effects of the Project and implementing adaptive management measures where required.

The Proposal concluded that the potential effects of the Project on economic development and the business sector, as a result of the procurement of labour, goods and services are beneficial.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review.

Responses to the four requests for supplementary information related to Section 15 and Section A.15 of the Project Proposal and SIR are provided below, as outlined in Table B.15.1-1. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

Table B.15.1-1 Requests for Supplementary Information Related to Employment and Income

Request #	Request for Supplementary Information	Response
R2-189	Further information on the implementation of employment strategies to mitigate for effects of closure or unplanned closure.	Section B.15.2.1.1
R2-190	Clarification on efforts that will be used to draw employees from unemployed or underemployed populations.	Section 0

B.15.2 BOOM AND BUST CYCLES

B.15.2.1.1 R2-189

R2-189. Further information on the implementation of employment strategies to mitigate for effects of closure or unplanned closure.

CMC considers "closure" to be the planned and scheduled cessation of mining and milling activities due to the complete processing of the resource. Permanent closure will be in accordance with the regulatory approved reclamation and closure plan. Closure may also occur due to a large shift in Project economics; however, this would be considered "temporary" closure, which would be also be defined in the regulatory approved reclamation and closure plan. Temporary suspension of mining and milling activities may also occur due to extreme unplanned events, such as earthquake or major accidents; however, activities would resume once site safety has been assured.

"Unplanned" closure is the abrupt, non-scheduled cessation of mining and milling activities, of which the Yukon has a long history. Abandonment of mine sites in the Yukon is usually due to the mine operator halting mining and milling, entering a period of care and maintenance, and finally entering receivership with responsibility of the site transferring to the Federal government (e.g., Faro mine, United Keno Hill Mines). In light of these abandonments, the Yukon Government created the Yukon Mine Site Reclamation and Closure Policy, which requires that "every mine will have an approved reclamation and closure plan that has been approved by the Yukon government before proceeding with development" (Yukon Government, 2006). Also, the Yukon Water Board has a stated objective to "issue licences only when there is a reasonable certainty that an acceptable level of reclamation of the site can be achieved during mining and/or following cessation of mining" (Yukon Water Board, 2012). Therefore, the concept of "unplanned" closure is an unacceptable outcome for modern mining operations, with assessment, permitting and licencing frameworks to prevent such closures from occurring.

Therefore, while details on the implementation of employment strategies for planned and unplanned closure are provided below, CMC iterates that unplanned closure of the Casino Project is not part of the Proposed Project, and as the Project has robust economics, and is able to continue to operate at low copper prices, is not proposed to occur. The unplanned closure discussion can be considered an aspect of "Accidents and Malfunctions" of the Project for consideration by the Executive Committee.

Planned Closure

CMC will establish a program to monitor the socio-economic effects of the Project during construction, operations, and closure. The monitoring program will include several objectives including working with local agencies to monitor project socio-economic effects, identifying unforeseen socio-economic effects, monitoring employment and skills training programs, and revising and developing new mitigation measures to manage unforeseen socio-economic effects, among others (Socioeconomic Management Plan, Appendix A.22F). This monitoring strategy will hold CMC accountable for its commitments to implement employment strategies.

A mine closure plan is a requirement of Quartz Mining Licencing. Detailed plans are required in order to receive authorization to develop and operate the mine, and subsequent updated plans must be submitted and approved periodically throughout mine development and operation (Yukon Government, 2013). CMC will work with affected communities to develop and refine this plan. Socio-economic considerations of this plan will include:

- Offering on the job training and skills upgrading to workers to provide them with increased capacity to find other jobs;

- Assisting in the development of new economic development opportunities such as by providing seed funding for local contractors to diversify into other sectors; and
- Helping identify new career opportunities and out-placement services such as working with other regional employers to find new jobs for mine employees.

CMC will also implement several strategies to mitigate the effects of closure. These strategies will include:

- Providing materials and support to employees that enable them to identify skills developed and used during their employment tenure on the Project, identify positions in other industries that require these skills, and assist them in the effective presentation of their skills and experiences with resume support.
- Completing a social impact assessment prior to planned closure in order to evaluate the potential social and economic implications of the Casino mine closure on communities and stakeholders as well as identify mitigation measures to minimize the social and economic effects of the Project's closure
- Monitoring and reporting of internal business activities and international markets in order to anticipate and prepare to the extent possible for unplanned closures or reduced operations.
- Evaluating support mechanisms for CMC employees, such as providing employees with a supplement to Employment Insurance benefits for a specified period to time to assist in job transition, in the event of a temporary or unplanned closure.

In each of these strategies, CMC will provide clear and transparent information on planned closure activities and provide as much notice as possible on closure activities.

Unplanned Closure

To present an evaluation of the effects of unplanned closure, and provide mitigative measure, case studies of how some of these small mining communities (and other single industry resource industry towns) have responded to industry closure have been reviewed. The main reference document is the Provincial and Territorial Departments Responsible for Local Government, Resiliency and Recovery Project Committee (PTDRLGRR) *Facing the Challenge of Industry Closure: Managing Transition in Rural Communities* report from February 2005.

Mitigating the effects of planned/unplanned industry closure is a shared responsibility between all community leaders, and the success of such mitigation depends, in part, on the ability of stakeholders to work together to overcome such a challenge (PTDRLGRR, 2005). Nevertheless, CMC will play a lead role in coordinating communications, planning and activities between all stakeholders in the community to advance plans to manage and mitigate a planned/unplanned closure. Research demonstrates that "effective transition management anticipates and plans for industry closure instead of reacting to it…[as] stakeholders should expect [closure] and prepare for it as a normal event in the life of industries that depend on non-renewable resources or resources that depend on shifting global markets" (PTDRLGRR, 2005).

CMC has reviewed the key conclusions and best practices identified by the PTDRLGRR Project Committee, and will incorporate these findings in their planning and activities (e.g. development of mitigation strategies) for a planned/unplanned closure. As found by the PTDRLGRR, there is no simple, transferable process to ensure the successful transition of a community following industry closure (2005). Rather, the successful transition of a community following an industry closure depends on a "complex interrelated range of action" directed by how an individual community defines or visions a 'successful transition' (PTDRLGRR, 2005). Thus, CMC will engage early with local leaders to establish a framework to initiate and guide the planning of a future planned/unplanned closure (see the Conceptual Socio-economic Management Plan, Appendix A.22F). This locally-relevant framework will then act as a tool to guide the collective planning and preparation(s) for industry closure throughout the life of the Project.

General Mitigations

Mitigations for both planned and unplanned closure in the Project Planning phase and construction and operations phases are detailed below.

Project Planning: Socio-economic Management Plan

During the initial Project planning stage, CMC will further develop the Socio-economic Management Plan (SEMP - Appendix A.22F). This SEMP will act as the framework to bringing the three parties (CMC, affected First Nations and Yukon Government) together to develop CMC's socio-economic monitoring program, and guide its development. The SEMP will describe such key details as, but not limited to: identifying the scope of the monitoring program (including those local agencies which will be involved in the monitoring of project-related socio-economic effects); the process(es) which the monitoring program will use to assess expected and unexpected socio-economic effects; the management of CMC's 'sustainable socio-economic initiatives' (e.g. employment and skills training programs); and, the consultation and engagement approach that the program will use to share monitoring program findings and inform monitoring program developments (e.g. adaptive management of mitigation measures, etc.).

Project Construction & Operations:

The socio-economic landscape is a naturally dynamic system which is always in flux and subject to the influences of changing conditions. Understanding how conditions are changing is important as it may influence planning objectives and mitigations, as well as identify socio-economic trends which are unrelated to a specific project.

To stay aware of socio-economic conditions during Project construction and operations and be able to direct project management and developments, CMC will complete the following:

- **Ongoing Consultation and Engagement**: A community's ability to transition through and recover from industry closure is related to the ability of key stakeholders (in addition to the proponent) to work together to support communities and/or individuals through this time of change (PTDRLGRR, 2005). As such, as part of CMC's ongoing consultation and socio-economic monitoring programs, CMC will work to continuously engage key stakeholders to help ensure that, if required, they will be well positioned to work together.
- **CMC Socio-economic Monitoring Program**: CMC will conduct ongoing socio-economic monitoring as detailed by the SEMP. It is anticipated that this socio-economic monitoring program will work to enhance the efforts of other such programs (e.g. the Minto Mine Socio-economic Monitoring Program) to maximize efficiency and reduce the potential of participant fatigue. As the SEMP will monitor and assess socio-economic conditions on an ongoing basis, this will contribute to CMC's ability to mitigate socio-economic effects, including unplanned closure.

  Further, the monitoring program will include a section focused on internal business activities and international markets in order to help anticipate, and prepare to the extent possible, for any unplanned closures or reduced operations. Literature supports that the recovery of an industry closure is easier if transition management begins early (eg. when financial indicators are consistently poor), rather than in a reactionary fashion after a closure announcement is made (PTDRLGRR 2005).
- **Social Impact Assessment (SIA)**: An SIA will be conducted approximately 5 years prior to planned closure in order to re-evaluate the potential social and economic implications of the Casino mine closure on

communities and stakeholders, as well as to identify mitigation measures to minimize the social and economic effects of the Project's closure.

The practice of conducting additional SIA(s) is becoming more commonplace among mining proponents as the value of this work is becoming increasing recognized. Subsequent SIAs can provide a better understanding of anticipated and unanticipated project-related impacts, reflect changes to the socio-economic landscape which may naturally occur over time, and consider the effects of cumulative and indirect social impacts on communities (Lockie et al., 2009).

- **Mine Closure Plan**: A mine closure plan is a requirement of Quartz Mining Licencing. Detailed plans are required in order to receive authorization to develop and operate the mine, and subsequent updated plans must be submitted and approved periodically throughout mine development and operation (Yukon Government, 2013). CMC will work with affected communities to develop and refine this plan. The Mine Closure Plan will incorporate the results of the ongoing consultation and engagement, SEMP, and SIA to ensure that the best available data is used. Elements of this plan applicable to socio-economic indicators will include, but are not limited to:
  - Offering on the job training and skills upgrading to workers to provide them with increased capacity to find other jobs;
  - Assisting in the development of new economic development opportunities such as by providing seed funding for local contractors to diversify into other sectors; and
  - Helping identify new career opportunities and out-placement services such as working with other regional employers to find new jobs for mine employees.

In addition to the commitments described above, CMC will also implement industry best practices for successful transition management, to help mitigate the effects of closure. These best practices apply to three general periods of time ('pre-closure', 'during the immediate transition', and 'long-term'), and may be focused at the community and/or individual level. Examples of what these best practices may entail are described below and are derived from the PTDRLGRR 2005 report.

Pre-Closure Phase:

CMC will work with community leaders to implement the following best practices in the pre-closure phase to support a successful community transition in the event of an unplanned closure:

- Work to establish a culture of responsibility and leadership;
- Provide the maximum warning of closure possible to communities, to help alleviate shock and provide communities and individuals an opportunity to adapt;
- Engage community leadership in the early and advanced planning of closure; and
- Maintain ongoing communications with the community and community stakeholders.

Immediate Closure Phase:

Several options for employee-level transition support may be offered by CMC following the immediate closure of the mine; these may include providing such support as:

- Severance payments;
- Extension of company benefits for a fixed amount of time;
- Relocation assistance;

- Early retirement options; and
- Job Retraining and Education Upgrading Assistance: This may include providing materials and support to employees that enables them to further develop and/or identify transferable skills used during their employment with CMC, identify positions in other industries that require these skills, and assist them in the effective presentation of their skills and experiences through resume support.

This strategy has been successfully demonstrated in other mining focused communities in Canada, as illustrated by BHP's Island Copper mine in Port Hardy, British Columbia, Canada. At the Island Copper Mine, two programs were implemented to support mine employees retrain and upgrade their education. In total, 155 employees found new jobs through this program (Veiga et al., 2000).

Long-Term:

Through its Closure and Reclamation Plan, and Post-Closure Monitoring and Inspection Programs, CMC will address such long-term effects as environmental hazards and wastes so that the lasting footprint of the Project is minimized and returned to a state which the community desires (PTDRLGRR, 2005).

B.15.2.1.2 R2-190

R2-190. Clarification on efforts that will be used to draw employees from unemployed or underemployed populations.

CMC has made a number of commitments to draw employees from unemployed and underemployed populations; for example, pick up points for shift change charter flights in Yukon communities outside of Whitehorse, subject to employment numbers.

In addition to commitments described in R383 and 384 of the supplementary information report, below are conceptual detail around how this will be implemented. These concepts will be subject to any provisions that are agreed to in Impact Benefit Agreements with affected First Nations:

- Provide advanced notification of employment opportunities, position requirements, and hiring schedules to local communities and the Yukon Government such that under- and unemployed individuals will have sufficient time to prepare for Project employment.
- Attract First Nation employees by ensuring that at least one Employee Relations Personnel can communicate in Northern Tutchone language, provide First Nations with specified number of days for unaccountable leave, and accommodate for subsistence harvesting and participation in cultural activities, among others.
- Require contractors to implement CMC's employment strategies in their hiring and recruitment practices.

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B.16 – COMMUNITY VITALITY

B.16.1 INTRODUCTION

The assessment of community vitality presented in Section 16 of the Proposal for the Casino Project (the Project) focused on the communities of Selkirk First Nation (SFN) / Pelly Crossing, Little Salmon/Carmacks First Nation (LSCFN) / Village of Carmacks and City of Whitehorse. The Proposal determined that both beneficial and adverse residual effects could potentially occur as a result of the Project, mainly through contracted employment, mine staffing, and accommodations.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review.

Responses to the three requests for supplementary information related to Section 16 and Section A.16 of the Project Proposal and SIR are provided below, as outlined in Table B.16.1-1. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

Table B.16.1-1 Requests for Supplementary Information Related to Community Vitality

Request #	Request for Supplementary Information	Response
R2-195	Identify local values within the category of community vitality and wellbeing as informed by communities and First Nations, including communities outside of Carmacks, Pelly Crossing, and Whitehorse where there is potential for significant project effects.	Section B.16.2.1
R2-196	Provide baseline data, and relevant indicators, for identified local values within the category of community vitality and wellbeing.	Section B.16.2.2
R2-197	An assessment of potential effects due to project activities to local values within the category of community vitality and wellbeing, relying where possible on relevant analogs.	Section B.16.2.3

B.16.2 COMMUNITY VITALITY AND WELLBEING

B.16.2.1 R2-195

R2-195. Identify local values within the category of community vitality and wellbeing as informed by communities and First Nations, including communities outside of Carmacks, Pelly Crossing, and Whitehorse where there is potential for significant project effects.

Local values were inferred through communication with the public, Aboriginal groups, local communities, and government stakeholders during the engagement process. These discussions resulted in the indicators and measures outlined in Table B.16.2-1. Assessment of these indicators in both the LSA and RSA is provided in Section 16 of the Proposal, including the following Project-specific effects:

- Effects on community vitality;
- Effects on population and demographics;
- Direct migration;
- Indirect migration;
- Employment effects;
- Income effects;
- Income-related effects on community well-being;
- Population-related effects on community well-being; and
- Work-related effects on community well-being.

Table B.16.2-1 Community Vitality Indicators and Measures

Indicators	Rationale	Measures
Population and Demographics	The population and demographics of LSA and RSA communities was considered as part of 'Community Vitality' as the size and composition of a community influences such aspects of community vitality as: community character (i.e. social cohesion, quality of life, etc.), infrastructure and services, and ability to plan for future community objectives.	• Size of registered Yukon First Nation citizen population (#); • Residency of registered Yukon First Nation citizen population (location); • Population change over time; • Migration patterns • Birth rate • Death rate • Ethnicity of population; • Population, by sex.
Community well-being	Community well-being describes the intangible, measurable aspects which contribute to the wellness of a community.	• Community Well-being Index (CWBI) • Crime rate, (by crime type) • 'Heavy' alcohol consumption rates (Yukon territory-level) • Emergency room visits due to alcohol • Emergency room visits due to illicit drugs

Community vitality was selected as a valued component (VC) due to the potential for the Project to affect the well-being of individuals, families, and communities in the LSA as a result of:

- Population migration effects: Project employment influencing people to move to the LSA, either permanently or temporarily, and subsequent changes to LSA demographics; and,

- Changes to the LSA community socio-economic conditions: New Project-related income and work schedules may affect social and behavioural conditions in LSA communities.

Key indicators selected to assess the VC “community vitality” were: Population and Demographics, and Community Well-being (Table B.16.2-1). Supplemental information to complement this section is provided in Section 13, A.13 Employment and Income, and related appendices.

The Community Vitality VC was identified in consideration of the values, information, and issues communicated by the public, Aboriginal groups, local communities, and government stakeholders during the engagement process conducted in support of this Proposal. Specifically, community well-being was discussed at the consultation events outlined in Table B.16.2-2, as documented in the Project’s Consultation Log (Appendix 2A). This VC and specific indicators were also selected based on professional judgement and experience in conducting socio-economic effects assessments.

Potential population changes are important to consider because demographics contribute to community character and effect demands on infrastructure and services. Socio-economic assessments routinely evaluate potential project-related population changes because of the potential for such changes to directly affect the quality of life in a region; further, such an assessment can assist public and private agencies in planning for future capacity requirements for various services. Population changes and new Project-related income can also affect the well-being of individual, families, and communities in the area. Section 16 of the Proposal assessed the potential effects of the Project on these conditions that could affect the vitality of the local communities.

The Local Study Area (LSA) spatial boundaries for this VC were delineated to include those communities which may have their ‘community vitality’ directly affected by the Project, through potential effects to population demographics and community well-being. These communities are located adjacent to the Project site and the proposed access route, and represent the closest and most accessible potential sources of direct labour, goods, and services needed for/by the Project; therefore, they are expected to experience *direct* Project socio-economic effects. The Local Study Area (LSA) for assessment of the Project on Community Vitality included the following communities:

- Settlement of Pelly Crossing and the Selkirk First Nation;
- Village of Carmacks and the Little Salmon/Carmacks First Nation; and
- City of Whitehorse.

In addition to LSA communities, consultation with other First Nations (e.g., White River and Carcross Tagish) was also conducted and consideration of potential Project-related effects were considered. Consultation with White River First Nation was initiated in 2013, and included exchanges of letters and emails, phone and in-person discussions, a meeting with Chief and Council and an Open house in Beaver Creek. The details of the consultations with White River are provided in Section 2.3.6 of the Proposal. CMC has continued meeting with White River First Nation to discuss engagement frameworks and funding opportunities for traditional land use studies. The Carcross Tagish First Nation (CTFN) have expressed concern with the trucking of materials through the CTFN community and impacts on the South Klondike Highway. CMC has endeavoured to meet with CTFN to discuss these concerns, and consultation efforts will continue throughout the assessment process.

Consultation with the Champagne and Aishihik First Nation and Kluane First Nation was also conducted in preparation for submission of the Project Proposal, and the results of this consultation is provided in Sections 2.3.7 and 2.3.8 of the Proposal, respectively.

The Regional Study Area (RSA) comprised the entire Yukon, in order to provide a broader socio-economic context for understanding potential Project related 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 (Section 15) such as changes to economic growth, business opportunities, government revenues, employment and income will be experienced throughout the Yukon.

CMC appreciates that communities are dynamic, and that over time their values related to ‘community vitality’ may evolve. As such, CMC will hire a community liaison in each of the LSA communities, in order to provide a local, ongoing opportunity for community members to share their values with the project. Specifics for each community include:

- **Pelly Crossing/SFN:**

  A comprehensive community-based survey detailed in the Minto Socio-economic Monitoring Framework was conducted in 2015. This survey includes numerous indicators related to vitality and well-being, including: cultural well-being; community stability and well-being; material well-being, family stability and well-being; and cultural vitality. The results of this survey are expected to be publicly available in late 2015. CMC will review the results of the 2015 Minto Socio-economic Monitoring survey, and will consider incorporating this information into the Socio-economic Management Plan, depending on input from LSA communities. CMC will conduct a gap analysis on the Minto Socio-economic Monitoring report (expected release date, late 2015) and its current ‘community vitality and well-being’ baseline to identify any gaps. For any gaps identified, CMC will commit to developing a baseline (with relevant indicators) prior to construction commencing.

  CMC will continue discussions with SFN Chief and Council in order to gain permission from leadership to engage SFN citizens, and to contribute to the development of the Minto Monitoring Survey, in order to avoid duplication of effort and support ongoing socio-economic monitoring efforts. More specifically, contributing to the development of the Minto Monitoring Survey may involve such tasks as: organizing round table discussions with SFN citizens to have in-depth discussions on issues/gaps not addressed by Minto; and, designing interview questions to inform the Minto Monitoring indicators which currently have no or limited data.

  Additional baseline data and relevant indicators related to local SFN values of community vitality and well-being will be gathered through this approach as requested. CMC will consider and/or incorporate this information into the Socio-economic Management Plan.

- **Carmacks/LSCFN:**

  Following the consultation conducted prior to Project submission, Casino has conducted extensive consultation with LSCFN since filing the Proposal, including the following meetings:

  - Socio-economic technical meeting on June 24, 2014.
  - Socio-economic Community Meeting #1 on September 25, 2014.
  - Socio-economic Community Meeting #2 on October 22, 2015.

  One of the outcomes of these meeting was the development of the Socio-economic Management Plan (SEMP – Appendix A.22F) that includes a dedicated section to ‘Social and Cultural Well-being’ outlining CMC’s commitments to ensuring the well-being of local communities.

  CMC will continue consultation with LSCFN, and use information gathered to improve understanding of identified comments and issues to inform Project developments. CMC will also work collaboratively with

LSCFN to develop a similar socio-economic monitoring program to the Minto Mine Socio-economic Monitoring Framework.

- **Whitehorse:**

  CMC utilized population and demographic information to examine population changes and changes to family structure, as well as the Community Well-being Index (CWBI) for the community of Whitehorse (Section 16). As the largest population center in the Yukon, statistical data was used more predominantly to document current 'community vitality and well-being' conditions in Whitehorse than in smaller LSA communities, where such data may not be available and/or as accurate. The material currently presented in the Project Proposal provides baseline data and relevant indicators for community vitality and well-being in Whitehorse.

  Further, CMC will establish a Community Liaison for Whitehorse, who will be responsible for establishing a framework for engagement, communications and reporting over the life of the Project with the City of Whitehorse. CMC anticipates that the City of Whitehorse could be incorporated in a limited fashion into the monitoring plan for socio-economic effects for the Project.

Further, CMC will mitigate the socio-economic effects of the Project on potentially affected communities through monitoring. The monitoring program for community vitality and community well-being will adaptively respond to the predicted adverse residual effects identified as part of the YESAB review and through consultations with YG, communities and First Nations. These processes may determine that it is appropriate and meaningful to monitor socio-economic effects outside of Pelly Crossing and the Village of Carmacks. CMC is also willing to work with the Tr'ondëk Hwëch'in, municipalities, and other First Nation governments to determine the appropriate level of socio-economic monitoring for project-related effects on their respective communities.

This adaptive approach to considering those First Nations and communities with the potential for significant project effects demonstrates CMC's commitment to mitigating the socio-economic effects of the Project on potentially affected communities.

Table B.16.2-2 Summary of Consultation Events where the Topic of Community Well-Being was discussed

CMC Record of Contact #	Event Type	Date	Participating Organizations	Event Summary	Issues Raised
29	Meeting	March 16, 2010	Selkirk First Nation, CMC Consultant, CMC	A copy of the CMC January newsletter was provided; CMC discussed submitting articles for future newsletters. CMC provided field assistant job posting notices. Selkirk First Nation stated they have potential candidates for the position. Discussed the summary of "Socio-Economic Impacts Contributing to Lacks in Community **Wellness**" provided by Selkirk First Nation. CMC will look into the Federal / territorial programs identified in the study.	
189	E-mail	October 1, 2012	City of Whitehorse, CMC Socio-economic Consultant	Socio-economic data collection. Discussed housing, employment and **community well-being**. Concerns: (a) availability and condition of rental housing; (b) potential negative effects on community well-being.	• Affordability and availability of rental units in Whitehorse • Yukoners prefer Casino workers to be housed in Whitehorse • Housing demands and issues (e.g., age, conditions, etc.) in Whitehorse and Yukon communities. • Concerns related to 'boom/bust' cycle and the negative effects that could have on the territory • Concerns related to increased drug and alcohol use, leading to anti-social behaviour
231	Meeting	October 3, 2012	Yukon Health & Social Services, CMC Socio-Economic Consultant	Socio-economic data collection. Discussed community social services, lack of local transportation, potential effects to community and personal **well-being** in Carmacks and Pelly. Concerns: (a) potential for drug and alcohol abuse, and need for mitigative strategies; (b) need for onsite skills development and career planning for project employment; (c) lack of public transportation.	
440	Meeting	February 13, 2013	Village of Carmacks, CMC Socio-Economic Consultant	Socio-economic data collection. Discussed infrastructure and services, recreation services, community **well-being**, economic development, tourism, and recreational fishing and hunting Concerns: (a) need for a local economic development plan to assist with procurement for industry.	• There are many recreational opportunities and programs and capacity is adequate. • There is a need for an Economic Development Plan, particularly to help people understand the supply chain for mining. • Bringing the company and the community together is important so local entrepreneurs can take advantage of service contracts.
443	Meeting	February 13, 2013	Yukon Energy, Mines & Resources, CMC Socio-Economic Consultant	Socio-economic data collection for the Carmacks area. Discussed services, mining in the area, local roads, local employment, community services and infrastructure, **social issues**, hunting. Concerns: (a) lack of community service resources; (b) high level of unemployment; (c) lack of resources at the school; (d) high number of foster homes and abandoned children;	• It's hard for people working at Minto to be away from their families. • Caribou and the impacts to land are important; impact on food security. • Service shortages are a serious issue, including government services; workloads are heavy and staff are overworked and overwhelmed. • There are 3 social workers in town. Social and community services are overburdened and they don't want it impacted by a project like this. • Concern that government officials and the people in Whitehorse don't care about staff being overburdened and overworked. • Concern that RCMP and fire fighters will be impacted by mine development.

CMC Record of Contact #	Event Type	Date	Participating Organizations	Event Summary	Issues Raised
				(e) potential effects on hunting.	• Increased population could affect the RCMP as they only have two officers but they should have three. • Infiltration of drugs and partying would be a problem, but could be managed with proper planning. • There is 1 conservation officer who is really concerned about this project and how it might affect hunting. • The Road will be a major issue for this area. People are talking about it and blocking the road. People need to get on board and discuss the road in a meaningful way. There are fears associated with this. • There are fears about fracking. People are passionate and afraid but money makes a difference. They don't want mining companies coming in and promising things to the locals with nothing happening. Not just about money but about social responsibility. BE CLEAR ON MITIGATION. This is crucial. • Concerns about whether the gas and food supply will be affected. • Concerns about lack of housing in Carmacks. • Concerns that many positions don't require full time. • Concerns about limitations in educational programming offered locally. Many parents send their children to Whitehorse for school. The expertise local teachers have limits what curriculum can be offered. • Many children don't graduate with classes they need • Concerns about being under-resourced at the schools. • Concerns about lack of physicians. • Concerns about changes in nursing and sending patients to Whitehorse. 3 nurses are on staff but rotating. – Concerns about being turned away from seeing a nurse. • Concerns that Health and Social Services have a lot of foster homes and there are lots of abandoned kids here. • Concerns about judicial system: overcrowding in the prison in Whitehorse; difficulties in staffing the local facility (3 cells); perception that judges turn away criminals to the street. • Highways police are short staffed. • Concerns about housing: Yukon Housing prioritizes staff housing. People are living in 4 bedroom houses for one person. Lots of abandoned housing in Carmacks but no one can rent it because it is on FN land. • Concerns about the local tax base: 300 people are living here and paying the tax base of 80 people. $80,000 for municipal services but it looks like 500 on paper. • Search and Rescue is disorganized, there is a lack of training and no WCB protection. Lots of concerns over liability.
165	Open House	May 28, 2012	General Public, Little Salmon-Carmacks First Nation, Selkirk First Nation, Village of Carmacks, Yukon Economic Development, Yukon Environmental and Socio-Economic	A community meeting was held in Carmacks, attended by approximately 40 people. Meeting consisted of display boards available for viewing and questions to project staff, as well as a presentation followed by a question-and-answer period. Discussion included the following topics: design, construction, reclamation, access road and traffic, aquatics, terrestrial, **human environment**, environment and safety, consultation and community meetings, and employment and business opportunities. Concerns: (a) design heavy metals, size of settling pond, elevation of	• Where is the coin now? • Why isn't it with the First Nations? • What are the social impacts of this project? • How will social impacts be studied? • Concerns raised about the impacts on social issues in communities • What percentage of workers will be fly in and fly out only? • What impacts will there be to health and social services? • How will procurement processes occur? • Has the company team looked at sourcing Yukon suppliers? • Can the company provide Yukon representatives with a list of suppliers the company might require?

CMC Record of Contact #	Event Type	Date	Participating Organizations	Event Summary	Issues Raised
			Assessment Board, CMC	mine site, water used for operations; (b) construction –transmission line location; (c) reclamation – cost, reclamation plan and cleanup; (d) access road and traffic – amount of traffic, size of trucks, effect on wildlife (habitat, migration, mortality on road), route, access through Little Salmon-Carmacks First Nation territory; (e) aquatics – effect on fish habitat and camps, compensation plan, effects on creeks and watersheds; (f) terrestrial – effect on migration routes, habitat and breeding, effects on harvesting, need for monitoring effects on wildlife; (g) human environment – effects on social services and community **well-being**, procurement process, need for benefits for future generations, economic development, level of local involvement vs. labour brought in; (h) environment and safety – effects on the environment, safety; (i) consultation and community meetings – IBAs, who is consulted and how often; (j) employment and business opportunities – who will be approached; (k) general – need for translation services, legacy.	• Comment that respondent would like to see benefits for future generations • Comment made that the benefits would be mostly related to economic development including employment, capacity and economic boosts • Carmacks needs more jobs and sources of income so this project was noted as being able to help • The company should focus on minimizing the negative social impacts and source Yukon suppliers and community suppliers • It is important to support and help build smaller Yukon communities such as building a community centre or a sports complex. • Most employment and investment benefits will accrue to outsiders • The project might be better for Yukon if it was smaller in scale and employed 300-400 people annually with a longer mine life • Does the company have an Impact and Benefit Agreement in place yet? • Is the company going to consult White River First Nation? It is important to consult with them because the tailings drain into their traditional territory • Comment made that they are glad to see the consultation happening in the community • Would like to see regular consultation with Yukon First Nations • Would like to see more community meetings with regular information sessions • Keep working openly with the community • Meetings were well-organized and provided a good overview of the project • Clear answers were given to questions
439	Meeting	February 13, 2013	Carmacks School, CMC Socio-Economic Consultant	Socio-economic data collection. Discussed school capacity and services, community **well-being**, community infrastructure and services, housing. Concerns: (a) low level of enrollment; (b) lack of adequate school equipment; (c) lack of single family dwellings and rentals; high cost of services such as fuel, phones, etc.	• Concern that things in the community are becoming less social; more people are staying home and not attending community events. • Concerns about housing availability and that options are often limited to Yukon Housing and they take 25% of each person's salary. • There are not enough single family dwellings and apartments; not enough housing for seniors. • Concern about cost of utilities: power is very expensive; supplied through Yukon Electric. Internet is $80 per month and phones are really expensive. Northwestel has a monopoly and so they hike the prices. Fuel is also really expensive and so is heating fuel. • Expressed a need for funding for the food program which supplies breakfast and lunch to most students. The cost is $5.00/meal for lunch program, which provides130 meals per day, 5 days a week. (700 meals a week.) They make sure meals are nutritious and natural. • They are working on regular delivery of apples and oranges for the classrooms. • One person makes all the food on his own so they would want to hire some help. • The school needs showers, bigger classrooms, and bigger offices. Money for programs would be helpful. They also need gym equipment. They are short on equipment for the program. Science labs are not properly set up.

B.16.2.2 R2-196

R2-196. Provide baseline data, and relevant indicators, for identified local values within the category of community vitality and wellbeing.

The key indicators used to assess Project effects on Community Vitality include: Population and Demographics, and Community Well-being – further details are provided above in the response to R2-195. A detailed baseline for these indicators is available in Appendix 13A: Socio-economic Baseline of this Proposal. Some updated information on demographics has also been provided in Section B.14.

B.16.2.3 R2-197

R2-197. An assessment of potential effects due to project activities to local values within the category of community vitality and wellbeing, relying where possible on relevant analogs.

Assessment of local values, as incorporated into indicators of community vitality, on both the LSA and RSA is provided in Section 16 of the Proposal, and includes assessment of the following Project-specific effects:

- Effects on community vitality;
- Effects on population and demographics;
- Direct migration;
- Indirect migration;
- Employment effects;
- Income effects;
- Income-related effects on community well-being;
- Population-related effects on community well-being; and
- Work-related effects on community well-being.

Further information is provided above, in the response to R2-195.

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APPENDICES

Appendix B.18A Heritage Resource Management Plan

B.18 – CULTURAL CONTINUITY

B.18.1 PREFACE

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review.

Responses to the eight requests for supplementary information related to Section 18 and Section A.18 of the Project Proposal and SIR are provided below, as outlined in Table B.18.1-1. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

Table B.18.1-1 Requests for Supplementary Information Related to Cultural Continuity

Request #	Request for Supplementary Information	Response
R2-198	A description of input from First Nations including traditional knowledge and how it will inform the plan	Section B.18.3.1
R2-199	A description on how mitigations regarding heritage resources will be implemented throughout the life of the Project	Section B.18.3.2
R2-200	A monitoring and evaluation mechanism.	Section B.18.3.3
R2-201	A comprehensive TLU study including traditional knowledge. The information provided shall cover traditional land use activities identified by First Nations.	Section B.18.4.1
R2-202	An assessment of effects of the Project on TLU.	Section B.18.4.2
R2-203	An assessment of effects of the Project on traditional economies.	Section B.18.4.3
R2-205	A description of plant species of traditional, cultural, or economic importance within the Project footprint. Include a description of any efforts to engage First Nations or other land users in identifying plants of concern and any ground studies that sought to identify and map plants of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1	Section B.18.5.1
R2-206	Provide a description of concerns raised regarding effects to traditional harvest areas and indicate the location of the areas of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1.	Section B.18.6.1

B.18.2 INTRODUCTION

Cultural Continuity was selected as a Valued Component (VC) by Casino Mining Corporation (CMC) because this component was deemed important from consultations with local First Nation and other regional residents. The Proposal assessed the potential effects of the Casino Project (the Project) on the ability of communities or individuals to sustain their cultural identity; this ability is dependent on having access to resources that support cultural retention and provide opportunities to participate in cultural activities.

The responses to supplementary information requests provided herein do not constitute a re-assessment of the effects on cultural continuity, but do provide a summary of Traditional Land Use used to generate the Project Proposal, and to assess effects. This information is substantial and extensive. The effects assessment on traditional land use activities such as hunting, trapping and fishing was provided in Section 18 of the Project Proposal, which generally coincided with the assessment of effects on First Nation Settlement Lands that was provided in Section 19 of the Project Proposal. The conclusions reached in those sections remain relevant. CMC believes that the information contained in this assessment of potential Project effects on cultural continuity is sufficient for the Executive Committee of the YESAB to initiate and conduct a screening of the Project. If additional information that is specific to the mine site or proposed upgrades to various segments of the Freegold Road or Freehold Gold Road Extension are required, CMC is committed to engage in further work in a manner and at a time acceptable to First Nations.

B.18.3 HERITAGE MANAGEMENT PLAN

B.18.3.1 R2-198

R2-198. A description of input from First Nations including traditional knowledge and how it will inform the plan

A Heritage Resources Management Plan that incorporates Project-related traditional knowledge is provided in Appendix B.18A. During the collection of heritage resources baseline data in 2013, field staff included members of Selkirk First Nation, and of Little Salmon/Carmacks First Nation. Traditional knowledge (TK) information was informally provided by the First Nation members to the cultural resources staff of Ecofor Consulting Ltd. throughout the baseline data collection program. First Nations participants also received training in heritage assessment services. Ecofor Consulting Ltd. staff subsequently wrote the Heritage Resources Management Plan provided in Appendix B.18A.

Further, as described in the response to R392, prior to its finalization, the draft Interim Heritage Resources Management Plan was provided to the following governments for review on September 11, 2015:

- Selkirk First Nation;
- Little Salmon Carmacks First Nation;
- Tr'ondëk Hwëch'in; and
- Heritage Resources Unit of the Yukon Department of Tourism and Culture.

Comments received from Tr'ondëk Hwëch'in and the Heritage Resources Unit were incorporated into the Heritage Resources Management Plan that is set out in Appendix B.18A. No comments were received from Selkirk First Nation or Little Salmon Carmacks First Nation.

B.18.3.2 R2-199

R2-199. A description on how mitigations regarding heritage resources will be implemented throughout the life of the Project

The Casino Heritage Resources Summary Report (Appendix A.18A) lists each of the known historic resources and the known archaeological sites that will be, or may be impacted by the Project. Some historic resources and archaeological sites may be avoided entirely with changes in the final engineering design such as the selection and location of borrow pits. Each of the resources and sites that will be impacted, will be the subject of archaeological site specific or historic resource specific data recovery plans to be prepared and reviewed by the Heritage Resources Unit. For example, some of the historic resources that will be impacted may have already been, or will be recommended for additional on-site recording, archival and/or informant interviews, to better document their past use history (see Appendix B.18A).

The Casino Heritage Resources Management Plan discusses site impacts in its Communication Protocol 1: Ground Disturbing Activities, and Communication Protocol 3: Planned Impact of Known Sites (Appendix B.18A). Data recovery plans for archaeological sites that will be impacted will focus on detailed hand excavation and archaeological analysis (dating or other testing where possible), and reporting to recover a representative sample of the site and its resources. This representative sample of excavation will range from only a small number of square meters for the smaller sites, up to nearly two hundred square meters of excavations for larger and more significant sites. These mitigation efforts will be conducted in advance of construction efforts and would be designed to retrieve the most information from those sites before they are impacted. The timing of the mitigation efforts will be coordinated with construction planning to be completed as construction moves forward. As construction work progresses some areas will be recommended for monitoring, and if chance finds or discoveries are made that warrant additional heritage assessment and mitigation efforts those sites and resources will be evaluated on a case by case basis. If required, supplemental data recovery or mitigation plans will be prepared, reviewed by the Heritage Resources Unit, and implemented prior to the continuation of construction. If sites are planned to be mitigated in close proximity to active construction then temporary fencing will be used to prevent impacts to the site.

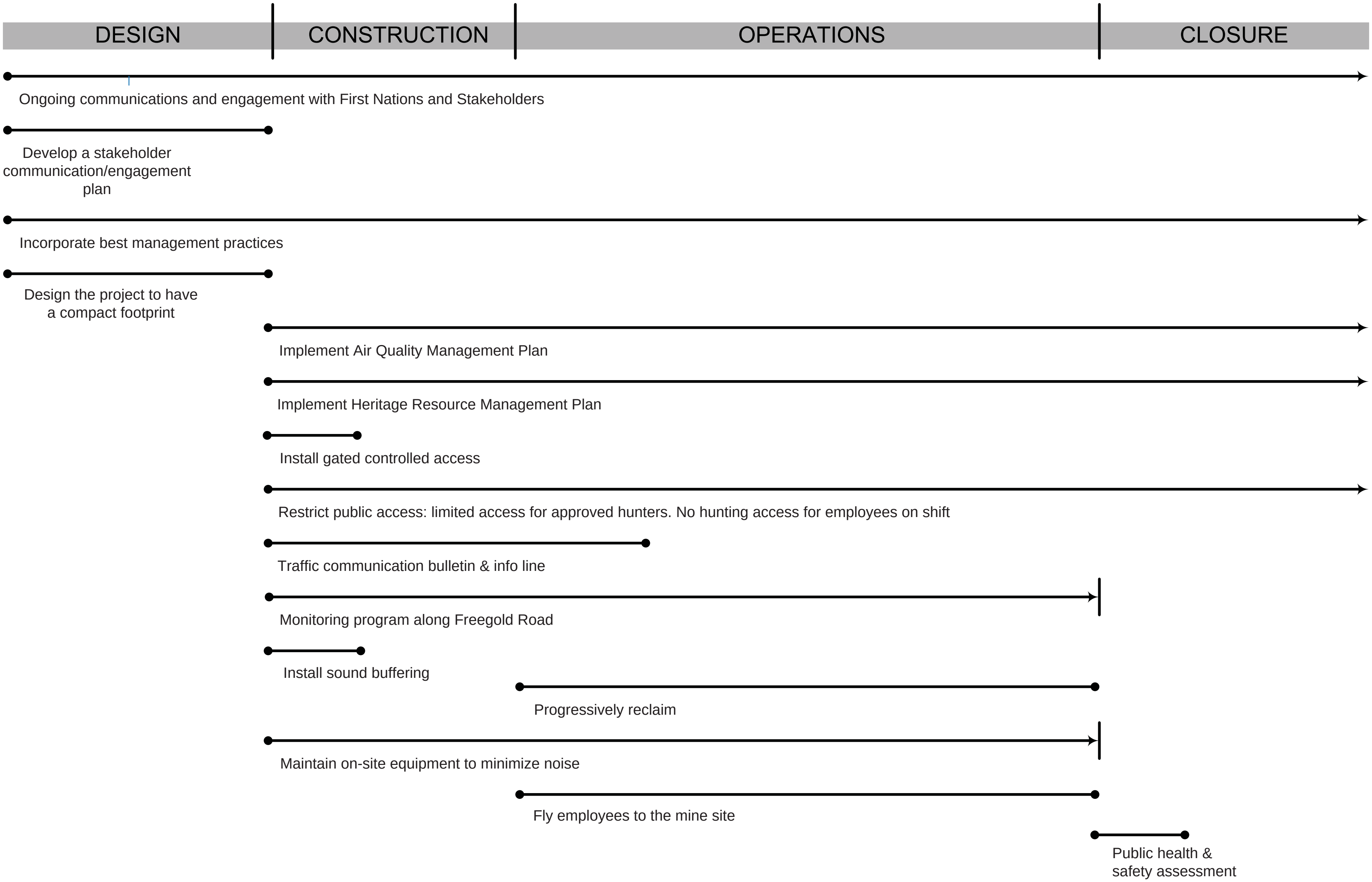
The Heritage Resources Management Plan defines “Heritage Sites” are those which contain historical and archaeological structures or artifacts, burial sites, sacred sites and archaeological and historic sites. Places of cultural value; subsistence and recreational harvesting; and traditional knowledge were incorporated as indicators for the Valued Component Cultural Continuity, detailed in Section 18 of the Project Proposal.

Mitigations included to minimize the effect on places of cultural value, subsistence and recreational harvesting and traditional knowledge were detailed in Section 18, and include the following, with the description on how mitigations regarding heritage resources will be implemented throughout the life of the Project provided in Figure B.18.3-1:

- Minimizing the effect on areas available for cultural activities or areas of potential archaeological or cultural significance by:
  - Designing the Project to have as compact a mine site footprint, to the extent practical;
  - Progressively reclaiming the Maximum Disturbance Area; and
  - Mitigating effects on archaeological sites through the Heritage Resource Management Plan.
- Implement a Road Use Plan to manage and limit access to the mine area and access road, to reduce the potential for hunting pressures on wildlife, wildlife-human conflicts, and protect existing wildlife-dependent land users through:
  - Restricting public access (access by permit, as directed and agreed by the Steering Committee);
  - Installing controlled, gated, manned access (located at the new bridge over Big Creek – or as otherwise agreed); and
  - Developing a stakeholder communication/engagement plan to ensure concerns are identified and addressed.
- Circulate a traffic communication bulletin/update and establish an information line to keep stakeholders informed of construction activities along the Access Road.
- Establish a monitoring program for local land users along the Freegold Road Upgrade.

- At closure, conduct a public health and safety assessment for the mine site to identify potential risks and develop appropriate, specific long-term mitigation and management measures (such as fencing and signage).
- Minimizing changes in local ambience, such as traffic, noise and emissions, and related wilderness experience 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.
- Allow limited road access to those approved for traditional use or other activities as may be allowed under the Road Use Plan and as regulated by the Territorial Government and First Nation Governments.

Figure B.18.3-1 Heritage Resource Mitigation Measure Implementation throughout Mine Life



B.18.3.3 R2-200

R2-200. A monitoring and evaluation mechanism.

Heritage sites include burial sites, sacred sites and archaeological and historic sites. Monitoring and evaluation for *heritage sites* that contain historical and archaeological structures or artifacts, includes checking known archaeological sites and historic resources to ensure site flagging is in place prior to construction. If flagging is not already in place, the historic site or resource will be flagged or fenced for avoidance. Some areas associated with known sites and resources will be recommended for avoidance and heritage monitoring. These monitoring efforts would ensure sites and resources that are not to be impacted, are properly flagged and signed so they are avoided. On-site monitoring during construction will be carried out to ensure sites to be avoided are indeed avoided. Other areas of heritage sites and resources that have been the subject of mitigation efforts may also be recommended for monitoring during construction to ensure chance finds are managed as per the chance finds procedure. The chance finds procedure has been presented in the Casino Heritage Resource Management Plan as Communications Protocol 2 (Appendix B.13B).

Heritage resources include harvestable resources; migration routes; waterways; salt licks; calving areas; traplines; medicines; raw materials; place names; camps, trails and caches and traditional knowledge. Monitoring and evaluation of Project effects and mitigation on *heritage resources*, will be conducted through the establishment of an ongoing joint process with affected First Nations and Yukon Government and through implementation of the Socioeconomic Management Plan (draft provided in Appendix A22F).

CMC will work with affected First Nations and Yukon Government to monitor the activities of the Project to avoid or minimize adverse socio-economic effects on community health and well-being, and to enhance benefits where applicable.

CMC, in collaboration with government departments and affected First Nations, will establish an effects monitoring program to monitor the socio-economic effects of the Project during construction, operations, and closure phases in order to accomplish the following objectives:

- Collect and document data related to socio-economic conditions of affected communities;
- Work with local agencies to monitor Project socio-economic effects;
- Confirm and verify the predicted socio-economic effects of the Project;
- Identify unforeseen socio-economic effects of the Project;
- Monitor employment and skills training programs by CMC and other institutions such as Yukon College and YMTA;
- Evaluate the effectiveness of mitigation measures in managing socio-economic effects; and
- Revise existing, and where appropriate, develop new mitigation measures to manage unforeseen socio-economic effects.

This monitoring program will lay out the commitment and framework for monitoring the effects described in the Project Proposal. CMC will generate annual reports to summarize the monitoring program results and will include data on the socio-economic predicted effects in order to track the changes from pre-Project conditions through operations.

Monitoring and mitigation of socio-economic effects will also inform development of adaptive management plans in consultation with local and regional institutions and government agencies to determine effectiveness of adaptive and mitigation measures.

B.18.4 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE

B.18.4.1 R2-201

R2-201. A comprehensive TLU study including traditional knowledge. The information provided shall cover traditional land use activities identified by First Nations.

CMC has provided the YESAB with considerable Traditional Land Use and Traditional Knowledge that describes the traditional land use activities identified by First Nations in proximity to the Project. The effects assessment on traditional land use activities such as hunting, trapping and fishing, was provided in Section 18 of the Project Proposal, which generally overlapped with the assessment of effects on First Nation Settlement Lands in Section 19 of the Project Proposal. The conclusions made in those sections remain relevant. A Socio-Economic Baseline Report (Appendix 13A) and Land Use and Tenure Baseline Report (Appendix 19A) were submitted as part of the Project Proposal. Both detail traditional knowledge and traditional land use in the Project Area and are derived from publicly available baseline data describing land use activities that occur near the Project. In addition, this information was supplemented with information received from affected First Nations during discussions that took place over a number of years.

Multiple discussions with the affected First Nations in advance of Project Proposal submission (SFN, 2012, pers. comm.) indicated insufficient interest or human capacity for conducting a Traditional Knowledge and Traditional Land Use (TKTLU) study for the Project. Rather, some of those discussions indicated that a TKTLU study may be considered after the Project Proposal submission to YESAB and an opportunity to assess potential effects (LSCFN, 2013, pers. comm.). Details of CMCs communication regarding conducting a TKTLU study with the affected First Nations are provided by First Nation in Section B.18.4.1.1, as are summaries of issued raised throughout that consultation. Of the offers made by CMC to FNs to fund FN conducted TKLU studies, none have yet been accepted. CMC has understood that First Nations hold considerable TKTLU information that they consider to be proprietary. CMC further understands that First Nations intended to use this information to inform their own review of the Project.

Traditional land use in the Project area has been relatively well known. Substantial information was generated during the negotiation of comprehensive land claim agreements in Yukon that were settled in the mid 1990’s with SFN, LSCFN and TH. In the absence of a formal Project-specific TKTLU study, CMC used this information to inform the design of the Casino Project. More recently, WRFN has made available TKTLU information in support of their asserted claim over the northern boundary of their traditional territory. In addition, key aspects of Project design (e.g., road route, waste management and deposition, and water use) were further informed by information obtained through multiple consultations with affected First Nations. A summary of traditional land use in the Project area, and the resulting Project design decisions and/or changes made on the basis of this knowledge, is provided below. The information contained in this section B.18.3 is from publically available documentation and not subject to confidentiality provisions.

CMC suggests that the information provided below forms a strong base of TKTLU information and is sufficient to enable the Executive Committee to initiate and complete the assessment process. Should further studies be conducted by the affected First Nations, CMC and YESAB will have the opportunity to include that information in the assessment, or incorporate its findings as part of the licensing processes or part of established adaptive management processes during the course of Project operation.

B.18.4.1.1 Consultation with First Nations with respect to TKTLU Studies

Consultation with First Nations with identified land use in the Project area was conducted during the years of data collection and impact assessment leading up to submission of the Project Proposal (2008 – 2013). Information on that consultation is summarized in Section 2 and Section A.2 of the Proposal and SIR, respectively. During the course of those consultations, CMC canvassed the need for collection and use of traditional land use with First Nations and their respective Renewable Resource Councils, and discussions continued during the YESAB process in 2014 and 2015. Information specific to Selkirk First Nation (SFN), Little Salmon/Carmacks First Nation (LSCFN), Tr'ondëk Hwëch'in First Nation (THFN), White River First Nation (WRFN), Champagne and Aishihik First Nations and Kluane First Nation are summarized below. The TKTLU summarized in the Socio-Economic Baseline Report (Appendix 13A) and the Land Use and Tenure Baseline Report (Appendix 19A) reflect input and the views of the affected First Nations.

The importance of protecting locations of traditional harvest of wildlife is a consistent theme through many of the discussions. Discussions to develop a TLU Study that would identify these sites and be led by LSCFN and SFN are ongoing. CMC has also assisted WRFN in applying for funding to conduct a WRFN specific TLU study. Since submission of the Project Proposal, CMC has incorporated publically available secondary source information and had in-depth consultation with LSCFN and SFN regarding important sites along the proposed access road route. This information was considered in relation to the Project but the Project Proposal was not changed because this new information was covered by the approach taken in the Project Proposal: the Project Proposal had already considered and taken into account potential adverse effects on existing natural resources (including wildlife) that are potentially used for traditional purposes by First Nations, as well as proposed corresponding mitigations.

Selkirk First Nation

CMC has extended numerous invitations to SFN to conduct and/or support a TKTLU study. Those discussions took place both prior to completion of the Project Proposal and after its submission to YESAB. Consultation related to TKTLU with SFN in advance of the Project Proposal submission (from 2008 – 2013) is summarized in Table B.18.4-1 and is based on the consultation log provided in Appendix 2A. A second table sets out meetings subsequent to submission of the Project Proposal in January 2014, between SFN and CMC during which TKTLU was discussed. Table B.18.4-1 summarizes the commitments made by CMC to address SFNs concerns which included:

- Potential Project effects on the Yukon River and local communities, and consideration of traditional knowledge.
- Road route effects, including access points for the project, increased traffic and spur roads, increased dust and noise from trucks, effects of increased numbers of large trucks on tourism in the area and increased safety risks with trucks driving through local communities.
- Effects on ability to practice traditional activities and effects on traditional activities, including traditional harvesting.

Early discussions with Selkirk led to the identification of a significant body of analysis, including Traditional Knowledge that was created in response to the original proposal for road access to Casino in the 1980's. This material (i.e., Pease and Weinstein, 1988) was made available to CMC, and used extensively to inform the design, route selection and proposed mitigation for the Freegold Road Upgrade. A literature search (Appendix

A.2A) was also conducted which provided further information, including TK, that was considered in the Project design.

Prior to submission of the Project Proposal, CMC shared the draft Socio-economic Baseline Report with the Selkirk First Nation and received and responded to their feedback. SFN commented that they would like to see 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 (Table B.18.4-1).

Subsequent consultation conducted since the submission of the Project Proposal is provided in Table B.18.4-2. Topics discussed included outlining the requirements for a TLU and commissioning a TLU study (TLUS) in 2015. A community meeting was held on April 30, 2015 and socio-economic and traditional land use was discussed. Most recently, CMC has met with the Selkirk First Nation to seek clarity with respect to their views on this matter, and to reiterate CMC's invitation and support of conducting a TLU study. SFN expressed its desire to conduct its own TKTLU study. CMC will follow SFN's guidance on when and how they wish to complete this work. CMC will support a comprehensive TLU study being conducted once the necessary guidance documents are in place, and to consider and integrate this information into the Project, as well as into the establishment of the socio-economic monitoring program.

Table B.18.4-1 Pre-Submission Summary of Consultation with Selkirk First Nation Regarding TKTLU Studies

Event	Date	Discussions related to TKTLU Studies
Meeting	May 3, 2008	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).
Open House	October 20, 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.
Meeting	June 10, 2009	TK: SFN would prefer to have TK integrated into the EA rather than be a separate report. Elders need to be involved. Field Assistant: SFN prefers to have a Lands and Resources staff member assist rather than a summer student to allow for better retention of learnings and improved opportunities for sharing TK.
Meeting	October 14, 2009	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.

Event	Date	Discussions related to TKTLU Studies
		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).
Meeting	November 4, 2009	Presented the findings of the July and September 2009 heritage and archaeology field program. SFN asked that field crews be accompanied by Elders and youth. SFN also noted that one-on-one or small group discussions with Elders would be a welcome approach to gathering TK information.
Meeting	January 7, 2010	Presentations were made to outline the baseline programs and proposed approach: Freegold Road extension, TK program, heritage and archaeology program, socio-economic program, cumulative effects assessment. Recommendations were made and approaches to be taken for each of the programs were determined.
Meeting	March 16, 2010	CMC 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. 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.
Meeting	April 13, 2010	Reviewed the archeological work completed and sites documented in 2009, and presented the 2010 fieldwork program. Altamira intends to have students and Elders involved in the fieldwork. Discussed potential mitigation options for sites that would be affected by the project. A number of potential heritage sites were noted during the meeting, and will be followed up by Altamira. SFN was concerned that WCG can proceed with activities that may damage heritage sites without assessing the sites for impact first. Also concerned about WCG's commitment to any SFN recommendations for protection and mitigation.
Meeting	April 29, 2010	Traplines: SFN is concerned about effects of traplines near the Yukon River. Also noted that the Freegold Road Extension access route may affect nearby traplines; this should be properly documented and mitigated where appropriate.
Meeting	May 3, 2010	Access and Roads: SFN raised concerns about spur roads and the amount of traffic anticipated for these roads. Suggested an alternate access route through White River. Information Sharing: SFN is looking at establishing a body of knowledge that can be shared by all companies contacting the First Nation for similar information. Also discussed the Freegold Road Users Group.
Letter	October 24, 2011	CMC provided an update on the status of the environmental and socio-economic work. CMC is anticipating submitting the Project Proposal to YESAB in early 2011. Noted that WCG will be establishing technical working groups on the project and would like SFN to participate. Also noted that they would like to incorporate TK into the proposal in a manner acceptable to SFN.
Meeting	October 15, 2012	Concerns: (a) project consultation should wait until Capstone’s consultation is complete; (b) Freegold Road Extension and its potential to open up access to other users; (c) potential negative effects on the Klaza herd and mitigation design; (d) potential effects on traditional practices.

Event	Date	Discussions related to TKTLU Studies
Meeting	February 20, 2013	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.
Meeting	July 9, 2013	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.

Table B.18.4-2 2014 – 2015 Summary of Consultation with Selkirk First Nation Regarding TKTLU Studies

Event	Date	Discussions related to TKTLU Studies
Meeting	June 25, 2014	Discussed results of socio-economic adequacy review filed with YESAB; SFN stated the importance of completing a TLUS and both will speak with SFN Chief and Council for further direction and to draft a Terms of Reference for CMC
Meeting	August 8, 2014	Ecofor and SFN to prepare a workplan to outline the scope of work needed for a TLUS.
Phone call	August 25, 2014	Meeting via phone with SFN regarding socio-economic information
Email	October 15, 2014	Email from CMC to SFN to propose time to discuss some unresolved items like the socio-economic work (TLUS)
Memo	February 24, 2015	Memo from Hemmera to discuss approach, timing and deliverables to produce a SFN supplementary report to address their review comments on the socio-economic components of the Project Proposal. Timing to review data gathering approaches for TLU set for March/April 2015 and for study implementation from May-August 2015.
Letter	February 27, 2015	Letter from CMC to SFN regarding requests from YESAB review that are relevant to the co-operative bilateral work between CMC and SFN. In particular, in previous discussions SFN and CMC had agreed that a TLU or TK study was not a priority for SFN at that time. CMC also noted that they wish to support/assist SFN with a TK/TLU study if they wish to do one and that the period during which the SIR is under review by YESAB (upcoming field season) would be ideal to complete a TLUS. CMC added that WRFN has indicated interest in a TLUS as well and perhaps the two First Nations could collaborate.
Meeting	April 30, 2015	Community meeting - socio-economics and TLUS discussed
Meeting	August 26, 2015	Tailings Management Facility Workshop: SFN technical consultant attended and raised concerns about the legacy impacts of the tailings management facility on the SFN traditional territory.
Meeting	October 1, 2015	Wildlife Working Group Meeting: SFN technical consultant attended and raised concerns about long-term effects of the road on wildlife and access.
Meeting	November 15, 2015	Meeting with SFN. TLUS discussed. SFN reiterated their desire that TLUS be done internally and be kept confidential within SFN.

Little Salmon/Carmacks First Nation

Consultation with Little Salmon/Carmacks First Nation (LSCFN) in advance of Project Proposal submission was conducted throughout 2008 – 2013, and consultation related to TKTLU with LSCFN is summarized in Table B.18.4-3, with the complete consultation record provided in Appendix 2A. Following submission of the Project Proposal to YESAB in January 2014, and based on discussions between CMC and LSCFN, CMC made a request to the Executive Committee of YESAB on May 23, 2014, to place the YESAB review of the Project Proposal on hold for all parties for a period of up to 180 days. The purpose of this request was to enable CMC to engage in additional consultation with LSCFN and other First Nations. A consultation workplan between CMC and LSCFN was developed that included a total of seven technical meetings (including a kick-off meeting) and six community meetings to be held throughout June to November, 2014. Key topics for discussion were the road access and management, wildlife mitigation and monitoring plan, and socio-economic impact assessment. The purpose of the consultation in 2014 was to enable LSCFN to gather enough information to make an early assessment of the potential positive and negative effects of the Project, including impacts on traditional pursuits and the cultural and heritage resources of the LSCFN and the measures to avoid, minimize or manage those impacts. Consultation activities conducted throughout 2014 – 2015 that related to TKTLU consisted of a field trip with LSCFN members along the Freegold Road and Freegold Road Extension, and technical and community based meetings on topics specific to wildlife, cultural and socio-economic impacts, a summary of which is provided in Table B.18.4-4.

Information collected by CMC related to traditional land use included:

- Identification by LSCFN of important areas (such as recreation sites, and heritage sites) and access points to traditional trails and areas of existing use that would need to be maintained through the road re-alignment. [During the June 18, 2014 Access Road field trip].
- Identification by LSCFN members of the importance of caribou and moose to their traditional harvest. [During the July 23, 2014 wildlife community meeting].
- Identification by meeting participants of some of the assumptions made around the demographic profile of fly-in/fly-out workers that needed clarification and making a request for further data review. It was noted that none of the scenarios fully incorporated the traditional economy and the associated impacts to that vital part of LSCFN lifestyle. [During the October 22, 2014 socio-economic community meeting].
- Identification by LSCFN of the need for a TLU report, but for one that LSCFN was "in control" of preparing and would be made available to CMC with provisions for confidentiality. LSCFN and CMC discussed that a joint TLU between LSCFN and SFN be conducted, and the resulting data be shared on a "one-time" basis with CMC. [During the June 2014 Socio-Economic technical meeting].
- Identification of concerns regarding effects on traditional harvesting due to traffic and access control, at the same time as recognizing that road improvements and increased incomes may allow for greater ability to partake in traditional activities. [During the September and October 2014 community meetings].

By way of a letter to CMC dated October 17, 2014, LSCFN identified that there was still a concern about the lack of community level socio-economic data and a need to document LSCFN traditional land uses that could be affected by the Project. Specifically, the letter stated that the current state of information in regard to LSCFN traditional land use in the Casino Project Proposal is a

> "significant weakness. The footprint of the mine site and the road to access the site alone will have a significant effect on the use of preferred harvest areas, heritage sites and the distribution of LSCFN land use over the life of the project and beyond. This use requires improved documentation for the effects of the project to be better understood."

In response to this request, and in recognition that the TKTLU related impacts on LSCFN would arise primarily in relation to upgrades to the Freegold Road and Freegold Road Extension, CMC suggested to LSCFN, in writing and at meetings, that the early implementation of a Road Use Working Group, as proposed in the Project Proposal, may be the best mechanism to address the complex issue of access for First Nation members and others that have an existing right of access. CMC stated its preference for a mechanism that controls public access but does not limit the right of access by existing users or those exercising aboriginal rights. CMC suggested that these topics would be best explored through community-based discussions like those proposed for the Road Use Working Group.

While consultation with LSCFN continued in 2015 (discussions were mainly in the form of CMC support for a Greenhouse Garden proposal, a Wellness Research study, and meetings with the Executive Director), plans for a formal TKTLU study have not progressed.

Table B.18.4-3 Pre-Submission Summary of Consultation with Little Salmon/Carmacks First Nation Regarding TKTLU Studies

Event Type	Date	Discussions related to TKTLU Studies
Letter	July 9, 2009	CMC advised Little Salmon-Carmacks First Nation of the heritage and archaeology study plans and invited them to contact Vector with any questions or concerns.
Letter	March 8, 2012	CMC provided a copy of the Historic Resource Impact Assessment of the Proposed Freegold Road Extension report to Little Salmon-Carmacks First Nation.
Meeting	June 5, 2012	CMC provided overview of project and the proposed access options. Little Salmon-Carmacks First Nation raised concerns regarding road development, access control, traffic management, and effects on traditional use of the area including subsistence harvesting.
Meeting	December 3, 2012	Meeting with Chief & Council to discuss the Project.
Meeting	February 12, 2013	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).

Table B.18.4-4 2014-2015 Summary of Consultation with Little Salmon/Carmacks First Nation Regarding TKTLU Studies

Event Type (Activity)	Date	Discussions related to TKTLU Studies
Meeting	June 17, 2014	Technical meeting and field trip; TLU discussed
Meeting	June 19, 2014	Fisheries Technical Session; TLU discussed
Meeting	June 24, 2014	Socio-economic Technical Session. LSCFN could consider working with SFN to complete a TLU; requires a cooperation agreement between the First Nations. Important to LSCFN that FN is “in control” of prepping a TLU. LSCFN to submit a work plan and budget for a TLU to CMC by July 2014
Meeting	July 29, 2014	Community meeting; TLU discussed
Letter	September 1, 2014	Letter from LSCFN to CMC asking about progress of addressing data gaps in socio-economic study (TLU)
Letter	October 11, 2014	CMC proposed Freegold Road Working Group to discuss road plan with TK holders and wildlife experts
Letter	October 17, 2014	LSCFN to CMC regarding TLU
Meeting	November 19, 2014	Community Meeting
Letter	March 16, 2015	Letter from CMC to LSCFN stating that CMC has submitted the SIR to YESAB, but that many issues LSCFN still considers outstanding (TLUS) can be worked on during the YESAB review phase.
Letter	May 29, 2015	Letter from CMC to LSCFN requesting community meeting and further discussions with LSCFN consulting team.
Email	June 7, 2015	Email from LSCFN to CMC to say that the schedule is full for LSCFN for the foreseeable future and they will be in touch ASAP.
Email	July 22, 2015	Email from LSCFN to CMC to say that they are unable to attend the Tailings Workshop on August 26, 2015.
Meeting	August 26, 2015	Tailings Management Facility Workshop: LSCFN technical consultant attended and raised concerns about closure and impacts to wildlife from the TMF.
Meeting	October 1, 2015	Wildlife Working Group Meeting: SCFN staff attended and raised concerns about access along the Freegold Road and impacts to traditional hunting areas.

Tr'ondëk Hwëch'in First Nation

CMC introduced the Casino Project to Tr'ondëk Hwëch'in First Nation (TH) in May 2009. Subsequently, CMC met with members of TH in May 2010, February 2012, and in April, May and September 2013, including the community Open House in September 2013 (see details in Section 2.3.5 of the Proposal). Following Proposal submission, TH expressed to YESAB that CMC had not met their consultation obligation; in particular they expressed concerns about salmon habitat, water quality and fortymile caribou as well as suitable material for heap leach pad construction.

In 2014 and 2015 CMC has continued consultation with TH, which has resulted in multiple technical meetings, mainly with regards to fisheries, water quality and caribou. In those discussions, the topic of traditional land use was discussed at the April 16-17, 2015 meeting. TH has stated that the Project should not affect the traditional pursuits of the First Nation. CMC and TH entered into a co-operation agreement for Project Assessment in July 2015.

White River First Nation

WRFN provided CMC with a report asserting the northern boundary of the White River First Nation's Traditional Territory, entitled "WRFN: Consideration of the Northern Boundary" (Easton et al., 2013). WRFN also provided YESAB with a report entitled "Compilation of Information Relating to Coffee Creek/White River Areas, January, 2014" (Dobrowolsky, 2014) in its response to the resumption of the adequacy review process in November, 2014 (YOR-2014-0002-268-1).CMC has considered these reports and incorporated them into the summary of traditional land use provided below in section B.18.3.1.2. The 2014 Dobrowolsky report itself is a compilation of the Coffee Creek Traditional Knowledge Summary (Winton, 2012) prepared for Tr'ondëk Hwëch'in, and the Easton et al. report.

In developing the Project Proposal, CMC used the Government of Yukon Traditional Territories of Yukon First Nations (Yukon Environment, 2012) and Umbrella Final Agreement to identify the boundaries of the White River First Nation Traditional Territories. White River has subsequently stated that their asserted traditional territory encompasses the Project area (YOR-2014-0002-279-1 and YOR-2014-0002-398-1), as defined in the Easton et al. report. This asserted traditional territory is represented in the summary of traditional land use provided below – specifically in Figure B.18.3-3.

WRFN have requested a TKTLU study specific to WRFN (YOR-2014-0002-398-1). As such, in 2015 CMC met with WRFN to discuss opportunities for funding of a WRFN TLU study through Canadian Northern Economic Development Agency (CanNor). CMC assisted WRFN in preparing a funding application to CanNor to progress its Traditional Land Use Study development. CMC will continue to support and assist WRFN in gathering TK and TLU information for consideration and incorporation into the Project Proposal. Further, if WRFN is able to secure funding for a TLU study, CMC will consider and integrate this information into the Project as well as into the establishment of the socio-economic monitoring program.

Champagne and Aishihik First Nations Consultation

In September 2013, CMC contacted the Champagne and Aishihik First Nations by letter and followed up with a meeting at which CMC 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. Interest was expressed in participating in economic opportunities if possible.

Kluane First Nation

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 representatives in Beaver Creek. Representation included a KFN Counsellor, the KFN Executive Director and staff of the KFN. 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 from Burwash Landing as was earlier proposed. It was apparent at the meeting that KFN's primary interest was to clarify that the proposed access route had changed and was no longer proposed to cross KFN Traditional Territory. They requested this clarification in writing.

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. No further consultation has been conducted with Kluane First Nation.

B.18.4.1.2 Traditional Land Use

CMC's Project Proposal has been informed extensively by TKTLU gained from a variety of sources during the course of baseline data collection, beginning in 2008. The major sources of information include:

- *Opening the Land: a Study of the Impacts of the Casino Trail on the Northern Tuchone of Pelly Crossing and Carmacks, Yukon Territory* (Pearse and Weinstein 1988);
- *The Agreement on the Casino Trail Project* (Yukon Government, 1988);
- *The Casino Trail Local Resource Group Workshop and Report* (Casino Trail Local Resource Group, 1989)
- *Community-Based Fish and Wildlife Work Plan Little Salmon Carmacks First Nation Traditional Territory 2012-2017* (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011);
- *WRFN: Consideration of the Northern Boundary* (Easton et al., 2013); and
- *Compilation of Information Relating to Coffee Creek/White River Areas* (Dobrowolsky, 2014).

This understanding, and examples of how this information was used is summarized in this section.

The LSCFN, SFN and Nacho Nyak Dun people are Northern Tutchone, part of the Athapaskan language group. The WRFN is a group of Northern Tutchone and Upper Tanana language groups closely related through traditional marriages, merged by the Canadian Government into a single White River Indian Band in the early 1950s (WRFN, ND). The WRFN were then further amalgamated with the Southern Tutchone speaking members of the Burwash Band; but were subsequently split into the Kluane First Nation, centered in Burwash and the White River First Nation, centered in Beaver Creek. The Tutchone of the Yukon Territory are a relatively small population whose ancestors were held together in the past by their contiguous territories, inter-marriage and closely related dialects (McClellan, 1981).

First Nations (FN) people in the area participate in a variety of traditional land uses, including hunting, trapping and fishing. The collection of plants for food and medicine is a traditional and current practice of FN peoples. The same basic hunting/gathering cycle was followed by all Tutchone FN from approximately May through October. Salmon and other freshwater fish were caught and dried for storage. Later in the summer hunting for whatever game was available in the upland areas was pursued and the meat dried and stored in caches scattered around the area (McClellan, 1981). As moose populations increased and caribou dwindled the Tutchone became increasingly more dependent on moose (McClellan, 1981). Many large and small animals as well as birds were caught by snares and bows and arrows.

Northern Tutchone peoples traditionally relied on the gathering and harvesting of plants as a source of food and medicine or for tools and goods. In the spring, birch bark and sap were used to construct canoes and baskets. In the summer, the Northern Tutchone gathered berries and other edible or medicinal plants (Gotthardt, 1987). This was also a time when stones, copper, birch bark and spruce roots were collected to make tools and utensils. During times of extreme hunger in winter, FN people sometimes collected dried roots, berries and mushrooms from squirrel and mouse caches.

The SFN people originally lived in Fort Selkirk where they used to go by the Hucha Hudan name. In the early days, the Selkirk people had a trading relationship with the Coastal Tlingit and would meet to trade during the summer fish camps on the site where Fort Selkirk was to be built by the Hudson's Bay Company (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. Fort Selkirk was closed in 1852 (Easton et al., 2013). Today, Fort Selkirk is an important heritage site and is co-managed by the SFN and the Government of Yukon. 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 (Yukon Community Profiles, 2004).

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.

Hunting, trapping, fishing, and gathering remain important traditional activities for members of SFN and are carried out in a cycle from approximately May through October. Caribou was once the principal species hunted for food, but as the caribou populations declined, moose became increasingly important and is now the major food source hunted (McClellan, 1981). Salmon and other freshwater fish are caught and either dried or frozen for consumption. Fish camps are often used in season by FN people. When the salmon are spawning in the Pelly River, for example, Pelly Crossing is nearly deserted, as people are out catching and drying fish for later use (Cardinal, 2009). Plants are gathered for food, medicine, or for use in constructing tools or goods, with summer being the season for most of this activity (Gotthardt, 1987), though spring has historically been important for birch bark and sap to be gathered for canoes and baskets.

LSCFN also carries out traditional activities based on the season with various parts of the year spent hunting, trapping, fishing, and gathering for food, medicines and goods throughout their territory. A wide variety of birds, waterfowl, large game, wolf, wolverine, fox, and marten are harvested for food, clothing, and other uses (Yukon Bureau of Statistics, 2013b). Plants gathered include Arctic raspberry, Labrador tea, cranberries, blackberries, stoneberries, and mushrooms (Nicholson, 2002).

The loss of the Northern Tutchone language and traditional practices were noted as concerns by community representatives. Tutchone elders have developed booklets on Northern Tutchone history and culture intended for schools and incorporation into the curricula (LSCFN, 2013, pers. comm.; Tantalus, 2013, pers. comm.).

Traditional activities play an important role in providing food, medicine, and materials and in supplementing income and the purchase of foodstuffs/materials from stores. There is an interrelationship between traditional (bush economy) and employment (cash economy), with the latter helping fund traditional activities. As more distant areas are more costly to access, they are not used as often and limited income is derived from them. Yet, more distant areas remain important and are harvested when game/fish/plant numbers are high and increased demands lead to these areas being accessed again. Gathering is more frequently practised than trapping, and the historical flexibility of where and when to trap is now limited by the requirements of registered traplines and specific areas to harvest (Pearse and Weinstein, 1988). Harvests of animals, fish, or plants are managed to ensure that populations are sustainable and activities are moved or rotated throughout the traditional territories based on availability and regeneration of the populations. Subsistence harvesting activities also represent an invaluable cultural and traditional experience for Aboriginal harvesters and a meaningful recreational pursuit (AECOM, 2009).

Important areas for traditional land uses including hunting, trapping, fishing, and the collection of plants is discussed below. Important traditional land use areas identified through publically available information sources, and through the 2014 consultation with LSCFN (for sites along the Freegold Road) are shown on Figure B.18.3-1.

Figure B.18.3-1 includes key areas identified for habitat protection to preserve habitat, encourage conservation and support FN harvesting practices (Environment Yukon, 2012 pers. comm.) in the Northern Tutchone planning region include the following:

- Devil's Elbow Habitat Protection Area;
- Horseshoe Slough Habitat Protection Area;
- Big Island Habitat Protection Area;
- The Ddhaw Ghro Habitat Protection Area;
- The Lhutsaw Wetland Habitat Protection Area; and
- Nordenskiold Habitat Protection Area.

These areas are designated as Habitat Protection Areas under Yukon's *Wildlife Act* (SFN, Government of Canada and Government of Yukon, 1997; and Government of Yukon, 2002), and are well outside the regional study area of the Project.

Places of Cultural Importance

Spiritual or aesthetic sites that were the focus of traditional use in the past have been identified in the vicinity of the Project along the Yukon River (AECOM, 2009). A number of historical and archaeological sites have been identified in the immediate vicinity of the Project, including Britannia Creek, Patton Gulch, and Patton Hill. All sites have been recorded with the Yukon archaeological and place name database. Additional details regarding historical and archaeological sites are provided in the Archaeology & Heritage Baseline (Appendix 18A). Areas assessed by CMC, and remaining to be assessed, are outlined in Figure B.18.4-1 and Figure B.18.4-2. During a trip along the Freegold Road in 2014 with members of LSCFN, various access points were identified by members of LSCFN as being important for access to culturally significant areas. These points were recorded by CMC, and are shown on Figure B.18.4-1 and Figure B.18.4-2. While site-specific GPS points are confidential, these points provide confirmation that there are access points to culturally sensitive areas along the Freegold Road, and as the Project progresses, the site-specific mitigations and accommodations will be detailed in consultation with LSCFN. These access points will be important to maintain during construction along the Freegold Road upgrade and extension.

Fort Selkirk, a historic townsite 70 km east of the Project, is a traditional gathering place for SFN members and is located at the confluence of the Pelly River and Yukon River. Fort Selkirk has been used by SFN members for at least 8,000 years and was the general location of the first Hudson's Bay trading post established in 1848 (later relocated in 1852). Attacked by Chilkat Tlingit warriors who looted the post in protest to perceived interference to their trade route with interior Athapaskan First Nations, the fort was rebuilt approximately 40 years later and became an important supply point along the Yukon River. It fell into disuse during the mid- 1950s after the Klondike Highway bypassed it and Yukon River traffic declined. Many of the buildings have been restored and the Fort Selkirk Historic Site is co-managed by SFN and the Government of Yukon (AECOM, 2009). Fort Selkirk serves as a place for spiritual and cultural renewal and provides evidence of some of the historical activities of the Selkirk people (Yukon Department of Tourism and Culture, 2013). Access to Fort Selkirk is via the Yukon River or the nearby Fort Selkirk Aerodome.

Coffee Creek, west of the Project, on the Yukon River, was also an important area for the Northern Tutchone people. Coffee Creek was a trading post and steamboat landing as a result of the gold rush and staking of placer mining claims in the early 1990s (Dobrowolsky, 2014). In the 1930s there were over 125 First Nation people at Coffee Creek, who visited regularly with the Fort Selkirk people (Dobrowolsky, 2014). Coffee Creek was largely abandoned once the sternwheeler traffic ended on the Yukon River in the 1950s (Dobrowolsky, 2014). In 1999, the last full-time resident of Coffee Creek passed away (Dobrowolsky, 2014).

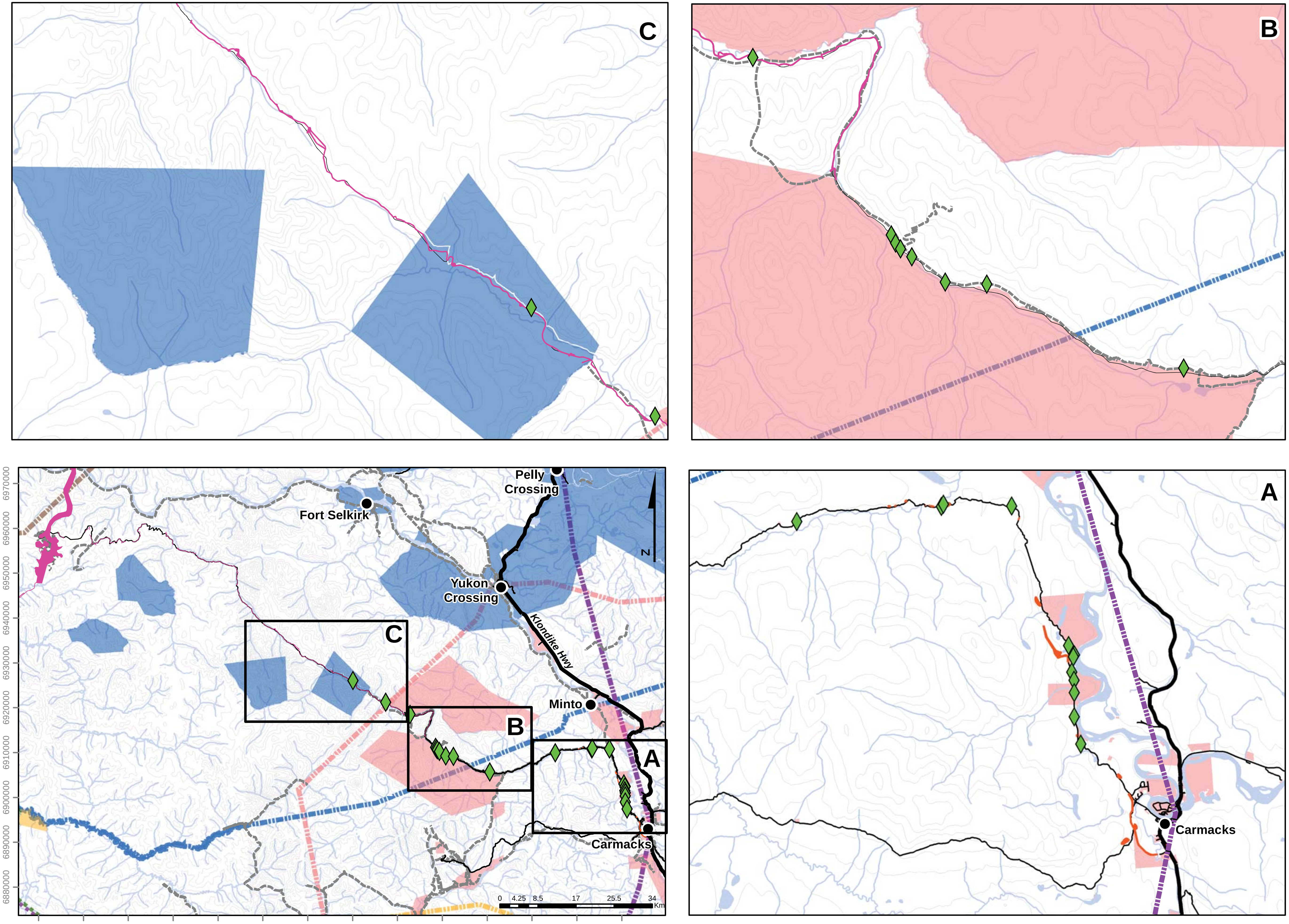
Tatlmain Lake (east of Minto and north of Carmacks) is an important place within the territories of Selkirk people, and has been for a very long time (SFN and Gotthardt, 1992).

The Yukon Government has also identified special management areas to "maintain important features of Yukon's natural or cultural environment for the benefit of Yukon residents and all Canadians, while respecting the rights of Yukon Indian people and Yukon First Nations" (SFN and Environment Yukon, 2013). The Habitat Protection Areas and Special Management areas are shown on Figure B.18.4-3.

CASINO

Figure B.18.4-1

Archaeologically Assessed Areas and Access Points to Areas of Cultural Significance to LSCFN



Access Points to Areas of Cultural Significance to LSCFN
Road
Klondike Highway
Trails
Contour
Watercourse
Waterbody
Proposed Polygon Facilities

Ecofor Assessed Areas

Assessed
To be assessed

First Nation Traditional Territories

Champagne and Aishihik First Nations
Kluane and White River First Nations
Little Salmon/Carmacks First Nation
Selkirk First Nation
Tr'ondëk Hwëch'in
WRFN Asserted Traditional Territory

First Nation Settlement Lands

Champagne and Aishihik First Nations
Kluane First Nation
Little Salmon/Carmacks First Nation
Selkirk First Nation
Tr'ondëk Hwëch'in

Date: 16/12/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

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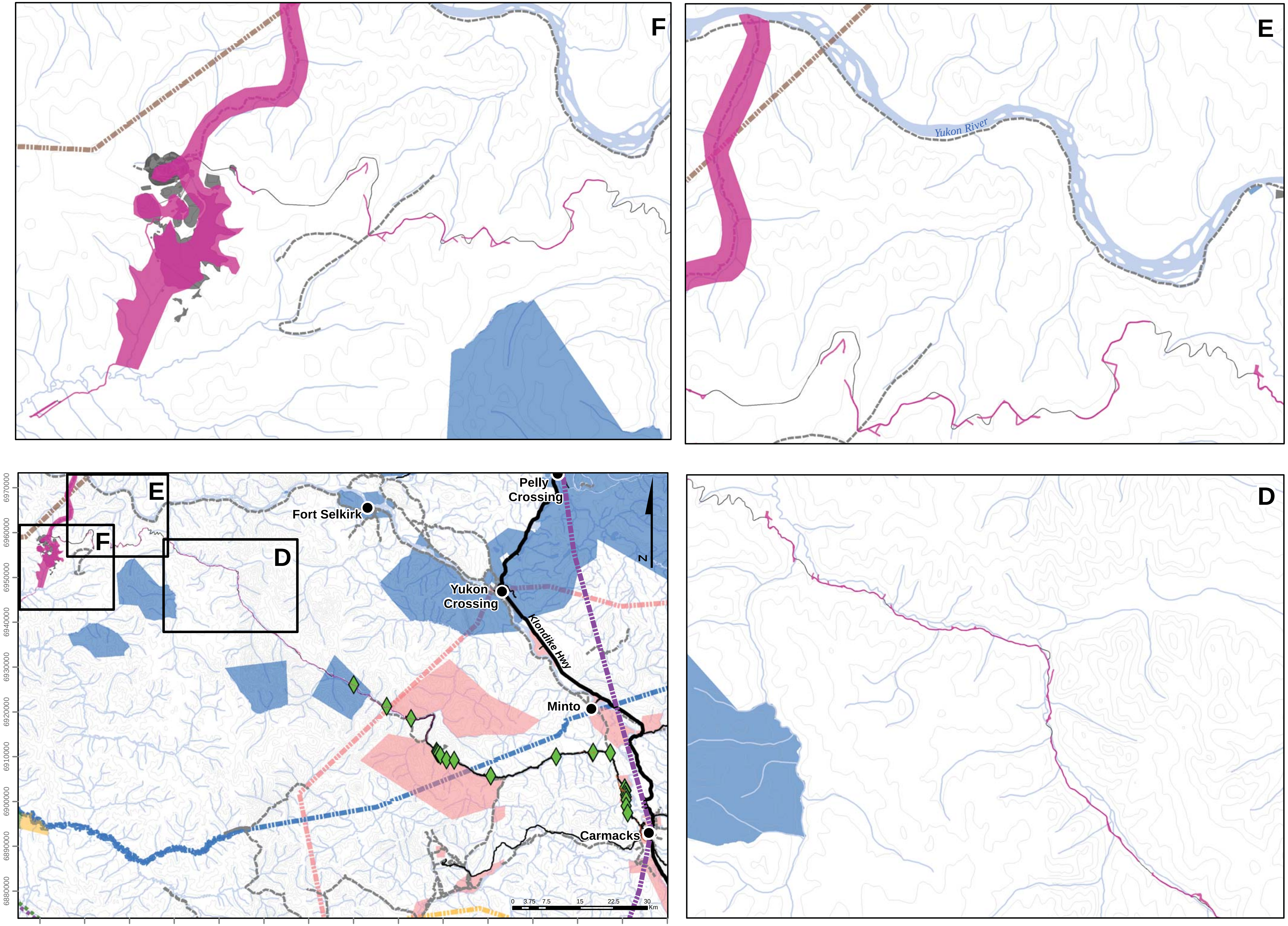

Figure B.18.4-2

Archaeologically Assessed Areas and Access Points to Areas of Cultural Significance to LSCFN

Date: 16/12/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983

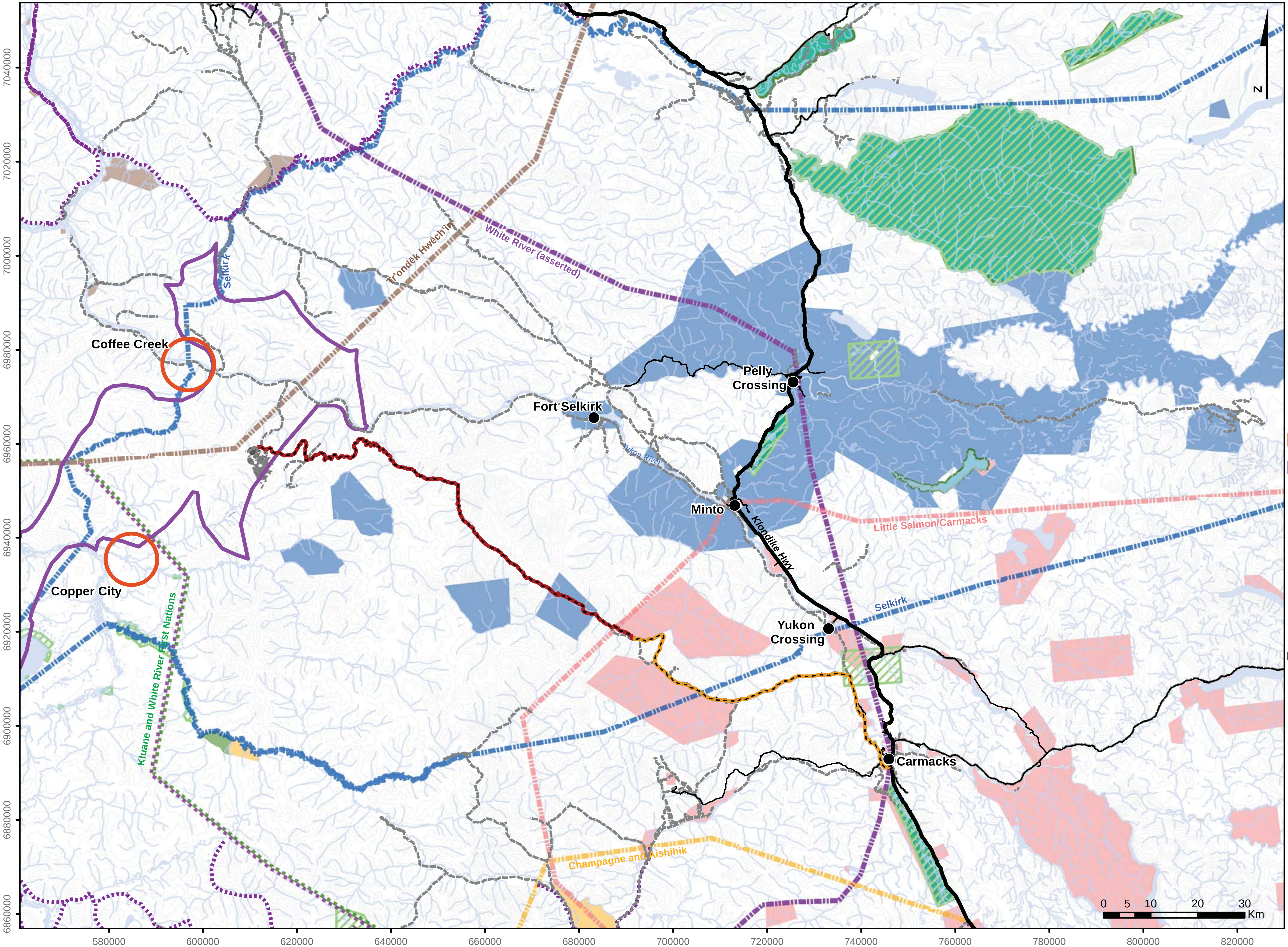

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Figure B.18-4.3

Traditional Land Use: Places of Cultural Importance

- Freegold Road Extension
- Freegold Road Upgrade
- Road
- Klondike Highway
- First Nation Heritage Routes
- Trails
- Contour
- Watercourse
- Waterbody
- Proposed Polygon Facilities
- OIC Territorial Lands
- Park and Protected Areas
- Traditional Land Use
- Location/area mentioned in Report "WRFN Traditional Territory: Consideration of the Northern Boundary"

First Nation Traditional Territories

- Champagne and Aishihik First Nations
- Kluane and White River First Nations
- Little Salmon/Carmacks First Nation
- Selkirk First Nation
- Tr'ondëk Hwëch'in
- WRFN Asserted Traditional Territory

First Nation Settlement Lands

- Champagne and Aishihik First Nations
- Kluane First Nation
- Little Salmon/Carmacks First Nation
- Selkirk First Nation
- Tr'ondëk Hwëch'in

Date: 16/12/2015
Author: hbrown
Coordinate System: NAD 1983 UTM Zone 7N
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Datum: North American 1983

Hunting

A 2011 SFN newsletter identified development of hunting, trapping and the traditional economy as a priority (SFN, 2011). SFN maintains strong links to hunting with many members obtaining a significant portion of their food supply through this means (Yukon Community Profiles, 2004). Similarly, a significant proportion of LSCFN residents hunt to meet their families' food needs. LSCFN families hunt one to two moose per year (LSCFN, 2013, pers. comm.). Other First Nations record the importance of year round hunting for moose and hare, and seasonal hunting of muskrat, beaver, caribou, bear and sheep (Easton et al., 2013). Harvested meat can have a high replacement cost value for northern and Aboriginal households.

Migrating fowl are hunted as they pass through the region and settle on lakes. Although trumpeter swans and goose eggs are protected from hunting, other birds remain staples within the subsistence diet, particularly the black duck (Easton et al., 2013).

In the early 1960s, the people of Little Salmon and Carmacks described their traditional hunting territory as extending almost to the Yukon and Pelly Rivers in the northwest, to the upper drainage of the Nisling, south almost to Hutshi and Lake Labarge, and east to include the lower Big Salmon River and all of Little Salmon Lake (Gotthardt, 1986). Records indicate Selkirk people travelling from Tatlmain Lake to Ptarmigan Mountain, east of the Project area, for hunting sheep, caribou, moose and gopher and setting up camp to dry meat (SFN and Gotthardt, 1992).

As a result of Final Agreements between Yukon First Nations and government, a total of eleven FN hold the title to approximately 32,000 km^2 of land. An estimated two thirds of this is classified as Category A lands (granting the title holder surface and subsurface ownership) and balance is Category B (the title holder is only entitled to surface rights) and fee simple lands (typically designated as special areas). Hunting on FN Lands requires consent from the FN that holds title to the land however exceptions include (Environment Yukon, 2013d):

- Hunting is permitted without consent on undeveloped Category B settlement lands; however, harvesting bison and elk is prohibited;
- Hunting water fowl is permitted on settlement lands where there is a waterfront right-of-way; and
- Gravel bars and shoreline below the high water mark are accessible when hunting by boat in proximity to First Nations lands.

Some First Nations harvest data can be inferred from an assessment of hunting efforts (Environment Yukon, 2003). Areas accessible by boat were most frequented, followed by hiking and driving access. Approximately 97% of moose hunters reported hunting for subsistence purposes, not trophies (Environment Yukon, 2003).

The areas around Apex and Prospector Mountains and the headwaters of Coffee and Casino Creeks are described as marten homeland. Other areas identified as important to hunting is on the highlands between upper Big Creek and Hayes Creek, which are particularly good marten habitat. Sheep are hunted in the area around Prospector Mountain and in winter in the lower reaches of Big Creek (Figure B.18.4-4). FNs have expressed concern that the road and attendant mining activity will impair the capacity of these special places to harbour sustainable populations of animals.

Wetlands are also important areas for hunting, fishing and medicinal plants. Wetlands are common hunting locations for waterfowl (ducks, geese, cranes) and other wildlife such as beaver, muskrat, moose and caribou and freshwater shrimp (Mease, 2008).

Of note is that the Game Management Subzones (GMS) that are accessed along the Freegold Road, and along the Casino Trail (522, 523, 524, 526) were closed due to hunting pressure in the 1980s, and remain closed. The GMS around the proposed mine site (509, 510, 511) remain open, but are relatively remote and have been subjected to relatively little hunting pressure (see the Wildlife Baseline Report – Appendix A.12B for more details).

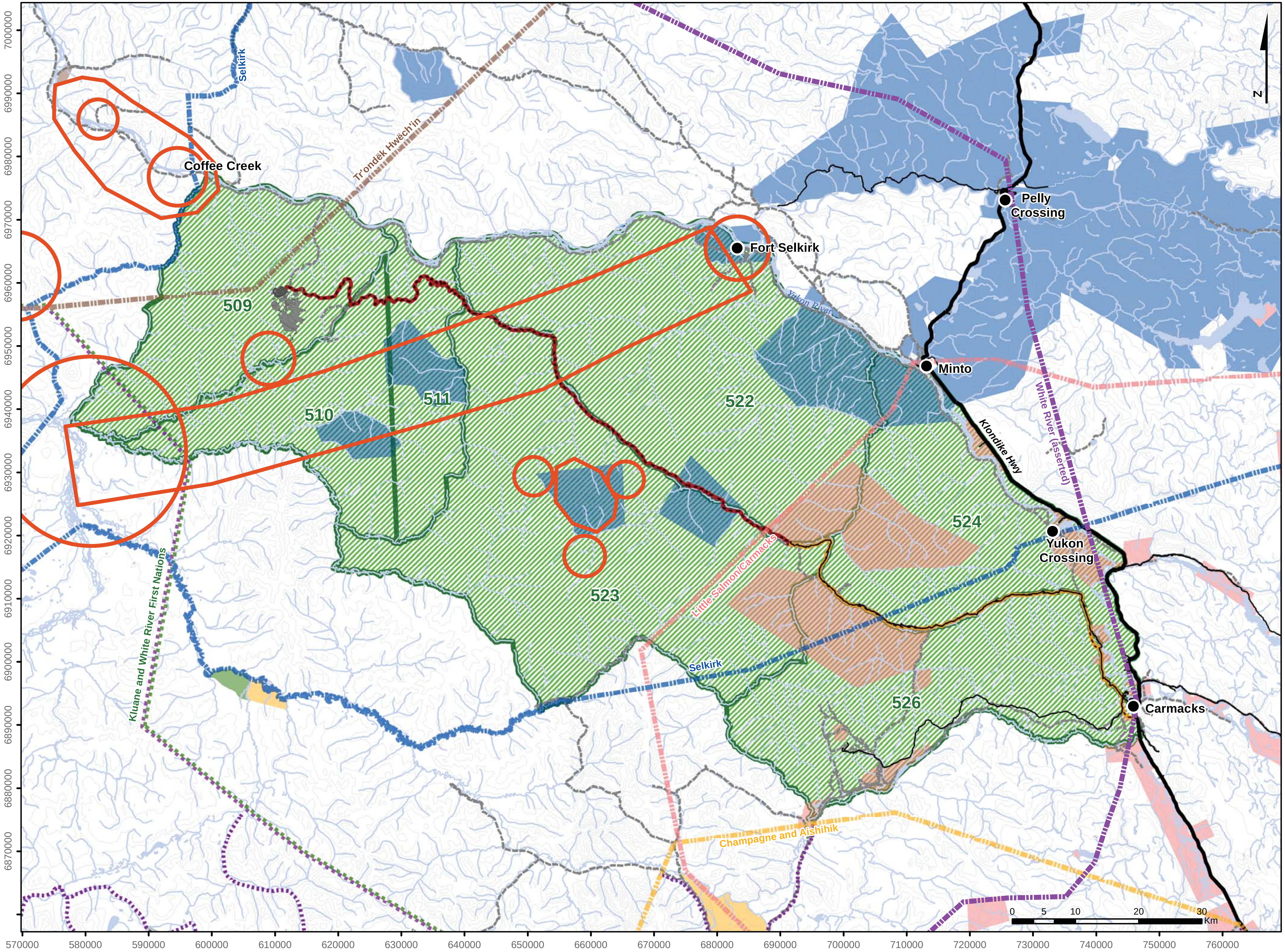

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Figure B.18.4-4

Hunting Game Management Subzones and Traditional Use Areas

- Freegold Road Extension
- Freegold Road Upgrade
- Road
- Klondike Highway
- First Nation Heritage Routes
- Trails
- Contour
- Watercourse
- Waterbody
- Proposed Polygon Facilities
- Game Management Subzone
- Traditional Use Area

First Nation Traditional Territories

- Champagne and Aishihik First Nations
- Kluane and White River First Nations
- Little Salmon/Carmacks First Nation
- Selkirk First Nation
- Tr'ondëk Hwëch'in
- WRFN Asserted Traditional Territory

First Nation Settlement Lands

- Champagne and Aishihik First Nations
- Kluane First Nation
- Little Salmon/Carmacks First Nation
- Selkirk First Nation
- Tr'ondëk Hwëch'in

Date: 16/12/2015
Author: hbrown
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Datum: North American 1983

Trapping

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). The Government of Yukon regulates trapping activities under the *Wildlife Act* (Government of Yukon, 2002). In the Yukon, 14 different species of furbearing mammals are trapped. They are:

- Beaver
- Coyote
- Wolf
- Marten
- Muskrat
- Fisher
- Coloured Fox
- Wolverine
- Mink
- Otter
- Arctic Fox
- Lynx
- Squirrel
- Weasel

A registered trapping concession is a parcel of land on which the holder is granted the rights to harvest fur-bearing animals. There are a total of 333 registered trapping concessions and 18 group areas (these are typically held by a family or FN) in the Yukon. There are approximately 400 trapping licenses in the Yukon the majority of which are held by registered trapping concession holders (the balance is held by assistant trappers). The trapping concession awards harvesting rights of the furbearing mammals to the holder for 5 years at a time (Environment Yukon, 2013a).

Trapper training is an important requirement for licensed trappers and concession holders (Environment Yukon, 2013b). Environment Yukon offers four-day-long (minimum 28 hours) trapper training workshops between October and March. The minimum age to participate is 12. It is estimated that less than a third of the available trapping concessions are active because the return on hides has decreased while the cost to maintain lines (increasing fuel costs) have increased (Hunting and Trapping Wolves in Yukon, 2011b).

Trapping was and still is a traditional activity for many FN in the Yukon, providing economic and sustenance benefits for both FN and non-FN residents. Trapping, which generally occurs in the winter months, is a way of life for many and a means of employment. An estimated 50% of trappers in the Yukon are FN (Environment Yukon, 2013a). Trapping was described as an activity that contributes to trappers' lives by allowing them to be present on the land and connected to the wilderness and wildlife that inhabit these areas (Registered Trapline Holders 2012, pers. comm.).

There are 11 registered trapping concessions that overlap or border the mine site or the Freegold Road Upgrade and/or Extension (Figure B.18.4-5). The owners of these traplines were contacted in 2012 and 2013 prior to Project Proposal submission and also in June 2015 (see Section B.2 for more details on communication with trapline concession holders). Traplines in the Project area are often remote, and two registered trapline holders indicated that access to the traplines can be time-consuming and costly (Registered Trapline Holders, 2012 pers. comm.). The trapping season generally occurs from January to March, although this may differ from trapline to trapline. Species most commonly targeted in the two traplines referred to above include wolf, wolverine, lynx and marten, while the species most commonly caught include marten and lynx (Registered Trapline Holders, 2012 pers. comm.). Another interview with a key informant revealed that Lynx, wolves, wolverines, squirrels and beaver are trapped in the area. Lynx is amongst the most valuable of the aforementioned species and is directly tied to the rabbit population, a food source for the Lynx (Registered Trapper, 2013 pers. comm.). A 2011 SFN Newsletter identified development of trapping infrastructure and the traditional economy as priorities (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).

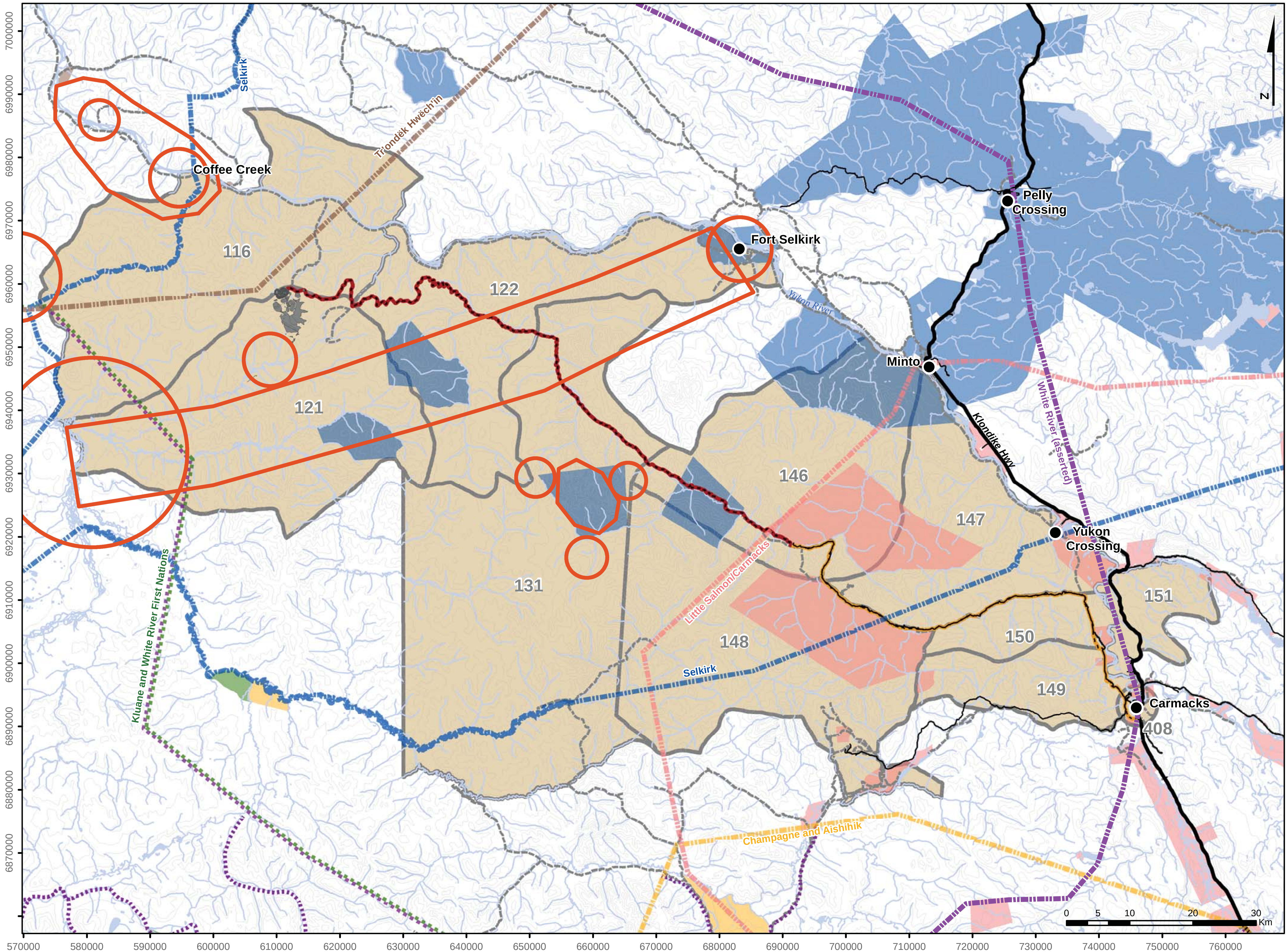

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Figure B.18.4-5

Trapping Concessions and Traditional Use Areas

Freegold Road Extension
Freegold Road Upgrade
Road
Klondike Highway
First Nation Heritage Routes
Trails
Contour
Watercourse
Waterbody
Proposed Polygon Facilities
Trapping Concessions
Traditional Use Area

First Nation Traditional Territories

Champagne and Aishihik First Nations
Kluane and White River First Nations
Little Salmon/Carmacks First Nation
Selkirk First Nation
Tr'ondëk Hwëch'in
WRFN Asserted Traditional Territory

First Nation Settlement Lands

Champagne and Aishihik First Nations
Kluane First Nation
Little Salmon/Carmacks First Nation
Selkirk First Nation
Tr'ondëk Hwëch'in

Date: 16/12/2015
Author: hbrown
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Projection: Transverse Mercator
Datum: North American 1983

Fishing

As with hunting, FN, residents and non-residents pursue the activity for a variety of different reasons ranging from subsistence to sport. Fish can make up 30-50% of the diet in any one year (Easton et al., 2013). The FN people would live in winter villages near lakes where they would use nets to capture fish under the ice (Morrell, 1991). This source of protein would augment their winter food cache of dried meat, berries and roots. Fishing is still considered an important component of traditional FN culture; many will spend a few weeks every fall fishing at their family's traditional fish camp. Chinook salmon, broad whitefish and lake whitefish are the most important species in the First Nation's fisheries in the Pelly drainage (Morrell, 1991). Chum salmon are taken by SFN members at Minto (Morrell, 1991). Fisheries for salmon and for resident species have been central to the First Nations' economies of the Pelly River system throughout history and continue to be important in the subsistence economies (Morrell, 1991). The salmon caught are frozen or dried and consumed over the winter. Today's FN are still known to use the nets placed under the surface of the ice to catch fish (SFN and Gotthardt, 1992).

The Yukon River, Tatchun River, and Ethel Lake are popular fishing destinations in the study area. The species found in these waterways include Arctic Grayling, Northern Pike, Burbot, Inconnu, and Chinook salmon (Fishing on Yukon Time: A guide to Fishing in Yukon (2011-2012), Easton et al., 2013). Big Creek was an important fishing site for residents of both Selkirk and Carmacks. Its outlet was a valuable place for grayling, whitefish, chum salmon, and king salmon. In the middle reaches, people fished for whitefish, grayling and kings; while in the upper reaches kings and grayling could still be caught. The creek has a fall run of grayling, and in low water years people could easily catch them in shallow pools (Pearse and Weinstein, 1988). East of the White River, the WRFN had salmon fisheries on the Yukon River at Coffee Creek (Figure B.18.4-6) and south of the Project area, on the Donjek, Klotossin, and Nisling Rivers (Easton et al., 2013).

At the head of Mica Creek, spawning whitefish were fished late in the fall (SFN and Gotthardt, 1992). The mouth of Mica Creek on the Pelly River was an important grayling and whitefish fishing site. In summertime, people went to Fort Selkirk or the Pelly River for salmon fishing; in early fall, they went to Minto for dog salmon by the trail along Legha Mān (SFN and Gotthardt, 1992).

The only stocked lake within the RSA is Gloria Lake II, the second lake on the left-hand side when travelling up the Freegold Road, about 14 km north of Carmacks (Environment Yukon, 2012). Anglers report good luck catching rainbows in the 1-2 kg (2-4 lbs) range. A gentle slope at the north end of the lake provides the easiest access route for launching a small boat, but a boat is not necessary. The shoreline is clear enough to walk around and to permit casting (Environment Yukon, 2012).

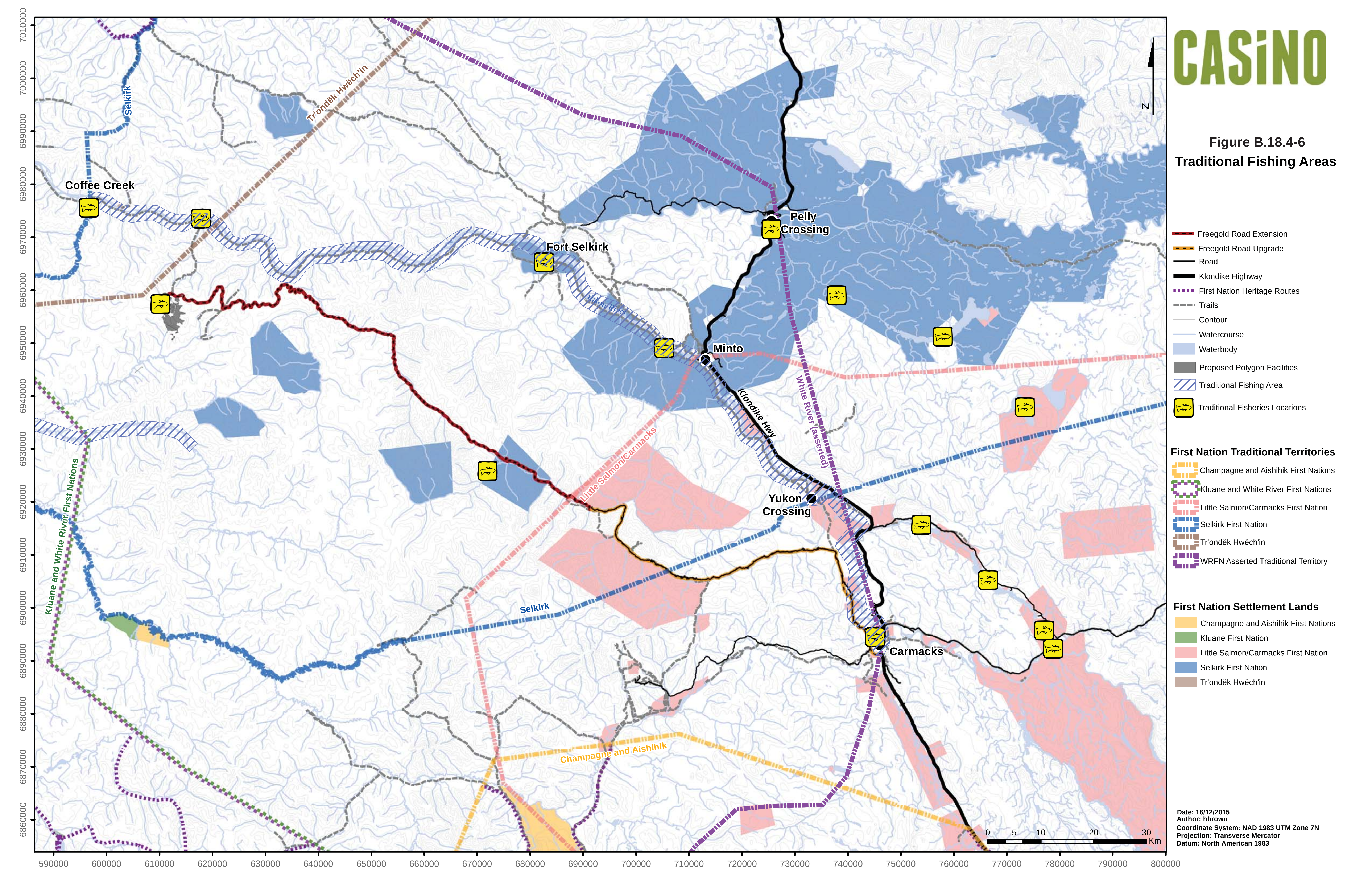

Figure B.18.4-6
Traditional Fishing Areas

Plant Collection

Plants are gathered for food, medicine, or for use in constructing tools or goods, with summer being the season for most of this activity. Receveur and Kuhnlein (1998) completed a territory-wide study of dietary benefits and risks associated with the consumption of traditional foods by Yukon First Nation people. They had the following observations: 1) traditional foods are consumed 57% of the year (80% in summer, and 40% in winter), 2) 58% of the households surveyed collect plants, 3) plant foods are consumed in summer and to a lesser extent, winter, 4) berries are consumed by the most number of people compared to other plants; in descending order of the top 10 species by summer use (blueberries, wild raspberries, low bush cranberries, wild strawberries, high bush cranberries, soapberries, crowberries, Labrador tea, mushrooms, balsam fir), 5) the younger generation (20-40) consumes more market food than older generations, including fewer berries, mushrooms, and wild rhubarb (Receveur and Kuhnlein, 1998).

LSCFN members collect Arctic Raspberry, Labrador Tea, cranberries, blackberries, stone berries and mushrooms in their traditional territory (Nicholson, 2002). In Yukon First Nation diets, typical edible plants include arctic dock (*Rumex arcticus*), fireweed *Epilobiumangustifolium*), wild onions/chives (*Allium schoenoprasum*), dandelion leaves (*Taraxacum officinale*), wild rhubarb (*Polygonum alaskanum*), bear root (*Hedysarumalpinum*), Labrador tea leaves (*Ledum* spp.), Bolete mushrooms (*Leccinum* spp.), puff balls (*Lycoperdon* spp.), morels (*Morchella* spp.), shaggy mane mushrooms (*Coprinuscomatus*), blueberry (*Vaccinium* spp.), crowberry (*Empetrum nigrum*), low bush cranberry (*V. vitis-idaea*), high bush cranberry (*Viburnum edule*), soapberry (*Shepherdiacanadensis*), strawberry (*Fragaria* spp.), cloudberry (*Rubus chamaemorus*), rosehips(*Rosa acicularis*), currants and gooseberry (*Ribes* spp.), and Saskatoon berry (*Amelanchier alnifolia*) (Nardelli and Wein, 1996; Receveur and Kuhnlein, 1998).

Wetlands are also important locations for medicinal plants such as: cranberries that are used for various reasons such as urinary infections; blueberries for inner healing; and the *chen ghŕo'* (puff-balls) that were used, among other things, as poultices for chest infections (Mease, 2008).

Trees species, including willow and spruce are important for a variety of traditional uses, including sewing and net making, medicine, gum, ointment, glue and heat. Birch wood was used for carving snowshoes, canoe frames, bows, sleds and the bark used to make containers, house lining, and sled and boat skins (Easton et al., 2013). Spring has historically been important for birch bark and sap to be gathered for canoes and baskets (Gotthardt, 1987).

Current access to plant collection sites tend to be limited to the area around the Freegold Road, as there is easy access to these areas either via truck or car, or into the bush via ATV or snowmobile.

The following plant species, discussed above, were observed during the rare plant surveys conducted in 2010 and 2012 (from Attachment C of the Vegetation Baseline Report – Appendix 11A):

- arctic dock (*Rumex arcticus*),
- fireweed (*Epilobium angustifolium*),
- dandelion leaves (*Taraxacum officinale*),
- wild rhubarb (*Polygonum alaskanum*),
- bear root (*Hedysarumalpinum*),
- Labrador tea leaves (*Ledum* spp.),
- soapberry (*Shepherdia canadensis*),
- strawberry (*Fragaria* spp.),
- cloudberry (*Rubus chamaemorus*),
- rosehips (*Rosa acicularis*),
- currants and gooseberry (*Ribes* spp.),
- wild raspberries (*Rubus idaeus*),

- blueberry (*Vaccinium* spp.),
- crowberry (*Empetrum nigrum*),
- low bush cranberry (V*accimium vitis-idaea*),
- high bush cranberry (*Viburnum edule*),
- willow (*Salix* spp.),
- spruce (*Picea* spp.), and
- birch (*Betula* spp.).

Ecosystems in which edible and medicinal traditional plants are found include the areas in the Local Study Area that are set out below. The LSA includes a 1 km buffer on either side of the 120 km length of the Freegold Road Extension, and the mine site, which includes Britannia Creek, Canadian Creek and Casino Creek watersheds, and upper Dip Creek. All proposed infrastructure associated with the mine, including the Yukon River pipeline and access road, and airstrip and access road is located within the LSA. See the Vegetation Baseline Report (Appendix 11A) for more details.

- *Subalpine bioclimate zone* — The subalpine bioclimate zone comprises ~36% of the LSA and is comprised predominately of subalpine moist shrub (e.g., dwarf birch (*Betula glandulosa*)), wet shrub (e.g., spruce-shrub on steep north facing slopes) and tall shrub vegetation communities. There is also a small component of mid to high elevation dry shrub communities that include mountain cranberry (*Vaccinium vitisidaea*), common bearberry (*Arctostaphylos uva-ursi*) and crowberry (*Empetrum nigrum*).
- *Boreal high bioclimate zone* - The boreal high bioclimate zone comprises ~47% of the LSA, of which 37% is comprised of moist broadleaf forest (Fbw), coniferous forest (Fc), sparse coniferous forest (Fcs) and mixedwood forest (Fm) that include tress species Alaska birch, and black and white spruce, and shrub species dwarf birch, Labrador tea, mountain cranberry, prickly rose, currant/gooseberry and willow.
- *Boreal low and boreal high bioclimate zone* – The boreal low and boreal high bioclimate zone comprises ~9% of the LSA. This zone includes shrub species such as prickly rose, grey alder, high bush cranberry and red osier dogwood, with Labrodor tea, mountain cranberry, and cloudberry common in the understory.

B.18.4.1.3 Incorporation of Traditional Knowledge and Traditional Land Use into the Project Proposal

During Project design, the consultations with First Nations about their traditional land use led to significant decisions about the proposed Project that was submitted to YESAB. These decisions were informed by the various meetings held with First Nations, the review of draft reports with First Nations and a review of publicly available information regarding traditional land use, as well as economic, environmental and technical considerations. The main Project changes made to reflect the importance of traditional land use include:

- Methods of Transportation – to avoid impacts to the culturally important Yukon River, CMC discounted transportation options that included barging along or crossing of the Yukon River (see Section 4.8.4.1).
- Selection of access road route – originally the access road route was the “Onion Creek” route to the port of Haines. Following consultation with First Nations, and further analysis of the environmental issues and potential impacts and First Nations interests, the Freegold Road Upgrade and Freegold Road Extension option was developed. Discussed further below.
- Tailings Management Facility location – while the TMF location in Canadian Creek, just above the confluence with Britannia Creek had the lowest capital, closure and post-closure costs, this option was discounted as it had the highest potential for groundwater quality impacts and impacts to the Yukon River, which is a culturally significant river (see Section 4.8.4.4 and Appendix B.4B for alternatives assessments).

- Incorporation of short-span bridges to minimize in-stream works, and potential effects on fish and fish habitat – short-span bridges will be used, wherever possible to minimize the installation of culverts. While more expensive, CMC has committed to minimizing impacts to fish and fish habitat wherever possible. The Freegold Road extension intersects areas of importance to traditional fishing (e.g., Big Creek), which will be protected in all ways possible.
- Freegold Road Extension – route refinements – A number of options for detailed routing were examined and discussed with First Nations over a period of several years. The final routing that was proposed is intended to carefully balance First Nation interests, particularly as they related to concerns over wildlife protection. The proposed route offered the best alterative by proposing the road upgrade along an existing impacted corridor, avoiding the sensitive habitats of several species (including salmon and sheep), and providing a safe constructible corridor to support the transportation of supplies and ore.
- Freegold Road Upgrade Nordenskoild bridge bypass – CMC adopted this bypass as part of the access design early in the project in response to concerns from the Carmacks community including concerns brought forward from First Nation members, about truck traffic through the community.
- Freegold Road Extension access control and management - a significant number of commitments as outlined in the Project Proposal, all of which are in response to both general and specific concerns brought forward in community meetings and discussions with both LSCFN and Selkirk FN are set out in CMC's Road Use Plan (Appendix A.22E).

B.18.4.1.3.1 Access Road Route Selection

Below is a summary of the access road route selection in reference to incorporation of traditional land use. A full discussion of the route selection process can be found in Section 4.8.4.2, Section A.4.2.2 and Appendix A.4.B.

A preliminary study examining transportation options for the Project (Project Transportation Scoping Study, Appendix 4A.B Information on Alternative Access Road Alignments) was conducted in 2008 by Associated Engineering. Associated Engineering examined seven alternative routes for an all-weather road access to the mine as well as alternative modes of transportation including barge, pipeline, rail, air, and truck. It was concluded that trucking presents the most reliable means of transporting concentrate and supplies to and from the Project and the Onion Creek route to the port of Haines would be the most economic alignment. Upon further review, CMC determined that the port at Skagway offers the advantage of developing a dedicated terminal and space for receiving and storage of concentrates.

Of the seven access road alignments/concepts considered by CMC since 2008, four of the seven access road alignments were screened out from further evaluation for reasons presented in Table B.18.4-5. Reasons include a consideration of socio-economic acceptability, primarily due to influence on traditional hunting and fishing activities.

Table B.18.4-5 Preliminary Access Route Concepts

Route Concept	Rationale Provided in the Proposal	Additional Rationale and Supporting Information
Aishihik Road: Casino Mine Site via Onion Creek to Alaska Highway to Aishihik Road	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	This route was considered a high risk option because: • Crosses areas of potentially significant and active First Nations traditional use • Multiple fish species habitat at the north end of

Route Concept	Rationale Provided in the Proposal	Additional Rationale and Supporting Information
Intersection	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.	Aishihik Lake, including Nisling River salmon • Crosses Aishihik caribou range • In proximity to approximately 20 parcels of settlement land and passes four First Nations traditional territories • Crosses Osprey nesting areas • Additional impact on Wood Bison core range • Crosses waterfowl and sharp-tailed Grouse nesting habitats • Salmon suitability in Aishihik drainage is unknown • Affects eleven trapping concessions and one group concession, in mostly undeveloped areas • Adjacent to additional outfitter camp
East Route: New Mine Access to Nisling River to East Route	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.	This route was considered a high risk option because : • One of the longest sections of new access of all options • Crosses First Nations settlement land • Crosses five First Nations traditional territories • Significant interactions with moose winter range • Crosses Bald Eagle nesting area • Crosses winter ranges of caribou (Klaza, Kluane and Aishihik) herds • Crosses core area within Bison Management Area (although Bison is abundant) north of Aishihik Lake • Crosses three salmon bearing streams, good fish habitat (Klotassin, Nisling and Nordenskiold rivers, and Rowlinson Creek) and wetland crossing • Crosses twelve trap-line concessions and two outfitter concessions • Adjacent to a trapping at Tyrell Creek and forestry reserves • Crosses grazing lease • In proximity to one outfitter camp
Klaza River: Mine Access to Nisling River to Klaza River Route	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	This route was considered a high risk option because: • Crosses through fall range and into core area of winter range of Klaza and Aishihik caribou herds • Crosses important winter habitat for thinhorn sheep • On the northern edge of the Bison Management Area (though bison are abundant)

Route Concept	Rationale Provided in the Proposal	Additional Rationale and Supporting Information
	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.	• Crossing of high suitability salmon habitat river and salmon bearing streams including Klotassin, Nisling and Klaza rivers • Increased interaction with place and quartz mining exploration activities • Crosses four First Nations traditional territories and the settlement lands of four First Nations • Crosses eight trapping concessions
Yukon River: Mine Access to Battle Creek to Yukon River Route	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.	This route was considered to be a medium risk option because: • Adjacent to First Nations Settlement Lands • Within one First Nations traditional territory • Northern edge of Caribou winter range and Gray falcon nesting area • Crosses two First Nations settlement land selections • Crosses three high suitability salmon habitat streams and good salmon habitat • High level of mineral claim activity resulting in increased interactions with other mine exploration activities • Route crosses trap-lines and two outfitter concessions

Of the remaining three options (Onion Creek, Minto and Freegold Road), 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 affected by the development of the Onion Creek route. Approximately 100 km 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. The Minto route also crosses First Nations settlement land and has the potential to open new access to wilderness areas along the route. The Freegold Road 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.

Following a meeting with representatives of the Kluane First Nation, CMC discounted the Burwash Landing (Onion Creek) access route option.

Finally, the Casino Trail route was chosen for further discussion, as it has a long history of engineering and baseline studies with planning dating back 45 years, including the following documents:

- Socio-economic impact review (1988);
- Terrain Analysis (1986);
- Moose population inventory (1987);
- Raptor nest survey (1988); and
- Caribou inventory (1991).

In 2012, in consideration of the Freegold Road potentially opening new access to wilderness areas and affecting the Klaza caribou herd winter habitat, consultations and additional investigations were carried out by CMC to explore alternative alignments to avoid potential impacts to the Klaza caribou herd.

In August 2012, a reconnaissance of the area was undertaken (Yukon River Crossing and Minto Route Reconnaissance, Appendix A4.B Information on Alternative Access Road Alignments). The alternative corridor investigations included the following three elements:

- Yukon River Bridge - Yukon River crossing locations and connecting roads near Minto, YT.
- The Minto Route Corridors - east-west route from Yukon River near Minto west to Hayes Creek.
- The Wolverine Route Corridor - Big Creek north to Wolverine Creek and west to Hayes Creek.

In November 2012, CMC shared with First Nations an overview of the access road alternatives considered for the Project (Appendix A4.B). The materials contained in this presentation were used extensively in a range of presentations and meetings with First Nations governments, Renewable Resource Councils and community meetings. After further consultation with First Nations, CMC decided not to further pursue the Minto to Hayes Creek route.

The outcome of the meetings in which these studies were discussed was that the preferred access road alignment chosen was the Freegold Road Upgrade and Freegold Road Extension - the option presented in the Project Proposal.

B.18.4.1.4 Assessment of Effects on Traditional Land Use

The effects assessment on traditional land use activities such as hunting, trapping and fishing, was provided in Section 18 of the Project Proposal, which generally overlapped with the assessment of effects on First Nation Settlement Lands in Section 19 of the Project Proposal, and the conclusions made in those sections remain relevant. The Local Study Area (LSA) used to describe effects on places of historical, cultural and archaeological value, TK, and subsistence and recreational harvesting is a 500-m buffer around the entire Project footprint, including the mine site, Freegold Road Upgrade and Extension and Yukon River Pipeline and Airstrip (Figure 19.2-1). The Regional Study Area (RSA), is based on defined Game Management Areas, and provides a representative buffer around the LSA that overlaps land uses potentially indirectly affected by the Project (Figure 19.2-1, equivalent to the borders of the GMAs highlighted in Figure B.18.4-4).

The Project will have a potential interaction with traditional and domestic use of land in the LSA: the Project will result in a direct loss of available area for carrying out traditional activities arising from land clearing/mine operations, noise, visual disturbance, traffic conflicts, and access (Table 19.1-1).

Change in Accessible Areas Due to Project Footprint

Traditional Land Use 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 to the Freegold Road Extension 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.

Change in Access

The construction of the Freegold Road Upgrade will provide easier access to areas frequented by FN members 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 of concern due to multiple factors (i.e. safety, real or perceived impacts due to increased access, etc.). 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 require co-operation and co-ordination of many parties including governments and FNs. CMC has actively encouraged the affected parties to initiation discussions to facilitate negotiation of an agreement that addresses these matters.

Change in Local Ambience

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, disturbed sites will be reclaimed. The local ambience is predicted to be naturalized and returned to conditions that blend into the surrounding environment.

B.18.4.1.5 Mitigation of Project Effects on Traditional Land Use

The Project took into consideration and incorporated available TK and TLU information throughout the Proposal, keeping in mind the need to protect sensitive information and ensure confidentiality. For example, CMC selected Valued Components (VCs) taking into consideration input from First Nations and local communities. In addition, all CMC consultants that provided input into the Proposal were instructed to incorporate TK and TLU information into their disciplines to the best of their ability and a number of personal connections were made over the years between consultants and knowledge holders which informed the Proposal. TK and TLU information was received from primary and secondary sources and integrated into the Proposal. Those sources include:

- Traditional harvest of wildlife;
- Traditional harvest of plants and plant products from secondary TK information;
- Avian-specific secondary TK information;

- *Community-Based Fish and Wildlife Work Plan Little Salmon Carmacks First Nation Traditional Territory 2012-2017* (Little Salmon/Carmacks Fish and Wildlife Planning Team 2011);
- *Opening the Land: a Study of the Impacts of the Casino Trail on the Northern Tuchone of Pelly Crossing and Carmacks, Yukon Territory* (Pearse and Weinstein 1988);
- *The Casino Trail Local Resource Group Workshop and Report* (Casino Trail Local Resource Group, 1989)
- *The Agreement on the Casino Trail Project* (Yukon Government, 1988); and
- Potentially important sites along the Freegold Road.

This information is incorporated into the mitigations for effects in each section of the Project Proposal.

In relation to direct effects on land use for traditional activities, the area required for the mine infrastructure will be the greatest and it will occur during construction and operations. Following closure and decommissioning, with implementation of the Reclamation and Closure Plan, the area remaining unavailable for other land uses will be decreased significantly. 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.

Potential effects associated with the various phases of the Project on the trapline concession areas and trapping tenure located within the area proposed as the access road to the airstrip will be assessed and mitigation measures identified in consultation with tenure holders.

Casino Mining Corporation has held in-depth consultations with LSCFN and SFN regarding potentially important sites along the Freegold Road Extension. These discussions about potentially important sites and relevant publically-available secondary sources of information have been incorporated into the Proposal. To mitigate for potential adverse effects to traditional uses related to the Freegold Road, CMC has proposed mitigation measures, including:

- Avoidance of known or suspected historical, cultural, or archaeological places. If the places cannot be avoided, then the necessary staged archaeological mitigation of the archaeological sites and recording and archival research as well as excavation and removal will be completed following the *Operational Policy for Heritage Resources Management on Yukon Lands* (Yukon Tourism and Culture 2010).
- The Freegold Road Extension will be managed as a privately owned and operated road with no public access from km 106 to the mine site.
- A Road Use Plan will be developed in coordination with First Nations and the Yukon Government to manage and limit public access, minimize increased hunting pressures on wildlife, reduce possible wildlife-human conflicts and protect existing wildlife-dependent land users (draft provided in Appendix A.22E).

B.18.4.1.5.1 Residual Effects

The residual socio-economic effects that are both beneficial and adverse to traditional land use are summarized in Table B.18.4-6.

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 predicted to be 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).

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 associated with limiting access within the mine site footprint are predicted to be 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.

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.

Table B.18.4-6 Summary of Effects on Traditional Land Use and Significance

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	
Loss of area available for traditional land use activities	Adverse	Low	Localized	Long Term / permanent	Infrequent	Reversible / Irreversible	High resilience	High	Not Significant
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
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 (Freegold Road Upgrade)	Beneficial	Low	Localized	Long Term	Frequent	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	
Reduced access to trapping concession 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 others whose activities may conflict with trappers (Freegold Road Upgrade)	Adverse	Low	Localized	Long Term	Frequent	Reversible	High resilience	Low / Moderate	Not Significant
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 utilizing the area (mine site, Freegold Road Upgrade and extension)	Adverse	Low	Localized	Long Term	Infrequent	Reversible	High resilience	Low / Moderate	Not Significant

B.18.4.2 R2-202

R2-202. An assessment of effects of the Project on TLU.

The effects assessment on traditional land use activities such as hunting, trapping and fishing, was provided in Section 18 of the Project Proposal, which generally overlapped with the assessment of effects on First Nation Settlement Lands in Section 19 of the Project Proposal, and the conclusions made in those sections remain relevant. Further details are provided in Section B.18.4.1.4 in the response to R2-201 above.

B.18.4.3 R2-203

R2-203. An assessment of effects of the Project on traditional economies.

Traditional economies in the Yukon are generally inferred to mean hunting, fishing and trapping. These activities have been considered in the assessment of potential effects of the Project on Subsistence and Recreational Harvesting in Section 18 of the Project Proposal, and in the assessment of effects on Traditional Land Uses in Section 19. The conclusions made in those sections remain relevant.

Additional assessment of effects on traditional economies including hunting, fishing, trapping and plant collection can be inferred from the following sections of the Project Proposal:

- Hunting – Wildlife (Section 12);
- Fishing – Water Quality (Section 7); Fish and Aquatic Resources (Section 10);
- Trapping – Wildlife (Section 12); and
- Plant collection – Rare Plants and Vegetative Health (Section 11).

B.18.5 HARVESTING OF PLANTS

B.18.5.1 R2-205

R2-205. A description of plant species of traditional, cultural, or economic importance within the Project footprint. Include a description of any efforts to engage First Nations or other land users in identifying plants of concern and any ground studies that sought to identify and map plants of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1

The effects assessment on traditional land use activities such as hunting, trapping and fishing, was provided in Section 18 of the Project Proposal, which generally overlapped with the assessment of effects on First Nation Settlement Lands in Section 19 of the Project Proposal, and the conclusions made in those sections remain relevant. Further details are provided in Section B.18.4.1.4 in the response to R2-201 above.

B.18.6 HARVESTING OF ANIMALS

B.18.6.1 R2-206

R2-206. Provide a description of concerns raised regarding effects to traditional harvest areas and indicate the location of the areas of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1.

The effects assessment on traditional land use activities such as hunting, trapping and fishing, was provided in Section 18 of the Project Proposal, which generally overlapped with the assessment of effects on First Nation Settlement Lands in Section 19 of the Project Proposal, and the conclusions made in those sections remain relevant. Further details are provided in Section B.18.4.1.4 in the response to R2-201 above.

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B.21 – ACCIDENTS AND MALFUNCTIONS

B.21.1 INTRODUCTION

Section 21 of the Proposal for the Casino Project (the Project) presented an assessment of potential environmental or socio-economic effects that could result from accidents or malfunctions of the Project. The intent of the Proposal was to identify potential hazards associated with the Project, assess the associated risks, and identify risk reduction strategies (mitigation measures) to reduce the risks to an acceptable level on a continuous basis.

The Proposal assessed credible accidents and malfunction scenarios with the potential for moderate to major effects or consequences; the analysis of risk included the evaluation of the likelihood of occurrence of a credible incident, and the consequences should the incident occur. A qualitative risk assessment was used with descriptive terms to identify broad likelihoods and consequences of events; the accidents and malfunctions were illustrated and ranked using a risk matrix.

On January 27, 2015, the Executive Committee requested that CMC provide supplementary information to the Casino Project (YESAB Project No. 2014-0002) to enable the Executive Committee to commence Screening. The Executive Committee considered comments from various First Nations, Decision Bodies and regulators on the adequacy of the Project Proposal in the preparation of the Adequacy Review Report (ARR). CMC provided a Supplementary Information Report (SIR-A) on March 16, 2015. Subsequently, the Executive Committee issued a second Adequacy Review Report (ARR No.2) on May 15, 2015 following a second round of review.

Responses to the eight requests for supplementary information related to Section 21 and Section A.21 of the Project Proposal and SIR are provided below, as outlined in Table B.21.1-1. CMC is providing this Supplementary Information Report (SIR-B) to comply with the Executive Committee's Adequacy Review Report ARR No.2; CMC anticipates that the information in the two SIRs and in the Proposal, when considered together, is adequate to commence Screening.

Table B.21.1-1 Requests for Supplementary Information Related to Accidents and Malfunctions

Request #	Request for Supplementary Information	Response
R2-217	Details on evacuation including anticipated timelines and seasonal considerations.	Section B.21.2.1.1
R2-218	Rationale for the two hours, or 682m³, as the minimum capacity for water storage on-site for firefighting capacity.	Section B.21.2.2.1
R2-219	A risk assessment of the transportation route that considers all major water crossings in relation to the transportation of hazardous materials.	Section B.21.2.3.1
R2-220	A human health risk assessment for the Project. Details should include: a. identify hazardous materials present on-site; b. evaluation of toxicity of hazardous materials; c. identify and assess pathways, including consumption of wildlife, fish, and traditional foods; and d. characterize risk to human health.	Section B.21.2.4.1

R2-221	Rationale based on an HHRA for the exclusion of a human health monitoring plan, or, alternatively, details on a human health monitoring plan.	Section B.21.2.4.2
R2-222	Summaries of discussions that support the proposed emergency response plans with emergency service providers, communities, and governments.	Section B.21.2.5.1
R2-223	Details on emergency response for LNG accidents or emergencies in relation to the response team and their equipment including details on training, composition, availability, and location.	Section B.21.2.5.2
R2-224	Please provide a comprehensive emergency response plan that addresses accidents and malfunctions related to major mine infrastructure. This must include consideration of structural and non-structural failure of the TMF dam as informed by the risk assessment and the dam breach and inundation study.	Section B.21.3.1.1

B.21.2 EMERGENCIES AND HUMAN HEALTH

B.21.2.1 Evacuation

B.21.2.1.1 R2-217

R2-217. Details on evacuation including anticipated timelines and seasonal considerations.

A general Site Evacuation Plan will be prepared for the Casino mine site for emergency situations where the Emergency Response Coordinator and/or the Incident Commander deem that an evacuation is necessary. A site wide notification either by radio, phone, or alarm system will be established and all staff and contractors on the site will be made aware of its use. Muster station(s) will be set up at the mine site and all personnel will be made aware of the locations. The key element of the mine evacuation plan will be to ensure that all staff, contractors and visitors are accounted for and that all personnel are evacuated in a rapid and safe manner.

The design of Casino Mine offers substantial separation between major structures such as the camp and the administration building from the major mine infrastructure. This enables the camp and administration buildings to be designated “safe zone” in the event of a major event at the mine and mill area. The primary safe zone would be the permanent camp as it is the most comfortable place of refuge. The secondary safe zone would be the administration building as it is large enough to shelter workers. A safety stock of emergency rations will be stored in secure storage containers in a location such that it will not be impacted in the event of a natural disaster or major event.

If required, an orderly evacuation can be undertaken with workers being transported off site by air transport, road transport or a combination of both. Relief supplies will be delivered to the camp on empty transports heading back to the mine site. An orderly evacuation using 2 busses and one airplane as outlined in the response to R422 where the round trip for a 47 person bus is 8 hours and the round trip for air transport (operating 16 hours/day) is 3 hours. At this capacity a full evacuation of the site will be accomplished within 48 hours. In the event that an evacuation coincided with inclement weather that impedes the availability of air transport a full evacuation using 2 coaches only can be accomplished in approximately 3 days.

As the Freegold road is designed as an “all weather” road, it will be maintained and kept clear as part of normal operations, with access available 24 hours per day, 365 days per year. Air transport to Casino can be limited by visibility (snow/fog) and extreme cold (-40°C). The development of a seasonal evacuation plan will result in similar outcomes as visibility issues can occur during any season.

As part of Casino mine’s normal operation, contracts with both air and ground transportation carriers will be established, provisions will be included for emergency evacuations, where minimum notice times and back up provisions will be determined.

Evacuation procedures, emergency exit routes, and muster points for each building will be posted throughout the mine buildings, including each individual room in the camp.

Further details will be provided in the Emergency Response Health and Safety Plan, as required in the application for Quartz Mining Licence, as detailed in the Plan Requirement Guidance for Quartz Mining Projects (Yukon Government, 2013), which will be reviewed for completeness by the Yukon Workers’ Compensation Health and Safety Board.

B.21.2.2 Fire

B.21.2.2.1 R2-218

R2-218. Rationale for the two hours, or 682m³, as the minimum capacity for water storage on-site for firefighting capacity.

The 682 m^3 was selected as the minimum capacity for water storage on-site as follows:

- Based upon preliminary layouts of the major facilities, the area and classification of fire zones to be protected was established.
- Using the area and classification of the zones, the firewater demand was established for the highest demand zone in accordance with NFPA, and an understanding of insurance underwriter expectations for facilities of this kind.
- A conservative 2-hour firewater storage capacity, based on the maximum zone demand was established.
- The proposed system design criteria are consistent with practice in the industry for mining facilities.

B.21.2.3 Dangerous Goods, Spills and Leaks

B.21.2.3.1 R2-219

R2-219. A risk assessment of the transportation route that considers all major water crossings in relation to the transportation of hazardous materials.

As outlined in Section 21.4.3.2, the Freegold Road Extension, 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 short-span bridge crossings. 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. A risk assessment of the likelihood and consequence of traffic accidents was considered in Section 21.4.3.2. A spill to water at any of the watercourse crossings along the transport route is summarized below.

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. The transportation route is approximately 200 km and the bridge and stream crossings in total represent in total length of approximately 500 m, the risk of an incident involving the waterways or any fish habitat can be characterized as relatively remote. 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.

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 individual LNG trailers contain less than 50 m^3 of LNG, such a small quantity, in the unlikely event of an accident resulting in a release of LNG, would not constitute a major spill nor would it have an effect lasting more than a few hours. Any damage to fish habitat or other would be very limited in scope and recoverable in a short period of time.

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.

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. 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.

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). 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).

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 (Appendix A.22B). The Project Road Use Plan (Appendix A.22E) 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.

While not assessed specifically, the risks of spills of hazardous materials to watercourses can be inferred from the risks assessed for collisions and spills, as summarized in Table 21.5-1, 21.5-2 and 21.5-3, summarized in Table B.21.2-1.

Table B.21.2-1 Risk Assessment for Hazardous Material Spills or Explosion

Scenario	Hazard	Likelihood	Consequence	Risk
6.b	Collision resulting in spill to land or water - reagent or concentrate	Possible	Moderate	Moderate
6.d	Collision resulting in fire or explosion	Unlikely	High	Low
10.c	Fire/explosion during LNG or diesel transport	Unlikely	High	Low
10.d	LNG or diesel spill during transport	Unlikely	Low	Non-actionable

Further, an LNG Management Plan was provided in Appendix A.22G and a Spill Contingency Management Plan in Appendix A.22B.

In previous assessments, the Executive Committee has determined that a hazard and risk assessment, in terms of a quantitative risk analysis (QRA) for LNG facilities and associated road route be required “during the regulatory approval process” (YOR 2013-0115-229-1). Additionally, the Executive Committee agreed with the Government of Yukon Oil and Gas Branch’s assessment that stated that through application of the Gas Plant Processing Regulation (OIC 2013/162) and the CSA standard 276-11, the “demanding regulatory requirements include comprehensive management, prevention, and contingency planning, such that adverse effects… are highly unlikely” (YOR 2013-0115-229-1). The design, manufacture, and configuration of the transportation vehicles for the Casino Project would be in accordance with the same codes & standards, as described in the approved LNG Project previously assessed by the Executive Committee.

Also, the Executive Committee found that “transportation of LNG falls under the jurisdiction of federal transport authorities. The transport company will haul the LNG under the Transportation of Dangerous Goods Regulations (Classification 2.1 - flammable gas). The transport company is responsible for all permitting and reporting of controlled or uncontrolled release while the LNG is in their custody.” (YOR 2013-0115-229-1). This conclusion applies to the Casino Project transportation of LNG as well.

B.21.2.4 Human Health Risks

B.21.2.4.1 R2-220

R2-220. A human health risk assessment for the Project. Details should include:

a. identify hazardous materials present on-site;

b. evaluation of toxicity of hazardous materials;

c. identify and assess pathways, including consumption of wildlife, fish, and traditional foods; and

d. characterize risk to human health.

a. Identify hazardous materials present on-site

b. Evaluation of toxicity of hazardous materials

The Executive Committee has requested an identification of hazardous materials present on-site and an evaluation of toxicity of hazardous materials on human health. CMC stresses that exposure to hazardous chemicals is considered under occupational health hazards (Workplace Hazardous Materials Information System (WHMIS)) and such exposure is not considered acceptable practice. 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 is the primary objective of the detailed Occupational Health and Safety Plan that will be developed by CMC and submitted to the Yukon Government for review and approval as part of the Quartz Mining License application (Yukon Water Board, 2013). The detailed Occupational Health and Safety Plan will outline potential worker exposure scenarios and procedures to minimize worker exposure. The Occupational Health and Safety Plan will also outline how worker health and safety will be monitored and what measures will be utilized in exposure situations.

c. Identify and assess pathways, including consumption of wildlife, fish, and traditional foods

A comprehensive list of potential Project – human health interactions is provided in Table B.21.2-2. Those potential environmental perturbations and potential human health influences that may not be readily amenable to avoidance through various best management practices – and which merit a more formal quantitative evaluation within a HHRA framework – are discussed below.

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Table B.21.2-2 Project Components or Activities as Candidate Sources of Contamination or Environmental Stress with Relevance to Human Health

PROJECT COMPONENT OR ACTIVITY	1) Noise Generation Potential			2) Releases to Air				3) Releases to Soil or Water
	a) Semi-continuous	b) Low Frequency	c) Intermittent/ Impulsive	a) Dust from weathered surface	b) Dust from ores and wastes	c) Combustion emissions	d) Other	
Mine Site								
Construction phase management of wastes (Section 4.3.1.5 of project proposal)								[6]
Open pit	✓	✓	✓ [1]	✓	✓	✓ [2]		Pit dewatering
Temporary ore stockpiles					✓			
Crusher and conveyor system	✓	✓			✓			
Tailings management facility					✓		cyanide loss to air [8]	Discharge from TMF; uptake into waterfowl on TMF [5]
Sulphide ore processing facility	✓				✓[3]			
Oxide ore heap leach facility	✓				✓			[4]
Smelting of Dore Bars						✓		
Copper and molybdenum concentrate storage and hauling to Skagway via road				✓	✓	✓		
Special Waste removal to appropriate disposal facilities								[6], [9]
Temporary topsoil and overburden stockpiles				[6]				[6]
Aggregate/borrow sources and stockpiles				✓				[6]
On-site power generation								

PROJECT COMPONENT OR ACTIVITY	1) Noise Generation Potential			2) Releases to Air				3) Releases to Soil or Water
	a) Semi-continuous	b) Low Frequency	c) Intermittent/ Impulsive	a) Dust from weathered surface	b) Dust from ores and wastes	c) Combustion emissions	d) Other	
Main power plant	✓					✓		
Supplementary power plant	✓					✓		
Diesel generators	✓					✓		
LNG storage, re-gasification and distribution								
Diesel storage and distribution								[9]
Casino airstrip and access road	✓			✓		✓		
Ancillary support facilities: admin. Building, change house (mine dry) and laboratories, warehouse and laydown area, light vehicle maintenance building, guard shed and scale house; explosives facility								[6]
Accommodations camp								[6]
Riverbank caisson and radial well system, distribution network								
Wastewater treatment plant	[6]							[6]
Water ponds, incl. process water pond, freshwater pond, temporary fresh water pond, TMF water management pond, HLF Events Pond								
Communications infrastructure								
Service and haul roads	✓			✓		✓		
Freegold Road Extension								
Two-lane, gravel resource road	✓			✓		✓		[6]
Aggregate/borrow sources and	✓			✓		✓		[6]

PROJECT COMPONENT OR ACTIVITY	1) Noise Generation Potential			2) Releases to Air				3) Releases to Soil or Water
	a) Semi-continuous	b) Low Frequency	c) Intermittent/ Impulsive	a) Dust from weathered surface	b) Dust from ores and wastes	c) Combustion emissions	d) Other	
stockpiles								
Temporary construction camp	✓			✓		✓		[6]
Freegold Road Upgrade								
Upgraded two-lane, gravel public road	✓			✓		✓		[6]
Carmacks by-pass	✓			✓		✓		[6]
Nordenskiold River bridge	✓			✓ [7]		✓ [7]		[6]
Aggregate/borrow sources and stockpiles	✓			✓		✓		[6]

[1] Includes blasting

[2] Haul trucks

[3] Fugitive releases

[4] Assumes that all heap leach barren solution and associated discharge will be captured and treated.

[5] During mine operations, the water management system associated with the TMF will collect any seepage, recycle it and manage against releases; therefore, it is assumed that there is no potential for environmental release beyond the TMF at adverse levels until after closure. Waterfowl and other wildlife, however, may use the TMF during the mining operational phase.

[6] Any potential effects via environmental releases can be readily avoided through application of best management practices (BMPS); therefore, the health effects potential is not considered further.

[7] Construction-phase only.

[8] Cyanide will be destroyed in HLP prior to discharge to the TMF

[9] Environmental releases associated with spills are addressed in the Accidents and Malfunctions portion of the Project Proposal, and are not included in the HHRA

Noise

Three categories of noise are considered based on the existing knowledge about noise health effects: average magnitude of continuous to semi-continuous noise, low frequency noise, and intermittent/impulsive noise types. Ground-borne vibrations are not considered as plausible sources of human health impacts, based on the limited distance that such vibrations can plausibly travel relative to the locations of humans that reside near or would expend extended periods near activities that result in ground vibration, outside of an occupational setting. Occupational exposures to ground vibration are not considered a source of potential adverse health effects, since the vibration is not expected to result in the same degree of stress and annoyance, or indirect influences associated with property destruction, as might be experienced by a member of the public with no positive interest in the mining related activities.

- Semi-continuous noise generation [e.g. assessed as daytime noise levels (L_D), night time noise levels (L_N), and day-night noise levels (L_{DN})]:
  - At/near proposed Casino minesite:
    - Open pit (excavation and hauling)
    - Crusher and conveyer systems
    - Sulphide ore processing facility (mill building)
    - Oxide ore heap leach facility (e.g. during loading)
    - Service and haul roads (noise from road transport)
  - Freegold Road Extension:
    - Construction and traffic along two lane gravel resource road
    - Aggregate borrow sources/stockpiles
    - Temporary construction camp
  - Freegold Road Upgrade:
    - Upgrades to and traffic along two lane public road
    - Construction of Nordeskiold River bridge
    - Aggregate borrow sources/stockpiles
- Low Frequency and/or Intermittent/Impulsive Noise events:
  - Open pit (especially based on blasting
  - Crushers.

Noise sources merit evaluation during both Project construction and operation. Low frequency noises and intermittent noises such as impulsive or transient higher energy noise events can increase the degree to which humans in a residential or long term setting feel stress and annoyance, and can result in sleep disturbance – especially if the peak noise energies (L_{MAX}) exceed 45 decibels (A-weighted; dBA) in the environment in which exposure is experienced (for example in an indoor setting) and if there are several impulsive or transient noise events at intervals through the sleep period. The evaluation of low frequency and intermittent noises, therefore, is important near communities and residential settings or encampments.

Air Emissions via Dust Generation and Fuel Combustion

Three categories of emissions to air merit evaluation in the context of possible human health effects (Table B.21.2-2):

1. Dust generation from land surface that generally do not contain concentrations of trace elements that are greater than average crustal abundances: i.e., areas of overburden, unconsolidated soil, road surfaces, etc. that are not unduly influenced by mineralization with sulphidic, oxidic or other metal/metalloid minerals.
2. Dust generation from areas of mine disturbance, ore extraction, stockpiling, and waste (tailings, waste rock) deposition: such dust may contain atypically high concentrations of one or more trace elements.
3. Particulate and gaseous (volatilized) emissions associated with fuel combustion, in minesite diesel equipment, power generation units run on lng or diesel, transport trucks, etc.

The following Project components and activities have the potential to generate airborne emissions of one or more of these three source types (Table B.21.2-2):

- Minimally mineralized dust:
    - Open pit
    - Copper and molybdenum concentrate hauling to Skagway
    - Aggregate/borrow sources and stockpiles near the minesite
    - Casino airstrip and access road
    - Minesite service and haul roads
    - Construction on and travel along Freegold Road Extension
    - Construction on and travel along Freegold Public Access Road, including Carmacks bypass
    - Aggregate/borrow sources and stockpiles along the access road improvements and used for routine road maintenance
    - Construction camps along the access road
- Mineralized dust:
    - Open pit
    - Temporary ore stockpiles
    - Crushers and conveyors
    - Tailings management facility
    - Sulphidic ore processing facility (as fugitive dust)
    - Oxide or heap leach facility (especially during loading)
    - Copper and molybdenum concentrate storage and hauling to Skagway via road
- Combustion-derived emissions:
    - Open pit (equipment use other than electrical shovels)
    - Copper and molybdenum concentrate storage and hauling to Skagway via road
    - Main power plant

    - Supplementary power plant
    - Diesel generators
    - Casino airstrip (air traffic) and access road (road traffic)
    - Service and haul roads (road traffic)
    - Construction on and travel along Freegold Road Extension
    - Construction on and travel along Freegold Public Access Road, including Carmacks bypass
    - Construction equipment activities to develop aggregate/borrow sources and stockpiles along the access road improvements and used for routine road maintenance
    - Construction camps along the access road
- Other activities that may generate Criterion Air Contaminants (CACs):
    - Smelting of Dore Bars (e.g. SO_2)

While a number of mine process chemicals will be used in either sulphide ore processing or the heap leach facility (HLF), these are not considered to be an issue for local air quality or human exposures, based on use of best management practices in the treatment of various solutions. For example, any cyanide remaining in spent liquor from the HLF will be destroyed prior to discharge of the spent solution to the Tailings Management Facility (TMF).

The three major categories of air emissions comprise different source types from a human health effects perspective, and should be addressed differently in the HHRA. For exposures to dust derived from mineralized areas, for example, it will be important to evaluate exposures to trace elements that are anomalously high in various portions of the overall ore deposit (and in stockpile areas) as well as waste areas.

Criteria air contaminants (CACs) such as fine particulate matter ($PM_{2.5}$, PM_{10}), NO_2, SO_2, CO, or O_3 and volatile organic contaminants or "mobile source air toxics" such as formaldehyde, naphthalene, and benzo[a]pyrene are the major substance of interest in combustion-derived air emissions.

Possible Environmental Releases to Water or Soil

Water and sediment, soil, and plant surfaces can become contaminated as a result of the secondary deposition of airborne contaminants to the extent that the airborne emissions themselves contain appreciable concentrations of limited volatility and adequately persistent substances. Such secondary exposure sources are considered above for dust and combustion-derived emissions as the primary source of environmental input.

There are a limited number of other possible exposure scenarios that could plausibly result in human exposures, including:

- During operations: uptake of trace elements from water in the TMF by waterfowl or wildlife that ingest the water, to the extent that the water contains elevated concentrations of such trace elements, followed by ingestion by humans.
- Following closure: uptake of trace elements from water or sediment in the TMF passive treatment wetland, to the extent that the water contains elevated concentrations of such trace elements, followed by ingestion by humans.

All other sources of potential exposure can be ruled out based on the use of best management practices to prevent environmental releases, or recover spilled materials and hazardous wastes following an accident or malfunction. It is assumed that the risk-based closure plan will effectively limit human exposures to all other potential source types. Detailed risk-based closure planning will likely include a formalized quantitative HHRA that captures site conditions near the end of the mine operational life.

Potential Receptors

HHRA is based on methodical analysis of potential contaminant/stressors sources, the potential receptors for any exposures arising from such sources, and the environmental exposure pathways that connect sources to receptors. For the purpose of the Project HHRA, the following receptor groups merit formal evaluation:

- Members of Selkirk First Nation;
- Members of Little Salmon/Carmacks First Nation;
- Members of the general public; and
- Occupationally exposed mine workers, especially for air quality

The HHRA focusses on those individuals and locations where people could be exposed to noise, air emissions and the deposition of airborne contaminants, or contaminated waterfowl and wildlife, for extended durations. This is because few if any of the source types discussed above have a potential to cause acute toxicity (for example, based on a one-time exposure or exposures over hours or days). Different cohorts as listed above, therefore, are expected to have different probabilities of engaging in land uses or various other activities that could plausibly result in exposures. Noise conditions and air quality at the operating mine, therefore, is deemed to be of relevance only to minesite workers, while the conditions adjacent to the operating mine may be relevant for the health of First Nations or members of the general public.

The HHRA will examine sensitive receptors and the locations where sensitive receptors may be found. Sensitive receptors are taken to mean any individual or groups of individuals that may experience greater exposure to the contaminant or stressor, as a result of their particular life history and habits, or that may be particularly sensitive to the effects of the contaminant or stressor. Developing children, the elderly, or pregnant women, for example, may be more sensitive to various environmental exposures than the general population.

Conceptual Site Models for HHRA

The conceptual model for the evaluation of human health risks associated with Project related noise is provided in Figure B.21.2-1. Human exposures to noise occur via airborne transmission of sound energies, as modelled in the noise assessment of the Project Proposal. Especially at or near the ground surface, noise transmission can be affected by masking from objects such as terrain or trees. The types of noise metrics that are used to formally and quantitatively assess health effects such as percent of an exposed sub-population that may experience feelings of being highly annoyed or sleep disturbance are generally available from the previously complete noise assessment (response to R444).

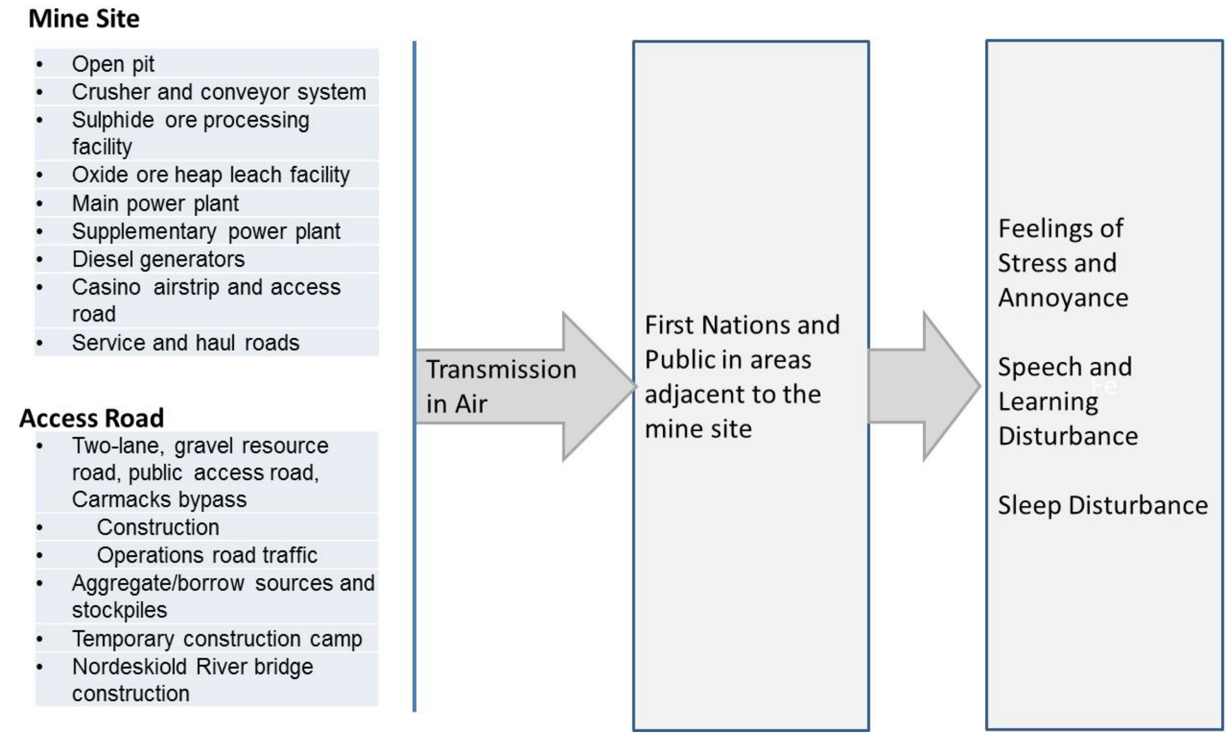

Figure B.21.2-1 HHRA Conceptual Model for Noise Exposures

The HHRA conceptual model for air emissions is provided in Figure B.21.2-2**.** Note in Figure B.21.2-2 that the line connecting humans to general dust is a dashed line, which is intended to signify that this is not likely to be a significant health concern. Dust or fine particulate matter with a particle size greater than approximately 2.5 µm once breathed in by humans tends to be deposited in the upper airways and respiratory tract rather than travelling into the deeper portion of the lungs and alveoli. Such inhaled particulates are then transferred out of the respiratory tract via mucociliary action and transferred into the gastrointestinal tract. Provided that the concentrations of contaminants in the coarse dust are relatively low (as is expected in the case of dust generation from highly weathered surface materials with low sulphidic or oxidic metal complexes), there is very limited potential for contaminant uptake in the stomach or intestines, and the exposure is likely to be comparatively benign.

As illustrated in Figure B.21.2-2, the vast majority of contaminants in combustion emissions are expected to affect humans via the pulmonary (inhalation) route, while there is only a limited number of substances that could also result in human exposures, at concentrations of concern for health, based on indirect exposure pathways: i.e. based on wet or dry deposition to water surfaces, soil or plant surfaces followed by dermal contact or ingestion.

Mine Site	General Dust	Mineralized Dust	Combustion Emissions
• Open pit	✓	✓	✓
• Copper and molybdenum concentrate storage and hauling to Skagway via road	✓	✓	✓
• Casino airstrip and access road	✓		✓
• Service and haul roads	✓		✓
• Aggregate/borrow sources and stockpiles	✓		
• Temporary ore stockpiles		✓	
• Crusher and conveyor system		✓	
• Tailings management facility		✓	
• Sulphide ore processing facility		✓	
• Oxide ore heap leach facility		✓	
• Main power plant			✓
• Supplementary power plant			✓
• Diesel generators			✓
Access Road			
• Two-lane, gravel resource road, public access road, Carmacks bypass	✓		✓
• Construction	✓		✓
• Operations road traffic	✓		✓
• Aggregate/borrow sources and stockpiles	✓		✓
• Temporary construction camp	✓		✓
• Nordeskiold River bridge construction	✓		✓

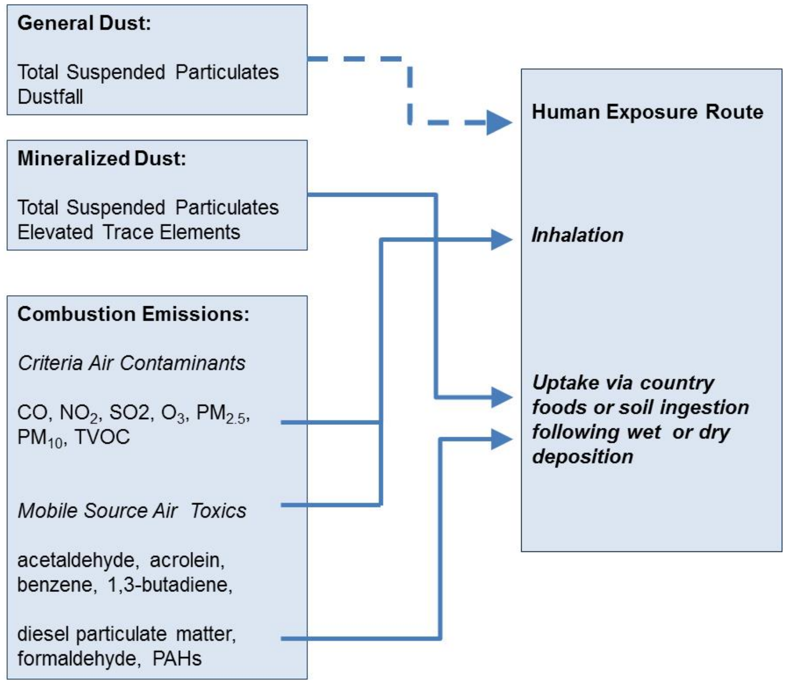

Figure B.21.2-2 HHRA Conceptual Model for Human Exposures Associated with Air Emissions

Figure B.21.2-3 provides a conceptual site model for human exposures via the ingestion of waterfowl or other wildlife that may be exposed to contaminants in water in the TMF or TMF treatment wetland. The exposure of humans via wildlife consumption is plausible only to the extent that the TMF surface water, or that of the treatment wetland following closure exhibits elevated levels of specific trace elements – detailed above. Further discussion on the impact of the TMF wetlands on waterfowl is provided in the responses to R2-183 and R2-184.

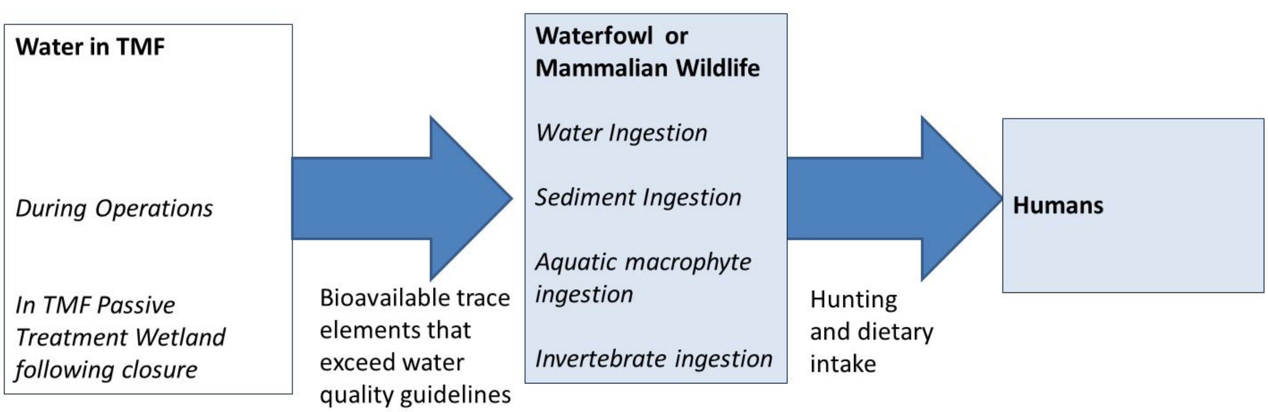

Figure B.21.2-3HHRA Conceptual Model for Human Exposures Associated with Trace Element Uptake on TMF and Treatment Wetland

CMC will conduct a more comprehensive human health risk assessment should metals in the water, soils and/or vegetation in the receiving environment exceed guidelines during any phases of the Project.

d. Characterize risk to human health

The current mitigations for the protection of water, soil and air quality, and the isolated nature of the Project indicate that there will be no significant impacts to human health from the Project. A description of potential impacts on human health from surface water quality and consumption of country foods (i.e., caribou, moose, fish, small trapped mammals, berries, etc.) is described below, as human health impacts from air quality and noise was described adequately in the response to R444.

Impacts to Surface Water Quality

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). Results of the Hydrogeology Baseline Assessment (Appendix 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 are captured in the surface water assessment.

As assessment on water quality was conducted in Section 7 of the Proposal, and supported with supplementary information in Sections A.7 and B.7 of SIR-A and SIR-B, respectively. These assessments compared predicted water quality to the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life. These guidelines are used as key indicators during the assessment to determine whether or not an effect is likely to occur. Baseline values indicate that exceedances of the CCME guidelines for the protection of freshwater aquatic life were evident for 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.

Water quality in the downstream receiving environment (Dip Creek) meets CCME guidelines for all modelled parameters except for copper, fluoride and selenium. Copper is naturally elevated in the watershed, and hence a 90^{th} percentile site specific water quality objective approach, and hence the background concentration procedure (BCP) was selected to calculate the SSWQO (P90) values for Casino and Dip Creeks. Predicted maximum copper concentrations do not exceed the SSWQO during any project phase. Predicted fluoride values in Dip Creek are less than the BC MOE guideline using baseline hardness (guidelines = 1.1 mg/L). Predicted selenium concentrations at W5 during discharge from the water management pond and TMF pond (April through November) exceed the CCME guideline only in May during the discharge period, and are less than the BC MOE guideline for all project phases.

Therefore, all parameter predictions fall below either site specific water quality objectives or are considered acceptable based on literature from the development of guidelines from other jurisdictions, by modelled station W5 on Dip Creek.

There is no use of the water upsteam of the W5 monitoring station, therefore, water use downstream of the Project is considered safe for use, and meets the guideline values for protection of aquatic life, and therefore there are no predicted impacts to human health due to consumption of surface water or to consumption of fish that may come into contact with this water.

Impacts to Country Foods

Country foods are animals, plants, and fungi used by humans for nutritional or medicinal purposes and that are harvested through hunting, fishing, or gathering of vegetation (Health Canada, 2010). People obtaining country foods by hunting, trapping, and collecting berries, mushrooms, and medicinal plants from the Project area, and by fishing inside and downstream of the Project area, can be affected by the quality of the country foods they consume. There are no identified use of the Project area for collecting berries, mushrooms or medicical plants; however, there is hunting and trapping in the area (see Section B.18 for more details).

The effect of the project on terrestrial mammals and birds is provided in Section 12 of the Project Proposal. Mitigations applicable to water, air and soil quality, outlined in Sections 7, 8 and 6, respectively, will result in mitigation of potential effects to country food. Impacts to fish and aquatic resources are assessed in Section 10. Monitoring to be conducted to prevent impacts to country foods include:

- An Air Quality and Fugitive Dust Deposition Monitoring Program will form part of the Environmental Monitoring, Surveillance and Report Plan, and will connect fugitive dust and potential effects on wildlife forage.
- Vegetation monitoring will be conducted as part of the Wildlife Mitigation and Monitoring Plan (Appendix A.12A) and will include metals analysis.
- Water quality monitoring for project infrastructure (i.e., TMF pond, pit groundwater discharge) and the receiving environment will be conducted throughout construction, operations, closure and post-closure.
- Monitoring of small mammals or large terrestrial mammals (e.g., moose, caribou), may be conducted at the recommendation of the Wildlife Working Group.

B.21.2.4.2 R2-221

R2-221. Rationale based on an HHRA for the exclusion of a human health monitoring plan, or, alternatively, details on a human health monitoring plan.

Should the results of the monitoring conducted through the following monitoring programs indicate a increases above baseline concentrations, CMC will consider conducting a quantitative HHRA that identifies trigger values of contaminants in key country food items or soil for decisions about increased risk management:

- Air Quality and Fugitive Dust Deposition Monitoring Program, which will form part of the Environmental Monitoring, Surveillance and Report Plan, and will connect fugitive dust and potential effects on wildlife forage.
- Vegetation monitoring conducted as part of the Wildlife Mitigation and Monitoring Plan (Appendix A.12A) and will include metals analysis.
- Water quality monitoring for project infrastructure (i.e., TMF pond, pit groundwater discharge) and the receiving environment will be conducted throughout construction, operations, closure and post-closure.
- Monitoring of small mammals or large terrestrial mammals (e.g., moose, caribou), may be conducted at the recommendation of the Wildlife Working Group.

However, currently, as no detrimental impacts are predicted to human health through impacts on surface water quality, consumption of country foods, air quality or noise, an human health monitoring plan is not proposed, as Human Health Monitoring Plans are generally created to monitor the health of sensitive populations to potential source(s) of contamination (e.g., Alberta Health 1999, Health Canada 2014).

As the Project is located in an isolated area there are no sensitive human receptors predicted to be affected by potential contaminants generated by the Project outside of the Project area (i.e., workers). Air quality and noise were evaluated for effects along the road route and in Carmacks, (Section 8 and 9 of the Proposal), and found to be lower than guidelines at all areas evaluated. As no impacts to human health are predicted, human health monitoring is not required, although, sources with the potential to impact human health (e.g., water, air, noise, wildlife, vegetation) will be monitored to ensure consistency with predictions.

The health of workers is protected under the *Occupational Health and Safety Act* and its supporting regulations. All Project related activities will be conducted in a manner that minimizes risk to worker health and safety through training, awareness, and continuous improvement. Worker health and safety is the primary objective of the detailed Occupational Health and Safety Plan that will be developed by CMC and submitted to the Yukon Government for review and approval as part of the Quartz Mining License application (Yukon Water Board 2013). The detailed Occupational Health and Safety Plan will outline potential worker exposure scenarios and procedures to minimize worker exposure. The Occupational Health and Safety Plan will also outline how worker health and safety will be monitored and what measures will be utilized in exposure situations.

B.21.2.5 Emergency Services

B.21.2.5.1 R2-222

R2-222. Summaries of discussions that support the proposed emergency response plans with emergency service providers, communities, and governments.

External emergency support providers outlined in the Emergency Response Plan (Appendix 22B), include health care providers in Whitehorse, Carmacks and Pelly Crossing, emergency responders, and Yukon Government. Discussions with those service providers are summarized in Table B.21.2-3. However, it should be noted that conversations will be on-going, and that this list is not intended to be all inclusive at this stage of the Proposal and will be updated prior to beginning the construction phase of the Project. An emergency response responsibility matrix will also be created for definition and quick reference.

Since the preparation of the Project Proposal, the Dawson City Community Hospital opened in December 2013. The Dawson City Community Hospital has 6 beds, and 28 staff (Yukon Hospital Corporation, 2015). It provides 24/7 emergency care, inpatient and ambulatory care (Yukon Hospital Corporation, 2015). The Dawson City Community Hospital will be an important option for emergency care from the Casino Project, as it will be the closest emergency facility, by air, to the Project. Decisions on where to take patients in an emergency will be made when the Medical Responder contacts Yukon Emergency Medical Services (EMS) Dispatch to provide history and an assessment of the situation. Medical support and/or evacuation is possible by air transport via the Casino Mine airstrip to support fixed-wing air ambulance and helicopters.

Table B.21.2-3 Summary of Communication with Emergency Services Providers

CMC ROC ‘	Event Type	Date	Participating Organization	Event Summary*
192	Meeting	October 3, 2012	Yukon Health & Social Services	Discussed emergency services planning and response relating to health and social services. Concerns: (a) distance to services during emergencies.
195	Meeting	October 3, 2012	Yukon Community Services	Discussed municipal infrastructure in Whitehorse, Pelly and Carmacks.
292	Meeting	February 20, 2013	Little Salmon-Carmacks First Nation	Discussed health services in Carmacks, including provision of services, users, service structure, the Project and potential changes if it is developed,

CMC ROC ‘	Event Type	Date	Participating Organization	Event Summary*
				government funding and health & safety concerns. Concerns: (a) lack of capacity, staff and equipment in the Carmacks health care system; (b) safety issue relating to trucks driving through the community (road safety, dust, noise).
436	Meeting	July 10, 2012	Whitehorse Hospital	Discussed hospital services. No major hurdles or issues were noted in relation to increased activity the mine may bring to the area. Discussed: health & safety, services provided and hospital use. Concerns: (a) access to injured workers at mine sites and transport to health facilities; (b) improvements in mining safety records; (c) health infrastructure needs related to increasing population.
437	Meeting	July 10, 2012	Whitehorse RCMP	Discussed crime, health and safety in the community. Concerns: (a) lack of resourcing.
440	Meeting	February 13, 2013	Village of Carmacks	Discussed infrastructure and services, recreation services, community well-being, economic development, tourism, and recreational fishing and hunting/ Concerns: (a) need for a local economic development plan to assist with procurement for industry.
442	Meeting	February 13, 2013	Carmacks Health Centre	Socio-economic data collection on services available at the health centre.
457	Phone Call	October 23, 2013	Whitehorse Fire Department	Discussed fire-fighting capacity and services.
458	Phone Call	October 23, 2013	Whitehorse Hospital	CMC requested information on hospital services, and was advised to re-contact the hospital in November to address questions with the relevant contact.
459	Phone Call	October 23, 2013	RCMP	CMC requested information on capacity, and was asked to provide questions in writing.
463	Phone Call	October 24, 2013	Whitehorse Hospital	Discussed health services capacity in Whitehorse, as well as benefits of potential new skilled workforce that could be available with the Project.
469	Meeting	May 17, 2013	Yukon Executive Council Office, Yukon Health & Social Services	CMC addressed concerns raised by the Yukon Executive Council about cyanide and its implications, traffic, wages and sourcing people, boundaries, camps, and increased service requirements.

*Full details in Appendix 2A

Whitehorse General Hospital

Whitehorse General Hospital (WGH) was contacted in 2012 and 2013, as follows, to determine the range of services available and to connect with the Hospital on the potential effects of the Project:

- Whitehorse General Hospital (July 10, 2012);
- Whitehorse General Hospital, Community Relations (October 23, 2012); and
- Whitehorse General Hospital, Patient Services (October 24, 2013).

Discussions with WGH were around the available programs at the hospital, and the capacity of the hospital, as well as private medical and dental clinics to support emergency services for the Project. 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). It was determined that WGH 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. Whitehorse will be the primary community in which off-site services will be relied on.

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.

A representative from the Yukon Government Health and Social Services department was interviewed regarding services available in Pelly Crossing. During the 2012 and 2013 consultations, representatives noted that residents of Pelly Crossing would likely receive emergency services at the hospital in Dawson City, once it is open.

Little Salmon/Carmacks First Nation and Carmacks

.A visit to the health centre and interviews with key representatives during 2012 and 2013 reveal the following aspects about the community health centre:

- The current health centre is not large enough to service 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.
- Currently, the Minto Mine is more likely to use the Carmacks health centre to treat injuries than the centre in Pelly Crossing.

It was noted that residents of Carmacks would also receive emergency services at the new regional hospital in Dawson City.

Yukon Government

Yukon Government Department of Health and Social Services (YHSS) was contacted on 8 occasions by CMC (October 3, 2012; April 18, 2013; April 19, 2013; April 29, 2013; May 2, 2013; May 14, 2013; May 16, 2013; May 17, 2013 – Appendix 2A), over phone, email and through in-person meetings. Emergency services were discussed and emergency response planning was evaluated. YHSS raised concerns regarding the distance to services in emergencies. In the May 17, 2013 meeting with the Executive Council Office and YHSS, CMC addressed concerns around increased service requirements.

B.21.2.5.2 R2-223

R2-223. Details on emergency response for LNG accidents or emergencies in relation to the response team and their equipment including details on training, composition, availability, and location.

It should be noted that the requirement for “specialized response teams”, as noted by ARCADIS (YOR-2014-0002-402-1), are teams that would be developed within the mine site, with employees housed on-site, as expedient response would be required in all emergency situations, not, as ARCADIS implies, from outside services.

The details of the emergency response teams and their equipment will be detailed in the LNG Management Plan, and through manuals required by the Yukon Oil and Gas Act (YOGA), developed in consideration of the principles and standards of practice of the Canadian Standards Association (CSA) standards CSA-Z276, CSA-Z731 and the National Fire Protection Association (NFPA) codes NFPA 59A, as well as other principles and standards of practice. Additionally, the YOGA Gas Processing Plant Regulations, requires the submission and approval of the following manuals, with the following requirements pertaining to emergency response team, prior to the commencement of operation:

Emergency Procedures Manual

Gas Processing Plant Regulations sections:

- 27(2)(e) an organization structure and resources to manage the emergency, including trained personnel, equipment and facilities.
- 27(2)(i) a description of the safety equipment and medical equipment.

- 27(3)(c) develop and implement a continuing educational program for the police fire departments medical facilities other appropriate organizations and agencies and the public residing in proximity to the plant or facility to inform them of its location, potential emergency situations involving the plant or facility and the safety procedures to be followed in the event of an emergency.

Staffing plan and training Program

Gas Processing Plant Regulations sections:

- 28(1) A licensee's staffing plan referred to in paragraph 25(2)(d) must provide for:
  - (a) the number of persons necessary to operate its processing plant or LNG facility safely; and
  - (b) the competencies required for each position.
- 28(2) The licensee must ensure that:
  - (a) its plant or facility is at all times staffed with the full complement of personnel in accordance with the plan referred to in subsection (1);
  - (b) all personnel have, before assuming their duties, the necessary experience, training and qualifications and are able to conduct their duties safely, competently and in compliance with this Regulation; and
  - (c) records of the experience, training and qualifications of all personnel are kept and made available to the Chief Operations Officer on request.
- 28(3) A licensee's training program referred to in paragraph 25(2)(e) must contain instructions for all personnel directly involved in the operation of its plant or facility respecting:
  - (a) the safety practices and procedures operation of the plant or facility;
  - (b) responsible environmental practices and procedures in the operation of the plant or facility;
  - (c) the proper operating procedures for the equipment that they could reasonably be expected to use; and
  - (d) the emergency procedures set out in the manual referred to in section 27.

Fire, safety, emergency equipment, staffing and training are regulated under the Yukon Oil and Gas Act as well as CSA-Z276. The following principles will be included in the Emergency Response Plan provided as part of permit application for the operation of the LNG facility and transportation of LNG to the mine site to meet the CSA-Z276 code requirements:

- Identify potential LNG spill scenarios and measures necessary to eliminate, mitigate and control, and minimize worker exposure. The scenarios will include vapor dispersion/thermal radiation from potential spills, and the layers of protection associated (i.e. a spill impoundment).
- Prepare detailed emergency response plans for potential LNG spills as they may cause fires if not contained. The plans will outline the potential scenarios and specific response actions including clearing the site, personnel, and the public as necessary.
- Develop and implement emergency response plans to respond to worker exposure to LNG/natural gas.
- Involve site personnel and stakeholders in the planning process.
- Periodically evaluate response procedures and capabilities and revise them as needed.
- Train appropriate personnel to operate the LNG receiving and unloading facility according to systems and procedures that protect human health, the community, and environment.

- Train workers to understand the hazards associated with LNG/natural gas.
- Train workers and personnel to respond to LNG/natural gas exposure and environmental releases, including use of first aid measures.
- Designate personnel and commit equipment and resources for emergency response as necessary.
- Develop internal and external procedures for emergency notification and reporting.

To ensure the protection of communities and the environment during transport of LNG to the Casino Project, the general guidelines below will be followed:

- Responsibility for safety, security, release prevention, training, and emergency response will be established in written agreements with producers, distributors and transporters.
- Emergency response plans and management measures will be implemented by LNG transporters.
- Casino Mining Corporation will require contractors retained for LNG deliveries to the Project will develop and implement a LNG Transportation Plan that is consistent with the LNG standards mentioned above, and should be integrated with the overall LNG management plan as well as with related management plans (i.e. the Environmental Management Plan).

The following practices will be described and implemented:

- Training of all personnel operating LNG handling and transport equipment.
- Emergency Response plans for a potential LNG release during transportation including:
- Designate appropriate response personnel and commit necessary resources for emergency response
- Emergency response training of involved personnel
- Descriptions of the specific emergency response duties and personnel responsibilities
- A detailed list of all emergency response equipment available during transport or along the transportation route
- A detailed list of all emergency response and personal protective equipment during transportation
- Initial and periodic refresher training in emergency response procedures

B.21.3 ACCIDENTS AND MALFUNCTIONS

B.21.3.1.1 R2-224

R2-224. Please provide a comprehensive emergency response plan that addresses accidents and malfunctions related to major mine infrastructure. This must include consideration of structural and non-structural failure of the TMF dam as informed by the risk assessment and the dam breach and inundation study.

A comprehensive emergency response plan (ERP), addressing accidents and malfunctions including the TMF dam will be developed during Detailed Engineering. The ERP is part of the regulatory process and will be submitted in the application to the Yukon Water Board (YWB) for a Type A Water Licence and to EMR for Quartz Mining License as per the *Dam Guide: Design Expectations and Required* Information (YESAB and Yukon Environment, 2012) which states that proponents should "*ensure that your licence application includes:…*

l) Detailed engineering design drawings of the dam, spillway, low level outlet and other features of the dam design with supporting information: iii. An emergency response plan (this is required for all dams with a Consequence of Failure Classification of 'high' or higher). This plan can be included as a section in the operation, maintenance and surveillance plan or a stand-alone document."

Typical contents for ERPs are summarized in Section 8 of the TMF Operation, Maintenance and Surveillance Manual (Appendix B.4D). The ERP will identify the actions to be taken by the owner/ operator and responsibilities assigned to appropriate individuals at the site, as well as those of other agencies and affected parties. The ERP will define actions to identify the potential for accidents, to respond in emergency situations, and to prevent and mitigate the environmental and safety impacts, both on- and off-site, associated with emergency situations.

The ERP will list (and classify) warning signs with reference to potential tailings and water management facility failure modes or emergencies – both from a structural failure and failure due to environmental impacts. Examples include:

- equipment failure;
- slope or foundation failure;
- overtopping;
- power line failure;
- seepage or piping;
- loss of process control; and
- flooding.

Warning signs and potential emergencies are site-specific. For each one listed and classified, the ERP will identify the appropriate actions and responses.

The ERP will specify and initiate a "call-out" process as appropriate, in the event of an incident. Lines of communication within the site (involving, for example, management, operations, engineers, consultants) will be specified and will include names, positions, telephone numbers (work and home) and e-mail addresses. Relevant off-site contacts, such as contractors or equipment suppliers will be included.

The process for notifying affected external stakeholders – municipalities, government agencies, local organizations, first aid, fire department, ambulance, other individuals, etc. – will be specified and will include telephone numbers and e-mail addresses.

The ERP will establish verification and follow-up procedures to ensure that appropriate parties have been contacted, and that the call-out process is kept up to date.

The ERP will also develop and maintain contingency plans. The plans will be tested for effectiveness, reviewed regularly and updated as appropriate.

The ERP will be widely distributed to appropriate personnel within the organization, as well as to potentially affected external stakeholders.

Typical Contents of Emergency Response Plans include:

- Identification of failure modes
- Identification of roles and responsibilities
- Identification of requirements of legislation, codes of practice, notification and reporting obligations
- Identification of available resources
- Mutual aid agreements
- Public relations plans
- Telephone lists
- Establishment of communication system for notifications and for post-notification purposes
- Risk analysis for on-site and off-site effects
- Inundation study, maps and tables for both physical and environmental releases (including dam break)
- Basis for activation of emergency response plan and emergency decision making
- Training of personnel
- Investigation and evaluation of incidents and accidents
- Contingency plans
- Restoration of safe operating conditions
- Validation drills, test of the system

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B.24 – CONCLUSION

Casino Mining Corporation (CMC) submitted a Project Proposal under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) to the Yukon Environmental and Socio-economic Assessment Board (YESAB) on January 3, 2014. The Project Proposal contained five volumes and 25 chapters of documentation to support the assessment of the Project under the YESAA regulations. As production capacity of the proposed Project is greater than 300 tonnes per day, the Project is subject to an Executive Committee Screening for the proposed construction, decommissioning and closure activities.

On May 23, 2014, CMC requested that YESAB place the review of the Project on hold for up to 180 days to enable CMC to continue engagement with affected First Nations. YESAB granted the request on June 2, 2014. The hold period was lifted on November 27, 2014, and YESAB issued the *Adequacy Review Report: Project Assessment 2014-0002, Casino Mine* on January 27, 2015.

CMC submitted a response to that Adequacy Review Report on March 16, 2015, in the form of a Supplementary Information Report (SIR-A) for evaluation by YESAB. After review of the SIR-A, YESAB issued *Adequacy Review Report Information Request No.2: Project Assessment 2014-0002, Casino Mine* (ARR-2) on May 15, 2015.

This Supplementary Information Report (SIR-B) has been written to respond to ARR-2. The information contained in SIR-B supplements information previously provided in the Project Proposal, and in Supplementary Information Report (SIR-A) submitted on March 16, 2015. There has been no change to the conclusion of potential effects and determinations of significance presented in the Proposal.

All 224 requests outlined in the Adequacy Review Report No.2 (ARR-2) prepared by the Executive Committee of the Yukon Environmental and Socio-economic Assessment Board (YESAB) have been responded to in the SIR-B. Several new commitments have been made by CMC in addition to the commitments previously provided in Table 24.1-2 of the Proposal, and previously updated in Table A.24-1. The further updated table of commitments is presented as Table B.24-1.

Table B.24-1 represents a complete list of the commitments made to date throughout the adequacy review process under YESAA. Non-consecutive numbers indicate that commitments in the Project Proposal have been replaced by commitments in SIR-A or SIR-B and have been deleted from Table B.24-1, to make the list of commitments more clear.

Table B.24-1 Updated Table of Commitments

Number	Commitment	Adverse Residual Effect	Proposal/SIR 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.	2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
		• Effects on increased access on 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 Appendix A.22C Spill Contingency Management Plan
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	• As described in Section 8.4.	22.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	and approvals required for Project operation.		
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 Appendix A.22A Waste and Hazardous Materials Management Plan
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 A.12A Wildlife Mitigation and Monitoring Plan
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	N/A	22.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section

	• CMC will develop a final plan prior to construction and operations;
	• 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
			Appendix A.22B Spill Contingency Management Plan

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 Emergency Response Plan
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	N/A	22.3 Appendix A.22A Waste and Hazardous Materials

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	with mitigation measures developed through the environmental assessment process, and terms and conditions of any applicable licences, permits and approvals required for Project operation. • A separate Cyanide Management Plan will be developed and implemented in recognition of the higher level of public concern associated with this substance.		Management Plan
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 A.22E Road Use Plan
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		23

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	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 • 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 Appendix A.22C Sediment and Erosion Control Management Plan
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	• Effects on water quality (general)	7.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• 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-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 Appendix A.22C Sediment and Erosion Control Management Plan
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 Appendix A.22C Sediment and Erosion Control Management Plan
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,	• Effects on water quality (general)	7.4 Appendix A.22C Sediment and Erosion Control Management Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	temporary seeding, and mulching.		
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
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 Appendix A.22C Sediment and Erosion Control Management Plan
32	Control contaminated 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/SIR 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/SIR 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 Appendix A.22C Spill Contingency Management Plan
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	• 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/SIR Section
	• 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 • 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	• 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/SIR Section
	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. • 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 Appendix A.22C Sediment and Erosion Control Management Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
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 protection of the dam shell with rip rap.	• Changes to Water quality - Lethal effects on fish and aquatic organisms	10.4 Table 10.4-11 Table 10.4-12
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 Offsetting 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 Appendix A.10A Updated Fish Habitat Offsetting Plan
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	• 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

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	undertaken in areas where fish stranding could occur.		
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 bearing waters.	• Lethal and non-lethal effects to fish and aquatic organisms	Table 10.4-11 Table 10.4-12
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 Appendix A.22H ML/ARD Management Plan
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
79	An erosion and sediment control plan will be developed as part of an overall environmental management plan,	• Habitat loss	5.2 Fish Habitat

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	prior to initiation of habitat compensation activities.		Offsetting Plan Appendix A.10A Appendix A.22C
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 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)	• Habitat loss	5.1 Fish Habitat Offsetting Plan Appendix A.10A
Rare Plants and Vegetation Health			
81	• Planning and conducting Project activities such 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	• Establishment of invasive species	11.4 Appendix A.22D Invasive Species Management Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	Council for invasive plant control.		
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. • Establish a program for invasive plant detection.	• Loss of rare plant habitat due to introduction or expansion of invasive species	11.4
Wildlife			
86	CMC commits to all of the mitigations listed in the Wildlife Mitigation and Monitoring Plan.	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	Appendix A.12A Wildlife Mitigation and Monitoring Plan
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,	• Loss of wildlife habitat • Restrictions on wildlife movement • Wildlife mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	mitigating mortality risk and habitat loss; and • Freshwater pipeline to well system will be constructed to allow animal movement across (over or under).		
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 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.	• Loss of wildlife habitat • Restrict wildlife movement • Increased wildlife mortality	12.3
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;	• Loss of caribou habitat • Restrict caribou movement	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	• 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.		
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; • 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.	• Increased caribou mortality	12.3
91	CMC will mitigate the risk of increased caribou mortality from harvest by managing the Freegold Road extension	• Increased caribou mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	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.		
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 • 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.	• Loss of moose habitat • Reduced movement	12.3
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	• Loss of grizzly bear denning habitat • Increased grizzly bear mortality	12.3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	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.		
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 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;	• 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/SIR Section
	• 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
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	14.4
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 incentive for educational attainment and training of local residents • Project employment will improve capacity and industry experience of workers	14.4
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	15.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
		employment	
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/SIR 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	16.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR 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.	reduce family and community well-being	
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.	17.4.2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
111	CMC will work closely on an ongoing basis with 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.	• Population change will alter demand for Protective Services	17.4.2
112	CMC will provide contracted security services that will focus on ensuring a secure and safe work site.	• Infrastructure and service capacity	17.4.2
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	17.4.2
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	17.4.2
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	17.4.2
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	• Demands on air transportation infrastructure	17.4.2 Table 17.4-3

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	passenger congestion.		
117	CMC will work with communities in the LSA to develop a mine closure plan that identifies strategies and actions to help minimize the potential adverse effects of closing the mine.	• decrease demand for housing and temporary accommodation and local services	17.4.2
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 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 Yukon and First Nation governments. • Controlled, gated, manned access at the new	• General cultural effects related to access as the result of the use of the Freegold Road Extension.	18.4 22 Appendix A.22E Road Use Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	bridge over Big Creek or as otherwise agreed. • A stakeholder communication /engagement plan to 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

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
129	Mine employees and contractors will be restricted from harvesting within the mine site footprint and while on shift at any time.	General cultural effects related to loss of plant/animal resources	18.4.2 & Table 18.4-4
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 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.	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	19.4.2
132	To mitigate against changes to access to traditional land, mineral tenures, and recreational lands CMC	• Changes to access to Traditional Territories, mineral tenures, trapping	19.4.2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	commits to: • 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.	areas, guide outfit concessions and 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	19.4.2
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	19.4.2
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135	CMC will voluntarily establish an Independent Geotechnical Review Panel for the Casino Project to review and consider the Project's Tailings Management	N/A	A.4

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	Facility and Heap Leach Facility with a focus on their structural stability and integrity.		
136	Casino Mining Corporation will establish Quality Assurance/Quality Control (QA/QC) procedures to maintain an effective quality control program for the Project prior to commencement and during execution of all works.	N/A	A.4
137	A Professional Engineer representing CMC will carry out periodic independent inspection and testing throughout the construction of the works. For quality assurance the Professional Engineer representing CMC will approve QA/QC testing results prior to proceeding with works. The QA/QC testing results will be recorded and available for inspection on site by regulatory inspectors.	N/A	A.4
138	CMC will undertake a dam breach analysis and inundation modelling consistent with the Canadian Dam Association's dam safety guidelines.	N/A	A.4
139	CMC will conduct additional site investigations during detailed design, including test pits and laboratory testing, to further characterize foundation soils for the TMF embankment.	• Embankment deformation or weakening due to thaw of frozen foundation materials.	A.4
140	CMC will conduct appropriate laboratory or field scale studies during operations to finalize the design of the treatment wetlands.	• Uncertainty and a lack of confidence in the proposed treatment system.	A.4
141	CMC will conduct a geotechnical site investigation for the Freegold Road Extension which will include the installation of thermistors to monitor ground temperature.	N/A	A.6

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
142	CMC will complete additional site investigation and thermal analysis, if the foundations of critical infrastructure are identified as potentially susceptible to the effects of thermal erosion.	• Thermal erosion from Project activities and climate change.	A.6
143 Replaces Commitments 27 and 28	The winter seepage management pond and associated seepage collection system will be installed during construction to collect surface runoff and seepage from the TMF embankments during operations and pump the water back to the TMF. A controlled discharge system will control discharge to Casino Creek.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage. • Change in surface water quality in Casino Creek and Dip Creek due to project discharge.	A.7
144	If future field investigations conducted as part of design engineering identify additional structures beneath the TMF, the effect on TMF seepage rates will be assessed.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage.	A.7
145	CMC will conduct information sessions following the determination of adequacy in the YESAB process to inform interested parties of details of the water balance modelling.	N/A	A.7
146	CMC will update the water balance model in support of the reclamation and closure plan updates as may be required.	• Change in surface water quality in Casino Creek and Dip Creek due to unrecovered seepage. • Change in surface water quality in Casino Creek and Dip Creek due to Project discharge.	A.7
147	Additional mitigation measures may be considered if concerns arise surrounding the proposed physical barrier to prevent fish passage. CMC will develop and implement an adaptive monitoring plan that evaluates the effectiveness of the barrier, with the inclusion of triggers for implementing further mitigation measures to	• Fish stranding downstream of the water management pond.	A.10

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
	protect resident fish. Other mitigation that may be considered may include other physical deterrents or flow management strategies.		
148	Any fish-bearing crossings requiring culverts will be designed to ensure fish passage and habitat losses will be assessed and, if required, offset accordingly in the Fish Habitat Offsetting Plan.	• Lethal effects on fish and aquatic organisms. • Habitat loss.	A.10 Appendix A.10A Fish Habitat Offsetting Plan
149	In writing the Erosion and Sediment Control Plan (for the Quartz Mining Licence application), the same overall erosion and sedimentation risk assessment will be conducted for all of the Freegold Road Upgrade, Airstrip Access Road and Casino Mine Site. Corresponding mitigation measures will be applied at the areas identified in the risk assessment.	• Change in surface water quality from increased erosion and sedimentation.	A.10
150 Replaces Commitments 72, 73, 74, 75, 76, 77 and 78	CMC will implement the compensation measures outlined in the Fish Habitat Offsetting Plan, once approved by DFO, and once the decision has been made to proceed with the Project.	• Fish and aquatic species habitat loss.	A.10 Appendix A.10A Fish Habitat Offsetting Plan
151	CMC understands that YG Environment is conducting fire regime scenario-building for the Klaza caribou range. CMC will consider reasonable scenarios and interaction with Project effects if they are developed and made available for review.	• Wildlife habitat loss.	A.12
152	CMC will work with SFN to adopt the scope, methodology, VCs and indicators of the Minto Mine Socio-Economic Monitoring Framework and to develop the Socio-economic Effects Monitoring Program for the Project, if mutually-agreed to by First Nations, local communities and Yukon Government.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
153	CMC is willing to work collaboratively with LSCFN to develop a similar monitoring program (to the program in commitment #154) that reflects the VCs and indicators that arise as a result of their two recent community driven processes for community readiness planning and development of community well-being indicators.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan
154	CMC is willing to work with the Tr'ondëk Hwëch'in, other First Nations and municipalities to determine the appropriate level of monitoring socio-economic effects of the Project on their respective communities.	• Effects of the Project to community wellbeing and community vitality.	A.16 Appendix A.22F Socio-economic Management Plan
155	CMC will incorporate YG and local first responders into the process for finalizing the conceptual Emergency Response Plan.	N/A	A.21
156	CMC will work with Yukon Government Department of Highways and Public Works to monitor, and actively manage if required, potential interactions between Project-related trailer truck traffic and other public highway users.	• Effects of Project-related traffic on other highway users.	A.21
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157	CMC will contact the Yukon Quest in early January of each year to establish a process for safe crossing of the Freegold Road during the race.	• Effects of the Project on the Yukon Quest	B.2
158	Where the Project has resulted in changes to the typical route charted for its race, CMC will help to establish safe routing for the Yukon Quest. The route shall follow existing linear disturbances (e.g., Freegold Road right-of-way, trails and cutlines) where possible, or result in the cutting of new trail less than 1.5 metres in width.	• Effects of the Project on the Yukon Quest	B.2

Number	Commitment	Adverse Residual Effect	Proposal/SIR Section
159	CMC will prepare a Permafrost Management Plan (PMP) that will be submitted as part of the Quartz Mining Licence application	• Effects of permafrost on the stability of Project infrastructure • Effects of the Project on permafrost	B.6
160	In response to these requests and discussion, CMC will conduct a second year of bear surveys. CMC will further engage with Environment Yukon to obtain their input before planning a second year of bear surveys.	• Potential effects on bear habitat	B.12
161	CMC will fly above 8,250 feet (2,512 m) while in transit between the Casino Mine Site and Whitehorse when no conflicts with Canadian Aviation Regulations exist. Other aircraft, such as helicopters or small aircraft, will also fly above 8,250 feet when in transit between the Casino Mine Site and Whitehorse, when there are no conflicts with Canadian Aviation Regulations.	• Potential indirect effect on sheep	B.12
162	Should new studies identify additional aboriginal traditional uses that have not been considered, CMC will review the results and commits to considering the results as part of established adaptive management planning for the Project.	• Effects to traditional land use	B.18
163	CMC will support and assist FNs in gathering Project-related TK and TLU information for consideration and incorporation into the Project Proposal. CMC will consider and, where appropriate, integrate this information into the Project as well as into the socio-economic monitoring program.	• Effects to traditional land use	B.18

B.25 - REFERENCES

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