Adequacy Review Report

Project Assessment 2014-0002

Casino Mining Corporation

Casino Mine

YESAB
Yukon Environmental and Socio-economic Assessment Board

January 27, 2015

Prepared by
Executive Committee
Yukon Environmental and Socio-economic Assessment Board

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Acronyms and Abbreviations

° C ..... degrees celsius
ABA ..... acid base accounting
ARD ..... acid rock drainage
As ..... arsenic
asl ..... above sea level
BC ..... British Columbia
BCP ..... background concentration procedure
CALMET ..... California meteorological model
CALPUFF ..... California puff model
CAP ..... oxide leach cap
CCME ..... Canadian Council of Ministers of the Environment
CCRP ..... conceptual closure and reclamation plan
CDA ..... Canadian Dam Association
CMC ..... Casino Mining Corporation
CN ..... cyanide
COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada
CSA ..... Canadian Standards Association
Cu ..... copper
d ..... day
dBA ..... decibels, a-weighting
DFO ..... Department of Fisheries and Oceans Canada
E ..... times ten raised to the power of
EMR ..... Department of Mines, Energy and Resources
EPA ..... Environmental Protection Agency
ESCP ..... erosion and sedimentation control plan
F ..... fluorine
FHCP ..... fish habitat and compensation plan
FOS ..... factor of safety
GDP ..... gross domestic product
GIS ..... geographic information science/systems
GPS ..... global positioning system
HEP ..... habitat evaluation procedure
HLF ..... heap leach facility
HMP ..... heritage management plan
HIS ..... habitat suitability index
HYP ..... hypergene
IDF ..... inflow design flood
K ..... hydraulic conductivity
KI ..... key indicator
km ..... kilometre
km² ..... square kilometre

kPa ..... kilopascal
L ..... litres
LDRS ..... leak detection and recovery system
LNG ..... liquefied natural gas
LSA ..... local study area
LSCFN ..... Little Salmon Carmacks First Nation
m ..... metres
m² ..... square metres
m³ ..... cubic metres
MDE ..... maximum design earthquake
MEND ..... Mine Environment Neutral Drainage Program
mg ..... milligram
ML ..... metal leaching
mm ..... millimetre
Mm³ ..... million cubic metres
MMER ..... Metal Mining Effluent Regulations
Mo ..... molybdenum
MOE ..... Ministry of the Environment
Mt ..... million tonnes
NAG ..... non-acid generating
Ni ..... nickel
NRCan ..... Natural Resources Canada
PAG ..... potentially acid generating
Pb ..... lead
PECG ..... Palmer Environmental Consulting Group
pH ..... decimal cologarithm of hydrogen
PHABSIM ..... physical habitat simulation model
PMF ..... probable maximum flood
PMP ..... probable maximum precipitation
QA/QC ..... quality assurance/quality control
RLS .... German Guideline for Noise Protection on Streets (Richtlinien für den Lärmschutz an Straßen)
RSA ..... regional study area
RSF ..... resource selection function
RTC ..... registered trapping concession
RUBL ..... rusty blackbird
s ..... second
SARA ..... *Species at Risk Act*
SART ..... sulphidization, acidification, recycling and thickening
SFN ..... Selkirk First Nation
SSE ..... safe shutdown earthquake
SSWQO ..... site specific water quality objectives
SUP ..... supergene
t ..... tonne

TH ..... Tr'ondëk Hwëch'in
TK ..... Traditional Knowledge
TLU ..... Traditional Land Use
TMF ..... tailings management facility
U ..... uranium
UK ..... United Kingdom
US ..... United States
VC ..... valued component
V_{s30} ..... shear wave velocity in the upper 30 m of ground
WBM ..... water balance model
WMP ..... water management plan
WQG ..... water quality guidelines
WQO ..... water quality objectives
WRFN ..... White River First Nation
WSC ..... Water Survey of Canada
WSMP ..... winter seepage management plan
YESAA ..... *Yukon Environmental and Socio-economic Assessment Act*
YESAB ..... Yukon Environmental and Socio-economic Assessment Board
YOR ..... YESAB On-line Registry
YG ..... Government of Yukon
YWBM ..... YESAB water balance model
Zn ..... zinc
ZOI ..... zone of influence

1.0 INTRODUCTION

The Executive Committee has reviewed the proposal for the "Casino Mine" submitted by Casino Mining Corporation (CMC) on January 3, 2014. The Executive Committee has determined that the proposal is inadequate. This Adequacy Review Report includes a request for supplementary information that is required.

A proposal is deemed adequate if the Executive Committee determines the proposal:

- has taken into account the matters referred to in paragraphs 42(1)(b),(c) and (e) to (h) of the *Yukon Environmental and Socio-economic Assessment Act* (Act);
- contains sufficient information to enable the Executive Committee to prepare a statement of the scope of the Project under s. 34 of the *Executive Committee Screening Rules*;
- contains sufficient information to enable the Executive Committee to commence the screening; and
- complies with the applicable rules.

The *Screening Rules* provide the proponent up to 180 days to either submit the requested supplementary information or to advise the Executive Committee in writing, when it will be submitting the supplementary information. All supplementary information must be provided to the Executive Committee within two years from the date the proposal was submitted to the Executive Committee. The form and content of the supplementary information submission should comply with all applicable Rules and requirements of the Board, including the general filing requirements.

For questions or comments regarding this report, please contact Nathan Aasman, YESAB Senior Assessment Officer assigned for this Project, by telephone 867-668-6420, by email at nathan.aasman@yesab.ca, or in person at Suite 200 – 309 Strickland Street, Whitehorse, Yukon.

1.1 ACKNOWLEDGEMENTS

The Executive Committee invited comments on the adequacy of the Project proposal from various First Nations, Decision Bodies, and regulators including:

- Selkirk First Nation
- Little Salmon Carmacks First Nation
- Tr'ondëk Hwëch'in
- White River First Nation
- Kluane First Nation
- Government of Yukon
- Environment Canada
- Natural Resources Canada
- Fisheries and Oceans Canada
- Transport Canada
- Northern Projects Management Office
- Aboriginal Affairs and Northern Development Canada

Table 1 lists input the Executive Committee received from parties invited to participate in the adequacy review of the proposal. The Executive Committee has considered this input when preparing this Adequacy Review Report.

Table 1: Input received from external parties

Party	Document Description	YOR Document #
Natural Resources Canada	NRCan Adequacy Comment Submission – 2014-04-30	2014-0002-245-1
Transport Canada	Transport Canada Adequacy Comment Submission – 2014-05-01	2014-0002-246-1
Environment Canada	Environment Canada Adequacy Comment Submission – 2014-05-23	2014-0002-249-1
Selkirk First Nation	SFN Adequacy Comment Submission – 2014-05-23	2014-0002-250-2
	SFN Submission – Kuipers Memo	2014-0002-254-1
	SFN Submission – LGL Limited Memo	2014-0002-255-1
	SFN Submission – MESL Memo	2014-0002-256-1
	SFN Submission – Northland Earth and Water Consulting Memo	2014-0002-257-1
	SFN Submission – North West Resources Memo	2014-0002-258-1
	SFN Submission – Wildlife and Vegetation	2014-0002-259-1
Fisheries and Oceans Canada	DFO Adequacy Comment Submission – 2014-05-13	2014-0002-251-1
Government of Yukon	YG Adequacy Comment Submission – 2014-05-23	2014-0002-252-1
Tr'ondëk Hwëch'in	TH Adequacy Comment Submission – 2014-05-26	2014-0002-260-1
White River First Nation	WRFN Comment Submission – 2014-12-22	2014-0002-279-1

Party	Document Description	YOR Document #
Little Salmon Carmacks First Nation	LSCFN Comment Submission – 2014-11-27	2014-0002-274-1
	LSCFN Comment Submission – 2015-01-06	2014-0002-280-1
	LSCFN Submission – Rob Walker Consulting Memo	2014-0002-281-1
	LSCFN Submission – ElknWillow Environmental Consulting Memo	2014-0002-282-1
	LSCFN Submission – Can-nic-a-nick Environmental Sciences Memo	2014-0002-283-1
	LSCFN Submission – Referenced Article	2014-0002-284-1

In addition, to support the adequacy review the Executive Committee retained four independent consultant teams to undertake a technical review of select components of the project proposal as listed in Table 2. The Executive Committee considered the technical memorandums in preparing this Adequacy Review Report.

Consultants were requested to review relevant sections and appendices of the proposal in their respective knowledge areas, and to provide a technical memorandum focused on the adequacy of information. Consultants were requested to:

- review and validate specific sections of the Casino Mine Proposal and related documents;
- identify key issues, concerns, information gaps, and required supplementary information;
- evaluate models used in the proposal including adequacy of field data, modeling assumptions and model analysis, uncertainty or limitations and model predictions; and
- provide professional judgment on key aspects of the project proposal.

Table 2: Consultants retained by the Executive Committee

Knowledge Area	Independent Consultant	YOR Document #
Hydrology and Aquatic Resources and Engineering Design and Geotechnical Considerations	EcoMetrix Incorporated	2014-0002-235-1
Wildlife and Wildlife Habitat	SLR Consulting (Canada) Ltd.	2014-0002-238-1
Socio-economic Considerations	Morrison Hershfield Limited	2014-0002-237-1
Use of Liquefied Natural Gas	SENES Consultants	2014-0002-248-1

1.2 SUMMARY OF ADEQUACY REVIEW

CMC proposes to construct, operate, decommission and remediate a copper, gold, silver and molybdenum mine. The Casino Mine is located approximately 150 km northwest of Carmacks and 300 km from Whitehorse. The Project will process approximately 120 000 tonnes of ore per day, or 43.8 million tonnes per year, over a 22-year mine life. The Casino Mine would be the largest mine in Yukon history and one of the largest in Canada.

The main components of the Project include an open pit, a tailings management facility, a heap leach facility, processing facilities, temporary stockpiles, liquefied natural gas power generation, and associated mine infrastructure components. Access to the mine site requires the construction of approximately 120 km of new all-weather gravel access road. This will be an extension of the Freegold Road and will generally follow the historic Casino Trail. In addition, the existing Freegold Road will be upgraded, a bypass around Carmacks will be constructed, and a new bridge over the Nordenskiold River will be constructed.

We have determined that the proposal is inadequate and have requested supplementary information from the proponent. The following Adequacy Review Report includes a request for supplementary information that is required in order for the proposal to be deemed adequate. It is 158 pages in length and contains 449 specific requests. Aspects where additional information has been requested include:

- description of project activities such as the heap leach facility, mine waste disposal, water management, and closure and reclamation;
- terrain features in relation to stability of mine infrastructure and access roads;
- water quality and quantity aspects including baseline data, geochemical characterization, handling of potentially acid generating and metal leaching materials, and water quality predictions;

- biophysical aspects such as fish and aquatic resources, wildlife, and plants and vegetation; and
- socio-economic aspects such as baseline information, heritage resources, and emergencies and human health.

The main concerns are related to the lack of information on: the tailings management facility and associated dam; the access road to the Project; traditional knowledge and traditional land use; closure and reclamation; human health and safety; and the use of liquefied natural gas for power. These concerns are summarized further in the following sections.

1.2.1 Tailings Management Facility

The tailings management facility (TMF) requires the construction of a dam across the Casino Creek valley to contain approximately 956 million tonnes of tailings and 658 million tonnes of waste rock and overburden material. A portion of the tailings and waste rock will be potentially acid generating and as a result will need to remain flooded within the TMF. The dam is comprised of the main embankment and a smaller west embankment constructed of a low permeability core, rockfill and non-reactive waste rock, and cyclone sand from de-sulpherized tailings. The main embankment will be approximately 286 m high at the deepest part of the Casino Creek valley and 2 460 m wide along its crest. The west embankment will be approximately 21 m high and 333 m wide along its crest.

The proposed TMF main embankment would be one of the world's highest dams and the highest tailings dam. As such, the proposed dam would be unique on a global scale. Little Salmon Carmacks First Nation's consultant, BGC Engineering, aptly states that it "is beyond the current state of practice" (YOR 2014-0002-274-1).

The TMF will be a permanent feature storing mine tailings and waste rock in perpetuity and has a high likelihood of significant adverse effects if it fails or does not perform as intended. Additionally, the probability of failure, even considering design standards such as a maximum design earthquake of 1 in 10 000 years, approaches 1.0 for a structure that must remain in place forever. We have requested additional information to support the design and feasibility of construction to inform our understanding of the geotechnical stability of the dam. This includes information such as design basis, foundation characterization, water management, and construction methods.

Additionally, in order to assess potential effects in the event of a dam breach, we have requested that CMC conduct a dam breach analysis with water/tailings inundation modeling. This analysis and modeling will provide information on the maximum extent of flooding relating to a sudden full storage dam breach. Based on this information, we have requested CMC include an assessment of downstream environmental and socio-economic impacts as well as mitigation measures in the event of a tailings breach.

1.2.2 Access Road

Access to the mine site requires upgrading and re-routing portions of the existing 83 km Freegold Road, constructing 120 km of new all-weather road as an extension to the Freegold Road, and

constructing a bypass around Carmacks. CMC has indicated that several sections will be re-routed through Little Salmon Carmacks First Nation and Selkirk First Nation Settlement Lands. The Freegold Road extension will generally follow the historic Casino Trail. Portions of the extension will pass through areas of high value in particular late-winter habitat for the Klaza caribou herd.

There are a wide range of potential effects in relation to road use and management. These include potential effects to wildlife, use of Settlement Lands, and general public access. An all-season road to the Casino property could also act as a catalyst for increased fishing, hunting, mineral exploration, resource development and road use.

In order to assess potential effects associated with the upgrade of the Freegold Road and construction of the extension, we have requested additional information on: crossing First Nation Settlement Lands; a road management plan; traffic predictions and response to accidents; traffic through Carmacks during construction; and types of dangerous goods being transported.

Of particular concern was the overall management of the Freegold Road. CMC indicated that a road management plan will be developed in order to address potential effects of the access road on various values, however, little detail has been provided. In addition, the means of managing access for the Freegold Road are unclear. We have requested that a detailed road management plan be developed for the entire Freegold Road. Additional information was requested in relation to the effects of the road on wildlife including mitigations, monitoring, management, and indirect effects associated with hunting.

1.2.3 Traditional Knowledge and Traditional Land Use

Traditional Knowledge (TK) requires continued and stable access to traditional land uses (TLU). CMC speaks to TK and TLU in developing the proposal both as informing values and effects as well as indicators for change. However, the potential effects of the Project on continued and stable traditional land uses remains unclear. Additionally no TK and TLU studies were undertaken as part of the collection of baseline data. The TK and TLU baseline information provided in the Land Use section of the proposal is inadequate and the Cultural Continuity section also fails to provide sufficient information on TLU in the Project footprint.

We have requested that CMC conduct a TK and TLU study for the Project. Additionally, we have requested that additional information be provided outlining the specific efforts and processes undertaken to gather TK and TLU and how that information informed the drafting of the proposal. In order to assess potential effects we have requested CMC provide an assessment of effects to traditional economy and provide a framework for monitoring effects to TLU resulting from the Project.

1.2.4 Closure and Reclamation

At closure, two wetlands will be constructed within the TMF area in order to capture and treat water from the TMF, the open pit, and the heap leach facility prior to discharge. The south wetland will treat water from the TMF prior to discharge while the north wetland will treat open pit discharge into the TMF. The wetlands are primarily designed to remove metals. While the south wetland is expected to

be operational on a year round basis, the north wetland will operate only seasonally. Discharge from the open pit to the TMF will correspondingly be on a seasonal basis. At closure, CMC predicts treatment of mine discharge will meet standards for aquatic life as set by the Canadian Council of Ministers of the Environment and their site specific water quality objectives.

The design of the wetland treatment system provided by CMC is necessarily conceptual in nature; however, the implications of its effectiveness are critical to understanding potential effects to a wide range of values. The information provided is inadequate.

We have requested additional information to support the chosen approach to closure and reclamation. This includes requesting the initiation of laboratory studies to confirm the effectiveness of the wetlands as a water treatment system and a detailed plan on further field studies to support and refine its effectiveness. Additional information is also requested on the design and operation of the wetland treatment system and on contingency or alternative treatment options.

1.2.5 Human Health and Safety

The Project has two major components when considering emergencies, the mine site itself and its transportation routes. There will be up to 1 000 personnel on-site during construction and up to 800 during operations. Mine sites inherently include various facilities that may pose a risk to personnel. Additionally, the Project is located in a remote area with limited access.

The Project proposes extensive use of the North Klondike, South Klondike and Alaska highways as well as the Freegold Road. Traffic will include the transportation of supplies, including hazardous materials, to the mine site and transportation of ore from the mine site. Traffic volumes are uncertain at this time but expected to be approximately 125 trucks per day (including inbound and outbound traffic) during operations. In addition, while traffic is much lower during construction (approximately 52 trucks per day), this traffic may be routed through Carmacks while the bypass is being constructed.

We have requested additional information on emergency response plans, both along the access road and at the mine site, in order to adequately assess risks and potential effects to human health and safety. Information is also requested on medical and emergency services that will be available at the mine site and along the transportation routes. Information requests focused on both mine site personnel safety and public safety.

We have also asked that CMC complete a comprehensive Human Health Risk Assessment (HHRA). This type of assessment identifies hazardous materials present on-site, evaluates toxicity, finds and assesses pathways, and characterizes risk to human health. An HHRA in relation to this Project should include an analysis of effects resulting from the consumption of wildlife, fish, and traditional food.

1.2.6 Liquefied Natural Gas Power Plant

Power for the Casino Mine will be from an on-site liquefied natural gas (LNG) power plant. The main power plant will have a total nominal capacity of 150 MW. During normal operations the plant will produce approximately 130 MW. LNG will be stored onsite in a 10 000 m^3 storage tank. LNG will be

trucked to the mine site from northern BC and will require approximately 11 trucks per day during operations.

Limited information was provided for the onsite generation of power using LNG. The proposal requires additional information on design, construction, and operation of the LNG transportation, storage, vaporization, and gas distribution facilities. We have requested additional information regarding the on-site LNG power plant including: a detailed description of all LNG related facilities; safety measures and separation distances from LNG facilities; design measures and operating procedures; and standards and codes applicable to the Project. Additionally, we have requested CMC identify and provide an assessment of potential hazards to LNG facilities in relation to seismic activity, extreme weather events, wildfire, unstable terrain, and degradation of discontinuous permafrost.

1.3 SCOPE OF ADEQUACY REVIEW

During the adequacy review period, many concerns were raised from a wide range of sources as listed above in Tables 1 and 2. Many of the concerns and issues raised by both consultants retained by the Executive Committee and external parties invited to comment were considered in preparing this Adequacy Review Report. However, not all concerns and issues resulted in a request for additional information.

The Adequacy Review Report and associated request for additional information focuses on ensuring that the proposal:

- has taken into account the requirements in the Act;
- contains sufficient information to prepare a statement of scope and to enable the Executive Committee to commence the screening; and
- complies with the applicable rules.

Questions and concerns raised during the adequacy period that do not meet the above objectives are generally not put forward to the Proponent in this report. This does not mean that those concerns will not be addressed in the screening process.

Many comments received referred to the methodology of the proposal's effects assessments or suggested mitigations measures. These types of comments and concerns will be considered as the Executive Committee conducts its effects assessment during the screening process. Where baseline data, project activities, or potential effects are not clearly understood, the Executive Committee has pursued the information required for it to conduct its effects assessments. Questions and concerns about proposal methodology will inform the Executive Committee on how to evaluate the validity of proposal effects assessments and how best to proceed in its effects assessments.

The following sections of this Adequacy Review Report specify the supplementary information that is required in order for the proposal to be deemed adequate.

2.0 PROJECT DESCRIPTION

2.1 ALTERNATIVES

Section 42(1)(e) of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) requires the Executive Committee to consider "alternatives to the project or existing project, or alternative ways of undertaking or operating it, that would avoid or minimize any significant adverse environmental or socio-economic effects." Additionally, s. 50(2)(a) requires proponents to consider s. 42(1)(e) in preparing a proposal. In the Casino Mine proposal, CMC quotes YESAB guidance that asks for "functionally different ways to meet the project need and achieve the project purpose" (p 4-109).

Section 4.8 of the proposal outlines alternatives to various Project activities. These activities include methods of transportation of ore, power generation, tailings management, and site access. Several other activities are explicitly excluded in table 4.8-4 from an examination of alternatives; this includes alternatives to employee accommodations, for example.

In addition, briefly, in table 4.8-2, the Proponent provides a cursory evaluation to alternatives to the Project as proposed: delay the Project, abandon the Project, proceed as planned, or change the location of the Project.

The Project is currently in the adequacy phase and thus no significant adverse effects have yet been determined. However, the magnitude of impact of some Project components, such as the tailings management facility and the proposed mine access are likely to result in significant adverse effects.

The Executive Committee requires additional information and detailed descriptions regarding alternatives to the mine access route and the method of tailings disposition in order to complete an assessment of the Project. It is important to note that these alternatives are not contingencies or mitigations, as are requested in other sections of the Adequacy Review Report.

2.1.1 Tailings Management Facility

The proposed tailings management facility is designed to contain tailings and waste rock. Section 4.8.4.4 of the proposal outlines alternative tailings management sites. Sub-aqueous disposal was the only considered option as "the anticipated production rates of the Project were determined early on in the planning phase to be in excess of what could be managed by dry stack tailings (p 4-129)." As such, all alternative locations involve a dam and tailings submersion in water.

The proposal briefly assesses four alternatives, including one involving three separate tailings facilities. The proposal provides some details for various aspects including geographical extent, capital cost, maintenance cost, dam height, and dam volume. Additional information regarding the rationale for the decision to select the proposed tailings management strategy is required. This includes a substantive rationale for the selection of sub-aqueous disposal in addition to work done or information available on the feasibility and design of different tailings management facilities examined in the proposal.

The Executive Committee requires more information in relation to alternatives to this Project activity. Therefore, please provide the following:

R1. All information and rationale used for the selection of the proposed tailings management facility over alternative disposal methods.

R2. Alternative dam construction methods to using cyclone sand.

2.1.2 Mine Access Route

Section 4.8.4.2 of the proposal outlines alternative mine site access routes as the mine will require a new all-season road in order to reach the mine site. The proposal selects three options for evaluation and provides cost estimates for both operations and maintenance. The proposal mentions that these three are considered in a greater degree of detail than others and includes references to the technical challenges of each route. This suggests that more information is available from the data used to determine the choice of access route used in the proposal. Any details on access routes that were not examined in greater detail and the method of selecting routes would aid the Executive Committee in understanding the rationale for the proposed routing in relation to potential effects. Therefore, please provide the following:

R3. All information and rationale used to justify the proposed road alignment over alternative alignments.

2.2 OVERSIGHT OF DESIGN, CONSTRUCTION, OPERATION, AND CLOSURE

Selkirk First Nations consultant, Northland Earth & Water Consulting Inc., notes a lack of details regarding “internal controls that will be used in guiding the design, construction, operation, and closure of the key components of the project which include the heap leach, open pit, and the tailings management facility” (YOR 2014-0002-257-1, p 5). Poorly defined or lacking quality assurance/quality control (QA/QC) measures can result in improper or inadequate oversight of significant mine infrastructure, which could lead to failures and associated adverse environmental and socio-economic effects. The Executive Committee requires additional details to understand the proposed oversight of the design, construction, operation, and closure of mine components. Therefore, please provide the following information:

R4. Identify whether broad-based stakeholder risk assessment processes, such as failure modes and effects analysis, will be completed and/or whether external expert review panels will be used as internal quality controls to guide the project.

R5. Identify if and how independent regulatory audits will be conducted.

R6. Describe how best practices, in relation to oversight, will be applied to the Project given the scale and nature of challenges associated with the proposed activities and site.

2.3 CONSTRUCTION

The Proponent proposes an ambitious timetable for Project construction, especially regarding the Freegold Road Extension and the heap leach facility. The timelines of some activities are dependent on the timing and rate of construction for other activities (e.g. cyclone sand production for the tailings management facility embankments). The staging activities that are required for adherence to proposed timelines are unclear. For example, Appendix 4B (Freegold Road Report) indicates that 75 barge loads will facilitate Project construction, yet no details of this activity are provided. In order to enter the construction phase efficiently, some staging and preparation activities may be required. This is especially true of the Freegold Road given its length.

Appendix 4B (Freegold Road Report) assumes that during construction an equivalent of 75 truckloads will be brought to the site via barge; however, this is mentioned only in a footnote. The Executive Committee requires more information regarding staging and preparation activities. Therefore, please provide the following:

R7. A description of all other staging and preparation activities. For example, equipment, fuel, and material staging for the upgrade to the Freegold Road and construction of the Freegold Road Extension.

R8. Describe the interdependency of and critical path for staging and construction activities.

R9. Details regarding planned barging activity, including frequency, temporal periods, and types of freight anticipated by barge. Additionally, please describe any ancillary activities associated with barging, such as landing sites and access road.

2.4 FEASIBILITY OF THE SULPHIDES REMOVAL PROCESS

Geochemical characterization of the Casino ore body and overburden shows that a majority of excavated rock, and as a result tailings and waste rock, will be potentially acid generating and/or have high metal leaching (ML) potential (CMC, 2014, p 23-5). Since the tailings management facility (TMF) embankments will largely be constructed out of tailings, CMC has proposed to remove sulphides from tailings prior to use in construction. As such, the process used to remove sulphides is critical for producing sufficient construction material for the TMF embankments, while ensuring that those embankments do not generate ARD/ML.

CMC proposes to remove sulphides through a pyrite flotation circuit that would generate two tailings streams – non-acid generating (NAG) and potentially acid generating (PAG). Twenty percent of tailings would be PAG tailings, deposited in the TMF sub-aqueously to reduce the potential for ARD (i.e. sulphide oxidization). NAG tailings would account for the remaining 80 percent of tailings; however, silts and clays, which account for half of NAG tailings, are inappropriate for TMF embankment construction. Generally, proposal documents refer to NAG tailings produced in the sulphide removal process as “cyclone underflow” and “cyclone sand” while finer particles are referred to as “cyclone overflow”. Only NAG tailings, or cyclone sand produced from the sulphide removal process, are a suitable construction material for embankment construction.

Little Salmon Carmacks First Nation's consultant, BGC Engineering, notes that the predicted availability of NAG material appropriate for embankment construction is approximately 12 to 12.5 million tonnes (Mt) while construction requirements will be 12.1 to 12.4 Mt (YOR 2014-0002-274-1). Variation, of even a few percentage points, in the split between PAG and NAG materials could have a significant effect on the availability of construction material. Likewise, the split between NAG cyclone sands, silts, and clays could affect the availability of construction material. BGC notes that the accuracy of predictions regarding the availability of construction material is "at best about ±15%" (YOR 2014-0002-274-1).

Ineffective sulphide removal could lead to insufficient material for embankment construction while increasing the volume of material the TMF must hold. This could result in a shortage of construction material necessitating the use of borrow materials. The proposal notes that borrow materials may be required for embankment construction should cyclone sand be unavailable in sufficient quantities. BGC Engineering states "[s]ince free-draining material must be used in the downstream shell to provide the necessary downward drainage for cellular compaction of tailings that is proposed, and free-draining materials are normally in limited supply, making up for cycloned sand shortages with natural borrow cannot be assured without further study" (YOR 2014-0002-274-1, p 7).

Alternatively, ineffective sulphide removal could lead to the incorporation of PAG material into TMF embankments resulting in ARD/ML from the embankment shell. This could lead to adverse effects to receiving water quality. With 120 000 tonnes of mill throughput per day and potential variation in tailings stream properties, EcoMetrix questions how construction material will be verified as NAG. If variations in tailings are not properly accounted for, portions of the downstream shell of the TMF embankment could become acid generating and lead to adverse effects to receiving water quality. The Executive Committee requires a clear understanding of the sulphide removal process and its implications to water quality. The sulphide removal process has implications on other aspects of the proposal such as water quality modeling, which uses parameters derived from desulphurization including the volumes of NAG and PAG material as well as embankment properties.

The Executive Committee requires more information on the sulphide removal process and its implications for embankment construction. Therefore, please provide the following:

R10. The reports that show results of metallurgical testing and sulphur removal performance from 2009 and 2010 bench tests, as well as the 2012 pilot test by G&T.

R11. Additional information to support the feasibility of the sulphide removal process. Details should include:

a. detailed description of the sulphide removal process;

b. how the process will account for variations in the mineral composition of processed ore and the large tonnage of tailings; and,

c. QA/QC for tailings classification including a detailed schedule for testing.

R12. Additional information on the NAG tailings, or cyclone sand, produced through the sulphide removal process. Details should include:

a. data to show that the sulphide removal will be effective for all ore types;

b. sulphide levels required to produce non-acid generating cyclone sand and tailings;

c. residual sulphide concentrations;

d. how the sulphide removal process will be managed and how the cyclone sand will be monitored and tested during operation to ensure that the required performance limits are consistently achieved; and

e. any remedial measures that may be required should the sulphide removal process be shown to be ineffective.

2.5 ROADS, SUPPLY ROUTES AND TRANSPORTATION

2.5.1 Freegold Road Extension and Upgrade

2.5.1.1 Temporary Construction Camp

Section 4.3.4.1 of the proposal describes a temporary construction camp that will be located near the existing terminus of the Freegold Road. The camp will be used for the construction of the upgrade and extension of the Freegold Road. Little information was provided about the size and scale of camp infrastructure. The Executive Committee requires additional information to assess effects related to the temporary camp. Therefore, please provide the following information:

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.

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.

2.5.1.2 Settlement Land

Section 4.3.4.2 of the proposal indicates that roughly 16 km of the Freegold Road upgrade will pass through Little Salmon Carmacks First Nation (LSCFN) Settlement Land. Section 4.3.4.1 indicates the

Freegold Road extension transects Selkirk First Nation (SFN) Settlement Land. There is no information provided to indicate that LSCFN or SFN would authorize the proposed alignment through their Settlement Lands. In addition, it is not clear what impacts this alignment will have in terms of effects to values of the LSCFN and SFN. The Executive Committee requires additional information regarding Settlement Lands and the access road. Therefore, please provide the following:

R15. Details and information regarding the authorization requirements of the proposed alignment through Settlement Lands.

R16. Discussion of potential impacts to values associated with Settlement Lands and mitigations proposed to address these effects.

2.5.1.3 Road Management Plan

The proposal mentions the road management plan in several sections of the proposal; however, the plan as presented in Appendix 22A fails to provide sufficient detail. This appendix envisions a road use plan developed after a road use agreement is in place. It is unclear how advanced progress is toward a road use agreement and consequently how complete the road management plan is.

There are a wide range of potential effects in relation to road use and management. These include potential effects to wildlife and the use of Settlement Lands. An all-season road to the Casino property could also act as a catalyst for increased fishing, hunting, mineral exploration, resource development and road use – concerns previously identified, such as in the Pearse report (Pearse & Weinstein, 1988).

Little Salmon Carmacks First Nation and Selkirk First Nation comments speak to the importance of road management. Rob Walker Consulting questions Proponent commitments regarding the Freegold Road upgrade, “The absence of the highway owner in the proposal for public highways introduces some uncertainty regarding what project is actually proposed” (YOR 2014-0002-281-1). Further, the means of managing access for the Freegold Road are unclear in terms of legal mechanisms available to the Proponent. Management plan options are both unknown and limited for the existing Freegold Road as this section of road is a public highway.

The proposal, in Section 18.4.1.1, states that during construction, use of the Freegold Road may be limited due to weather or construction. During these times, access may be restricted. The timing and management of closures may lead to adverse effects for existing users. It is unclear how the road management plan will address coordination and communication with other users.

The proposal references several different road use plans, it is unclear if these are in fact referencing the same plan. Therefore, please provide the following clarification:

The Executive Committee requires a road management plan that includes the entire Freegold Road (i.e. bypass, upgrade and extension). Therefore, please provide the following information:

R17. Describe progress on the Road Use Agreement and relevant details that informed the Road Management Plan.

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.

R19. Please confirm that the Road Use Plan, the Extension Access Management Plan, and the Traffic Management Plan refer to the same management plan.

2.5.1.4 Closure

The Freegold Road Report states that:

> Following the completion of mining and the active phase of closure activities, a decision could be made, with the agreement of all stakeholders, to decommission the Freegold Road Extension. Decommissioning of the road will ensure that future vehicular access will not be possible. (YOR 2014-0002-125-1)

Considering that some of the mine infrastructure that will remain in post-closure will require some level of monitoring and maintenance in perpetuity (e.g. TMF west and main embankments), access via the Freegold Road may also be required in the long-term. Little Salmon Carmacks First Nation consultant, Rob Walker Consulting notes:

> It is an unreasonable risk to assume that after 34 years a road will not be required to maintain the mine site, including the wetland treatment facility, the tailings dam or the spillway. Furthermore, qualitative changes such as the pit filling and beginning to clow into the wetland treatment facility do not occur for an estimated 96 years after “final closure”. It should be expected that remedial earthworks will be required on the spillway for a dam with a long a design life (and size!). Spillway remediation has been required on Yukon Energy Dams with each 25 year water licence renewal. Road access for heavy equipment and materials should be contemplated on a much longer timeframe, perhaps 200 years. (YOR 2014-0002-281-1)

The Executive Committee requires additional information in order to assess potential effects related to the Freegold Road and the need for on-going monitoring and maintenance. Therefore, please provide the following information:

R20. Reconcile the intention to decommission the access road with the need to maintain access in order to monitor and maintain permanent infrastructure. Details should include a detailed discussion of access requirements for on-going monitoring and maintenance of site infrastructure and how these activities will be undertaken if the road is decommissioned.

2.5.2 Existing Highways

2.5.2.1 Traffic

The Project proposes extensive use of the Klondike and Alaska highways. Morrison Herschfield raises the concern that the volume and composition of Project related traffic is unknown, making an effects assessment difficult. The proposal's socio-economic baseline report suggests the Alaska Highway is already nearing capacity in places; however, no discussion or information on how this may affect Project operations, or, conversely, how the Project will affect road capacity is provided.

The remote nature of many portions of highways in Yukon means emergency response may be delayed. Given the scale of the Project, and potential hazardous cargoes, the Executive Committee requires information on fleet management.

Project use of public highways will be one of the most visible and regular disturbances to both tourists and residents of Yukon and as such warrants additional analysis. The Executive Committee expects CMC to provide more information on the use of public highways. Therefore, please provide the following information:

R21. A breakdown of Project related traffic volumes, by vehicle type, for the Alaska, North Klondike, and South Klondike highways. Provide a comparison against current traffic levels and capacities including seasonal fluctuations.

R22. Implications of projected traffic due to this Project on the Alaska, North Klondike, and South Klondike highways.

R23. Details on fleet management to ensure rapid response to possible accidents or spills.

2.5.2.2 Weight Restrictions and Spring Thaw

The proposal relies on long logistic transportation routes such as liquefied natural gas (LNG) from British Columbia along the Alaska Highway; ore concentrate sent to Skagway via the South Klondike Highway; and other routes for employees and materials traveling to and from the Project site. Potential risks associated with long and vital transportation routes include spring road restrictions, avalanche, forest fire, export capacity, and import availability. Section 17.3.6.1 of the proposal outlines the threat of spring road closures stating:

> Because much of the Yukon highway system is exposed to extreme freezing and thawing episodes throughout the year, roadways are subject to more damage from truck traffic than normal paved roads. As a result, the Yukon government imposes seasonal weight restrictions on highway traffic in the spring when the frost is coming out of highways and other public roads. Weight restrictions to 75% of maximum legal weight (63.5 tonnes) are typically in effect from the second week in April to the second week in May … it is possible to secure a special bulk commodity permit for heavy haul vehicles throughout the year and during the weight restriction period to enable the carrier to increase the maximum gross weight… (p 17-16)

Given the importance of transportation routes for critical aspects of the Project (e.g. a steady supply of LNG to ensure adequate power at the site), the Executive Committee requires additional

information to address transportation route concerns. Therefore, please provide the following information:

R24. Describe if weight restrictions are predicted to interfere with Project logistics including the anticipated frequency for which a special variance permit may be requested.

R25. Describe maximum predicted haulage weights, including maximum anticipated weights for the importation of equipment and infrastructure.

2.5.3 Traffic Through Carmacks During By-pass Construction

Section 4.3.4.1 of the proposal indicates that the Carmacks by-pass will follow a Government of Yukon surveyed route. The intention of the by-pass is to minimize the effects of mine related transportation through central Carmacks; however, there is an absence of information on traffic and road use prior to the by-pass completion. During construction of the by-pass there may be significant traffic and use of existing roads through Carmacks for an indeterminate length of time.

The Socio-economic baseline report highlights a public safety concern in Carmacks related to the lack of sidewalks and the pedestrian movement that occurs along the shoulder of the Klondike Highway and area bridges. Furthermore, a major medical concern in Carmacks is motor vehicle related accidents, as stated in the Socioeconomic Baseline Report. As such, increases in traffic may have a disproportionate effect on health services in Carmacks. Despite the effort to minimize this effect by building a by-pass, concerns relating to traffic during the construction phase remain. As such, the Executive Committee requires more information on the management of traffic within and near the community of Carmacks. Therefore, please provide the following:

R26. Traffic projections for mine related traffic within Carmacks, detailed by vehicle class and type, prior to the Carmacks by-pass becoming operational.

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.

2.5.4 Imports and Exports

The proposal is unclear on the sourcing of several key materials, as well as the challenges associated with transporting product to market. While the proposal indicates potential sources for LNG, confirmation of supply routes is required for other materials, especially hazardous materials. The proposal indicates that CMC intends to export ore via Skagway (table 4.1-1) and provides some

details on facilities in Skagway (17.3.6.5); however, the proposal is lacking in details on the feasibility of using the Port of Skagway to export ore from the Project. The Executive Committee requires additional information in order to review the impacts to public roads from transportation routes. Therefore, please provide the following information:

R28. Describe the sourcing of primary mine materials, delineating supplies arriving from Skagway from those from British Columbia and elsewhere. Please distinguish between materials such as primary flotation supplies, heap leach supplies, lubricants, fuels, and cyanide.

R29. Confirm that the export plan is, or will be, logistically possible.

2.5.5 Dangerous Goods

The proposal is unclear on the volumes of potentially environmentally harmful materials and materials harmful to human health. The Proponent intends on processing 120 000 tonnes of ore daily. This will necessitate considerable volumes of flotation, heap leach, and explosive chemicals, among others. For example, an 8 000 tonne pebble lime silo will be on-site. The Executive Committee requires additional information regarding the transportation of dangerous goods in order to determine potential effects related to emergency response and for public interest. Therefore, please provide the following information:

R30. Describe, as best as possible (if data are unavailable, please indicate anticipated rates of use), the frequency, weight, size, truck type, and carrying capacity of trucks carrying:

a. pebble lime;

b. sodium disobutyl dithiophashinate;

c. sodium diethyl dithiphoshinate;

d. methyl isobutyl caribinol;

e. potassium xanthate;

f. sodium hydro-sulphide;

g. sodium cyanide;

h. sodium hydroxide;

i. hydrochloric acid;

j. sulphuric acid;

k. ammonium nitrate;

l. diesel;

m. lubricants;

n. liquefied natural gas;

o. ore concentrates; and

p. other hazardous materials.

2.6 WATER MANAGEMENT PLAN

A Water Management Plan (WMP) is provided in Appendix 4C (Water Management Plan) of the proposal and presents a strategy for managing water at the Casino Mine in the phases of construction, operations and closure. There are several issues that have been identified with the WMP, including the need for more data collection, data analyses, as well as clarification of WMP infrastructure component designs. The questions related to the WMP raised are grouped by technical issue as follows and are discussed further below:

- Conveyance of water during the instantaneous peak flows from the site catchments and the resulting sediment that will be generated;
- Storage of water that is chemically impacted or sediment laden during high intensity flow events and prolonged wet periods over several weeks or months; and
- Failure probabilities for water management plan infrastructure.

Section 2.10.9 of this report also discusses:

- Seepage Water Management from the main embankment of the tailings management facility (TMF) after closure.

The WMP identifies overall site water management and includes strategies for operational water management and sediment and erosion control. The plan considers all phases of the mine life (i.e. baseline, construction, pre-production, operation, closure and post-closure). However, CMC's WMP is conceptual in nature and lacks specific details in several areas. For example, although the WMP includes staged layouts of the mine site showing water management infrastructure, there is no inclusion of design drawings, plans or cross-sections of proposed infrastructure.

A detailed water management plan is essential for identifying how projected water inputs and outputs will be managed through all phases of the Project and is critical to the functionality of key mine site infrastructure (e.g. heap leach facility and TMF).

The Executive Committee requires detailed information regarding water management practices in order to understand the potential impacts to key mine site infrastructure and associated adverse environmental and socio-economic effects. Therefore, please provide the following information:

R31. Additional detail in the Water Management Plan that includes all Project components and phases. Details should include:

a. appropriate figures and plans illustrating site water management, including flow sheet information such as monthly water volumes; and

b. figures, plans, and sections for key collection and conveyance facilities associated with the Project.

2.6.1 Conveyance of Water

Large river systems in the region generally have annual peak instantaneous stream flows that occur during spring snowmelt. However annual peak instantaneous flows for small streams in the region may also be generated by summer convective rainstorms or rain on snow events. These peak instantaneous flows in the regional river systems can occur anytime between May and November. This provides a challenge for water management during the construction phase of the mine as these instantaneous peak flows could occur anytime during the prime spring, summer and fall construction period. The site water management structures must be designed and constructed to convey these potential flow events at the beginning of construction.

The Proponent outlines a conveyance channel general design criteria for a 24-hour storm event period in the WMP. However, this is not appropriate for all areas drained by a ditch. The time of concentration (the time when all areas of a catchment will be contributing to the discharge assuming a uniform rain over the catchment) of each catchment must be considered to select the critical storm time for each catchment.

The Executive Committee requires more information requiring conveyance channel requirements and modeling. Therefore, please provide the following information:

R32. A description of the methodology used to determine flows for storm events including supporting information such as catchment areas, time of concentrations, inclusion of rain and snow melt events, design events, and results.

R33. Detail and describe the methodology and references used to determine the probable maximum precipitation in relation to conveyance channel design and events pond standards.

The design details for proposed run-off diversion ditches up gradient of stockpiles and the HLF are insufficient to assess their effectiveness for high flow conditions. High flow events, which may increase in frequency and magnitude due to climate change, could result in erosion, water flow under the HLF, clean intercepted run-off diverted to the TMF and damage to the integrity of the HLF. Erosion concerns are magnified for potentially steep channel gradients in several areas associated with the HLF that may require special engineering considerations for long-term stability due to high-flow velocities.

Despite the WMP objective to “keep non-contact water clean,” there are several examples in proposal where non-contact water from a variety of sources will report to the TMF. For example, the WMP states that diversion ditches “are designed to divert non-contact surface runoff around mine facilities to downstream areas. 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” (YOR 2014-0002-119-1). It is understood that water from various sources will be directed to the TMF for operational use. However, diverting clean run-off water into the TMF seems to violate the WMP strategy of keeping non-contact water clean. In addition, more clarity is necessary to assess how water will be collected and conveyed to the TMF.

The Executive Committee requires additional information to understand water management infrastructure. Therefore, please provide the following information:

R34. 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.

R35. A discussion of measures to be taken should one or more sections of the proposed heap leach facility (HLF) diversion ditches be found to be ineffective or should excessive erosion become an issue.

R36. A discussion of alternatives that CMC considered, including justification and rationale for the use of the proposed ditches.

R37. A description of the diversion ditch on the southwest side of the HLF, including a drawing indicating its proximity to the edge of Byrnelson Creek north tributary sub-watershed. Include a discussion of potential effects to and relevant mitigations for this watershed

R38. Additional information regarding design of channels in the area that will be susceptible to erosion.

R39. Rationale for directing various non-contact water sources into the TMF. Include a discussion of how non-contact water will be managed throughout the life of the Project.

2.6.2 Storage of Water

There are several facilities required at the mine for the storage of water. These include water storage in the TMF, TMF seepage storage during winter, HLF water and solution storage, HLF events pond and water and solution storage.

The WMP states that the water management pond and sedimentation ponds will be designed to accommodate the 10-year peak flow and safely convey up to and including the 200-year flood. It is unclear if return periods for design events is for rainfall events or rainfall-snow melt events. Also extended retention times and slow release of water may be required for adequate sediment removal. The WMP does not clarify whether the design sizes of the water management pond and sedimentation ponds are for settling out specific target particle sizes or for meeting effluent objectives. It is unclear whether the proposed infrastructure is appropriate for all intended purposes. The Executive Committee requires additional information to understand the objectives of the ponds' designs in terms of intended functions. Therefore, please provide the following information:

R40. Further rationale for sizing of the water management pond and sedimentation ponds in terms of sediment removal and confirm if the proposed sizes will meet objectives.

R41. Clarify whether the size of the event pond is for managing return period rainfall events or return period snow melt-rain events.

2.6.3 Probability of Failure Analysis of Infrastructure Components

The selection of return period design criteria for the site WMP is not clear. The probability of design exceedances (and, thus, likely failure) of each component requires closer evaluation. For example, the HLF embankment spillway is designed to convey a peak flow from a 1 in 200-year storm event. The HLF spillway, with four years of construction, 18 years of operation, and five years ore detoxification is proposed for 27 years. This results in a 12 percent chance of one event greater than a 1 in 200-year event and nearly a one percent chance of two or more events of this magnitude. A failure probability of nearly 13 percent appears to be high.

The choice of return periods used as design standards for all WMP infrastructure components needs further support. Of particular concern is the permanence of many components of the WMP. The Executive Committee requires more information regarding design standards of WMP infrastructure. Therefore, please provide the following:

R42. 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.

2.7 HEAP LEACH FACILITY

2.7.1 Foundation Conditions and Preparation

The proponent plans to construct a large heap leach facility (HLF), which will contain a total of 157 Mt of ore with a maximum vertical thickness of 150 m. Construction of the pad for the HLF will require the stripping of “approximately 0.5 metres of topsoil and vegetation and the removal of any talus boulders” (YOR 2014-0002-161-1, p 21). Where ice rich soils are encountered excavations will continue to competent bedrock to ensure a smooth surface for the HLF; the pad will be backfilled and graded if necessary. However, the origin of required backfill material is not clear within the proposal.

BGC Engineering raises concerns that competent bedrock may be an irregular surface and deeper than expected. Due to a lack of historical glaciation, bedrock may be weathered and, as such, inadequate as a foundation for the HLF pad (YOR 2014-0002-274-1).

Environment Canada highlights uncertainty regarding QA/QC criteria during construction of the HLF. QA/QC is essential for proper functioning of the HLF liners. Concerns include preparation of the ground for the liner as well as the liner itself (YOR 2014-0002-249-1).

Environment Canada notes that the consultation materials (Appendix 2B) indicate that foundation drains may be required (YOR 2014-0002-249-1). There is no other reference to required drains. A robust understanding of foundation conditions during design and construction is essential to ensure facility stability. The Executive Committee requires more information regarding the HLF foundation conditions. Therefore, please provide the following:

R43. Detailed information on the sources and quantities of suitable borrow materials.

R44. Clarify whether HLF excavations will be to competent bedrock or weathered bedrock. Provide justification and the criteria used to determine the suitability of the foundation for the HLF.

R45. Details on foundation preparation including drainage management and accommodation of the proposed liner.

2.7.2 Liners

The HLF will use liners to collect solution leachate and reduce the potential for leachate leaks into the surrounding environment. The HLF will use two different liners, a single liner system for the upper portion of the HLF pad, and a “ponded” double liner system for the lower portion to hold solution and water.

Environment Canada comments that with a maximum vertical thickness of 150 m, the use of a 30 cm low permeability soil liner may be insufficient (YOR 2014-0002-249-1). The liner systems will be protected during ore stacking by the overliner. However, BGC Engineering points out that the overliner will likely be less permeable than the stacked material above it given that the overliner layer, built of crushed ore, will contain more fines than the ore above it (YOR 2014-0002-274-1). This may inhibit drainage along the top of the liner, which could result in higher than acceptable hydraulic head.

The Executive Committee requires more information on the liner systems proposed as part of the HLF; therefore, please provide the following information:

R46. Rationale for the sufficiency of a 30 cm thick soil liner.

R47. A description of the composition and potential effects of the overliner on the performance of the liner considering permeability and hydraulic head.

2.7.3 Leak Detection and Recovery

The leak detection and recovery system (LDRS) is designed to collect solution that leaks through the HLF liner system. The nature and effectiveness of the leak detection and recovery system is unclear. The HLF will be monitored for leakage by a network of 16 detection cells; however, there is a lack of detail regarding leakage recovery mechanics, leakage transport and repair options post-leak discovery.

The Executive Committee requires more information on the LDRS; therefore, please provide the following information:

R48. Details on the mitigation and management of leaks from the HLF including during all stages of operations.

R49. Details on the maintenance and repair of the LDRS sump and pumps.

2.7.4 Leachate Solution and Water Flows

The HLF includes various structures and systems to manage and control leachate solution, including: a confining embankment; liners; an overliner; a leachate collection system; a leak detection and recovery system; an events pond; and, pipelines and pumps.

Section 4.3.2.4 and the Knight Piésold report titled Feasibility Design of the Heap Leach Facility outlines details on the general design and construction of these components with the notable exception of infrastructure such as pipelines and pumps. Pipelines and pumps will be required to transfer leachate solution between the gold recovery building, HLF, events ponds, etc. Additional infrastructure will be required to apply barren solution to the HLF to initiate leaching. This type of infrastructure can be a source of contamination to the environment due to spills or leaks at various points.

The Executive Committee requires more information on the infrastructure for conveying HLF solution and water between HLF components in order to address potential effects associated with spills and leaks of leachate solution. Therefore, please provide the following:

R50. 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.

The water balance of the HLF in the report “Feasibility Design of the Heap Leach Facility” indicate that the HLF will operate in a water deficit for most of its operational life. Makeup water requirements are predicted to be highest during the initial years of operation, decreasing throughout operation. For the final years, the HLF will operate with a water surplus. Water makeup requirements over the life of the HLF are estimated at 4.3 million m^3, however the proposal notes that the water balance model for the HLF is sensitive to moisture content values for the stacked ore. The water balance also assumes average climactic conditions. It is unclear how varying wet or dry conditions may affect water and solution balances. Solution balances, in wet and dry conditions, related to irrigation, evaporative loss, ore wetting, and flow to the ADR plant, are also unclear.

The events pond is designed for a 1 in 100-year 24-hour storm event while the spillway is designed for a 1 in 200-year 24-hour storm event. LSCFN’s consultant, BGC Engineering, expresses concern over the lack of clarity over the volume of solution that would be contained within the events pond during a storm event (YOR 2014-0002-274-1). BGC Engineering requests expected volumes by source behind the embankment and in the events pond, as well as clarification that full heap draindown can be stored.

BGC Engineering also raises concerns on the design criteria of the events pond and the spillway, as it is unclear why these return periods were chosen. The consequence of a storm event that exceeds the design specifications is also unclear.

The Executive Committee requires more information on the solution and water flows of the HLF. Therefore, please provide the following:

R51. Volumes and sources of water stored in the embankment and the events pond during a 1 in 100 year 24-hour storm event.

R52. Sensitivity analyses for makeup water requirements and water retention requirements for different moisture content values for stacked ore and wetter or dryer climatic conditions. Include a discussion on any implications in relation to HLF and events pond storage capacity.

R53. A description of the HLF solution balance including in wet and dry conditions.

R54. Rationale for the selection of design criteria for HLF events pond and events pond spillway sizing. Include a discussion on potential consequences resulting from larger hydrological events.

2.7.5 Wells

CMC proposes three leachate recovery wells located at the base of the downstream slope of the HLF pad. The upper portions of these well casings are located within 3 m of compacted crushed ore, while the lower portions of are set within 3 m of screened gravel. BGC Engineering notes that this may present a risk to the integrity of the well casings as materials which are not compacted settle within the HLF. The drainage capacity of this screened gravel may also be compromised due to the migration of fines. The Executive Committee requires more information on the leachate collection wells of the HLF. Therefore, please provide the following:

R55. Discussion on the potential for the buckling and decreasing efficiency of collection wells for leachate recovery.

2.7.6 Ore Stacking Rate

EcoMetrix notes that “Once constructed, many of the elements of the HLF would be difficult, if not impossible, to modify or change” (YOR 2014-0002-235-1). Certain conditions such as unexpected ore characteristics could result in greater-than-expected leach times, which could lead to reduced stacking rates. The proposal includes an allowance to divert and temporarily store excess oxide ore in the gold ore stockpile; however, there are no other contingencies in the proposal to address the potential need for additional stockpiling of oxide ore.

If the Proponent’s estimates for leach time per lift are not accurate or conservative, there may be otherwise unexpected consequences on other aspects of the operation. The Executive Committee requires additional information to assess the potential impacts of longer-than-projected leach times or reduced HLF stacking rates. Therefore, please provide the following information:

R56. Estimates for the approximate tonnage in each ore lift within the HLF.

R57. Clarification on the leach cycle activities and durations.

R58. Identify additional metallurgical test work that has been undertaken or is planned prior to/during construction and operation to improve leach cycle time estimates.

R59. A discussion on the implications of the following scenarios and provide consideration of options that the mine could implement should the following unforeseen conditions occur during construction and operations:

a. leach times that are significantly increased for short or extended times. As an example, if the leach cycle is unexpectedly increased from 60 days to 100 days for an extended time;

b. shortages in stockpile capacity for excess oxide ore should the expected HLF stacking rate need to be reduced;

c. possible extension of the HLF operation beyond Year 15 due to longer than anticipated leach cycles; and

d. requirements for additional gold ore stockpile capacity and/or provisional spare leach pad later during operations since the surface area of the lifts will be reduced as the heap extends upslope.

2.7.7 Road Section Details

The confining embankment at the toe of the HLF will provide stability to the stacked ore and in-heap storage for leach solution. However, it appears that the embankment will also accommodate road traffic as well as house infrastructure (e.g. pipelines and electrical cables) that run between the main power plant, concentrator buildings, gold recovery building and cyclone plant. The proposal describes the construction of the confining embankment in general terms. However, considering the multi-functionality of the confining embankment, the Executive Committee requires additional information to assess the compatibility of these features and the integrity of the structure throughout the various stages of the project. Therefore, please provide the following information:

R60. Additional details regarding the HLF confining embankment giving consideration to the varying functions of the structure (i.e. HLF stability, leach solution storage, road traffic, and housing services). Details should include:

a. construction methods and design of the section of the access road situated between the confining embankment toe and the events pond;

b. measures incorporated into its design to protect any buried services and the confining embankment drainage blanket; and

c. clarification regarding whether or not the confining embankment drainage blanket will extend under the road and daylight in the tailings management facility area.

2.7.8 Construction and Commissioning

Section 4.3.2 of the proposal outlines tasks to develop and bring the HLF and associated facilities into operation in Years -4 to -3 (i.e. 4 to 3 years prior to the operations phase). Phase 1 of the HLF development will require construction of the foundation, confining embankment, liner system,

leachate collection system, events pond, storm water management infrastructure, etc. The proposed construction schedule may be optimistic due to several considerations, including:

- requirements for personnel with specialized training to operate, maintain, monitor and oversee the HLF construction and associated operations;
- challenging climatic and physical conditions at the site; and
- challenges in securing adequate borrow materials for construction (quantity and/or quality).

Construction and start-up of the HLF will coincide with other construction activities and delays could influence other project components not contemplated in the proposal. It will be critical to ensure that adequate quality assurance/quality control (QA/QC) measures are in place with attention to the considerations above. The Executive Committee requires additional information in order to review the feasibility of construction and commissioning the HLF as proposed. Therefore, please provide the following:

R61. A detailed schedule for the works required to construct the HLF and commence leaching operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays.

R62. Implications of scheduling delays or suspension of HLF construction.

R63. Details on the specialized personnel required to construct, operate, maintain, monitor and oversee the HLF.

2.7.9 Missing Information

There are numerous references in the proposal to Section 4.4.4 in which detailed information is supposed to be provided describing the operation of the HLF. This section is missing from the proposal. Therefore, please provide the following information:

R64. The missing Section 4.4.4 of the project proposal.

2.8 TAILINGS MANAGEMENT FACILITY

The tailings management facility (TMF) requires the construction of a dam across the Casino Creek valley to contain approximately 956 million tonnes of tailings and 658 million tonnes of waste rock and overburden material. The dam is comprised of the main embankment and a smaller west embankment constructed of a low permeability core, rockfill and non-reactive waste rock, and cyclone sand from de-sulpherized tailings. The main embankment will be approximately 286 m high at the deepest part of the Casino Creek valley and 2 460 m wide. The west embankment will be approximately 21 m high and 333 m wide.

The proposed TMF main embankment would be one of the world's highest dams and the highest tailings dam. As such, the proposed dam would be unique on a global scale. Little Salmon Carmacks First Nation's consultant, BGC Engineering, aptly states that it "is beyond the current state of practice" (YOR 2014-0002-274-1).

This section speaks to the design details and construction of the TMF dam. Additional issues associated with the dam can be found in other sections of this report including sections: 2.10, Conceptual Closure and Reclamation Plan; and 4.0, Water Quality and Quantity.

2.8.1 Design Methodology and Feasibility

The TMF will be a permanent feature storing mine tailings and waste rock in perpetuity and has a strong potential for significant adverse effects if it fails or does not perform as intended. The TMF dam provides not only the physical containment of tailings, but the geochemical containment. If the TMF fails in physical containment it would allow "uncontrolled acid generation and metal leaching from the released tailings" (YOR 2014-0002-274-1). Geochemical containment can also be lost should the TMF be ineffective in providing a long term water cap for tailings. Both physical and geochemical containment of tailings must be maintained forever. This will require care and maintenance of the dam, including "the repair of damage to the dam and ancillary structures due to multiple maximum credible earthquakes and probable maximum floods" (YOR 2014-0002-274-1). The proposal is not clear as to how the TMF dam will, or can, remain stable in perpetuity. Given the importance of the TMF's reliability in perpetuity, the Executive Committee cannot complete an assessment of the Project without more clear evidence of the TMF's feasibility, design, and effectiveness.

BGC Engineering questions the Proponent's "high" classification of the dam under the Canadian Dam Association's (CDA) Dam Safety Guidelines (Canadian Dam Association, 2007) and suggests an "extreme" rating is more appropriate considering the unique nature of the facility and the fact that it must remain functional in perpetuity.[1] EcoMetrix also suggests an "extreme" rating as "[a] breach failure of this dam could result in the release of major amounts of both contaminated water and liquefied NAG and PAG tailings." (YOR 2014-0002-235-1)

Considering the unique nature of the facility BGC Engineering suggests that the Proponent "convene a review board of experienced tailings dam engineers at the feasibility stage to examine the design for critical components that may affect the technical feasibility of the dam" (YOR 2014-0002-274-1). The proposed TMF dam is beyond the current state of practice. Most dams of this size and status engage a review board at the feasibility stage to examine the design for critical components.

Both EcoMetrix and BGC Engineering question the use of a safety factor of 1.3 during construction. EcoMetrix notes that the factor of 1.3 is intended to account for "the build up excess of pore pressures during construction, which would later dissipate with the factor of safety being brought up

[1] An "extreme" hazard classification includes losses affecting "major storage facilities for dangerous substances" and/or "major loss of critical fish or wildlife habitat. Restoration or compensation in kind impossible." Proposal DOC 20-8. CDA Dam Safety Guidelines for an "extreme" classification require a design for probable maximum flood (PMF) and a 1 in 10 000 year earthquake rather than a flood one third between a 1 in 1 000 year flood and the PMF and a 1 in 2 500 year earthquake.

to a minimum of 1.5." Since the downstream embankment of the TMF dam is to be built with free draining materials, there will be no buildup of excess pore pressures. BGC Engineering notes that a factor of safety of only 1.3 is required during construction only if fluid is not impounded since failure "the consequence of a dam failure is limited to repair of the dam." (YOR 2014-0002-274-1) As the TMF dam will be impounding tailings throughout the course of most of its construction, a factor of safety of 1.5 is required. EcoMetrix also notes that the lower safety factor of 1.3 only applies "prior to the first reservoir filling." (YOR 2014-0002-235-1)

The Executive Committee requires confidence in the feasibility of the dam. While unique, the structure may have similarities or comparable qualities to other existing dams or geomorphologically stable natural formations. As such, the Executive Committee requires more information regarding the feasibility and hazard classification of the TMF dam. Therefore, please provide the following:

R65. Additional justification and rationale for the "high" hazard classification for the tailings management facility. In addition, provide details on construction and design implications of using an "extreme" hazard classification.

R66. If available, comparisons with other similar sand embankments or compacted sand dams, and/or natural analogs within similar environments. The discussion should include details on permeability, stress, strength, and performance of these structures.

R67. Detailed rationale for the selection of the factor of safety during dam construction.

R68. Evidence demonstrating that the stability of the proposed TMF dam can be achieved through a post-closure period lasting thousands of years. Include a discussion on technically feasible options for managing the risk to downstream areas in perpetuity.

2.8.2 Earthquakes

The proposal places the tailings dam over an area with existing artesian conditions. Excavations required for the construction of the TMF dam foundation will result in dam drains below the water table. If the base of the dam is saturated, there exists a potential for liquefaction of the base of the dam during an earthquake. Accordingly, BGC Engineering asks for "details of the methods that were used to justify the assumption that the cycloned sand will remain well drained." (YOR 2014-0002-274-1)

The derivation of parameters related to dam stability is unclear. These parameters include the amplification factor used for ground motion along a potential slip surface through the embankment and for the average shear wave velocity in the 30 m closest to ground surface. For the latter it is unclear if an average V_{s30} of 560 m/sec reflects local conditions or generalized National Building Code of Canada criteria. It is also unclear why a factor of 1.2 was used to derive mean peak ground accelerations from median peak ground accelerations. BGC Engineering suggests that they be derived directly from the EZ-FRISK analysis.

Natural Resources Canada indicates that the uniform hazard spectra for the TMF location has a peak amplitude at a period of 0.2 s. BGC Engineering questions figure B.2 of the Report on Feasibility Design of the tailings management facility which indicates a spectral period of approximately 0.75 s.

The extent of deformations or remediation is not clear in the event of a maximum design earthquake (MDE). Appendix C of the TMF feasibility report states that "limited deformation of the tailings embankment is acceptable" provided that the TMF maintains its integrity, but the report continues, "some remediation may be required following the MDE". While Appendix B of the TMF feasibility report states that exceedance of the MDE is approximately one percent, this is for only the operating period of the Project. The TMF will pose the greatest hazard upon completion, at its maximum height and with maximum containment of PAG materials. The probability of an MDE, even of a 1 in 10 000 year event, approaches 1.0 for a structure that must remain in place forever. More information on potential deformation, monitoring, and remediation activities are required to assess a structure that is proposed to act in perpetuity.

The Executive Committee requires more information regarding the assumptions and outcomes related to potential earthquake events. Therefore, please provide the following:

R69. An explanation on the likelihood and implications of saturation of the TMF dam's foundation, drains, and lower portions.

R70. Justification and rationale for using a factor of 1.5 for ground motion amplification for potential slip surfaces in the embankment foundation.

R71. Clarification if V_{s30} is site specific and how it was derived.

R72. Mean peak ground acceleration values derived from EZ-FRISK.

R73. Explanation of the difference between Natural Resources Canada spectral periods and the spectral periods presented in the report on the feasibility of the TMF.

R74. Explanation on monitoring and remediation activities that may be required during closure including the extent of remediation required in event of an MDE.

2.8.3 Flood Modeling

The proponent conducted modeling to determine the inflow design flood (IDF) requirements of the TMF. The IDF is defined as one third between a 1 in 1 000 year flood and the probable maximum flood as indicated in for "high" hazard classification dams in the CDA Dam Safety Guidelines (Canadian Dam Association, 2007). Section 2.8.1, above, discusses concerns regarding the dam classification. Confidence in modeled flood magnitudes are critical to understanding dam structural requirements.

Government of Yukon notes that "the methodologies describing the inflow design flood (IDF) events and probable maximum precipitation (PMP) are not clear" and that the IDF and PMP "described are deficient" in their derivation and as such require re-analysis and additional modeling (YOR 2014-0002-252-1). In particular, YG identifies that the PMP method is "dated and too simplistic" and that "more modern storm expansion techniques should be used given the size and potential impact of failure of the TMF (YOR 2014-0002-252-1)." They also note that "it is not clear what the rationale is for using a 100yr design snowpack, rather than a longer time period event." As IDF and PMP are

critical to informing TMF design, the Executive Committee requires more information regarding these parameters. Therefore, please provide the following:

R75. Reassess and model the IDF and PMP using modern storm expansion techniques. In addition, provide:

a. a full description of the methodology used; and

b. rationale for using a 100-year design snowpack.

2.8.4 Spillways

During construction and operation, the Proponent does not intend to build or use a spillway for the TMF. A spillway will only be constructed after operations as part of site closure, which will drain TMF discharge from the south wetlands into Casino Creek above the confluence with Brynelson Creek.

Emergency spillways are typically a critical design component of earthfill or rockfill dams to prevent overtopping. There are potential scenarios where an emergency spillway would be required to protect the physical integrity of the dam, including higher-than-anticipated operating water levels in the facility or failure of the HLF and/or ore stockpiles (i.e. potential displacement of water related to a slide of solids into the TMF).

During closure, when a spillway is proposed, the Proponent has not clearly modeled spillway outflows. AEH and BGC Engineering suggest more elaboration on the parameters that informed spillway design and their derivation, including the time distribution of rainfall for a probable maximum precipitation event along with relevant hydrographs. Maintenance and monitoring activities of the spillway are unclear, especially in terms of maintaining adequate clearance.

Section 10.4.2 of the proposal notes the discharge from the TMF closure spillway will increase flow in Casino Creek during spring freshet by 25 to 50 percent. BGC Engineering notes a steep gradient of 14 percent for the spillway that pose a long term erosion risk (2014-0002-274-1). Spillway discharge into Casino Creek may also increase erosion within Casino Creek. Further information is required to understand potential effects of erosion due to the closure spillway.

The Executive Committee requires rationale for the lack of a spillway during operations and additional information about the design and operation of the closure spillway. Therefore, please provide the following information:

R76. Rationale for not constructing an emergency spillway for the TMF during operations.

R77. A discussion on potential consequences of HLF failure resulting in displacement of water in the TMF.

R78. A discussion and details of the methodology used to determine closure spillway requirements and relevant data such as time distribution of rainfall and relevant hydrographs.

R79. Discussion of the potential for closure spillway blockages and expected extent of maintenance and monitoring the spillway.

R80. Identify mitigations, with appropriate thresholds for implementation, and monitoring activities for closure spillway related erosion, both in the spillway channel and downstream water bodies.

2.8.5 Embankment Failure

The proposal and supporting documents do not adequately consider potential adverse effects downstream of the TMF should the main or west embankment fail. The results of an embankment failure would be extreme, but the proposal information does not allow for a meaningful evaluation of the potential effects. The 'Report on Feasibility Design of the Tailings Management Facility' recognizes that:

> The environmental impact on downstream watercourses has the potential to be significant if a failure resulted in the release of tailings and/or process water into Casino Creek. An uncontrolled release into Casino Creek may flow into Dip Creek and potentially to the Yukon River by way of the Klotassin, Donjek and White Rivers (YOR 2014-0002-176-1).

Full consideration of the consequences of potential embankment failures requires a dam break and water-tailings inundation study, followed by a quantitative study of the impact to the downstream aquatic and terrestrial resources. EcoMetrix notes that the current classification of the main embankment may be inappropriate because of the extreme, long-lasting environmental impacts downstream following a breach failure (2014-0002-235-1). The dam break analysis and inundation mapping should inform the consequence rating for the TMF embankments and appropriate design standards.

In accordance with YESAB's *Dam Guide: Design Expectations and Required Information* (YESAB and Yukon Environment, 2012), the Executive Committee requires additional information to understand and assess potential effects within the downstream environment. Therefore, please provide the following information:

R81. A dam breach analysis with water/tailings inundation modeling consistent with the Canadian Dam Association's dam safety guidelines including:

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.

2.8.6 Dam Core and Downstream Filter

The TMF main embankment core is proposed to be a uniform thickness of 20 m from 830 m asl to the crest of the dam at 998 m asl (Figure 1). Downstream from the dam core is a 4 m wide filter zone to move any seepage from the core through the embankment.

The core of the dam appears to be relatively thin for much of its height. EcoMetrix (YOR 2014-0002-235-1) notes that dam cores are generally one quarter to one third of the differential hydraulic head, while BGC Engineering (YOR 2014-0002-274-1) adds that the thickness of the proposed core is roughly one eighth of the differential hydraulic head or "very thin". The relative thinness of the core, and downstream filter zone, may lead to increased risk of failure due to deformation of the core and filter.

The Executive Committee requires further information regarding the design of the TMF in relation to core width. Therefore, please provide the following:

R82. Rationale for the proposed thickness of the core and downstream filter, considering the dam height and permanent performance requirements.

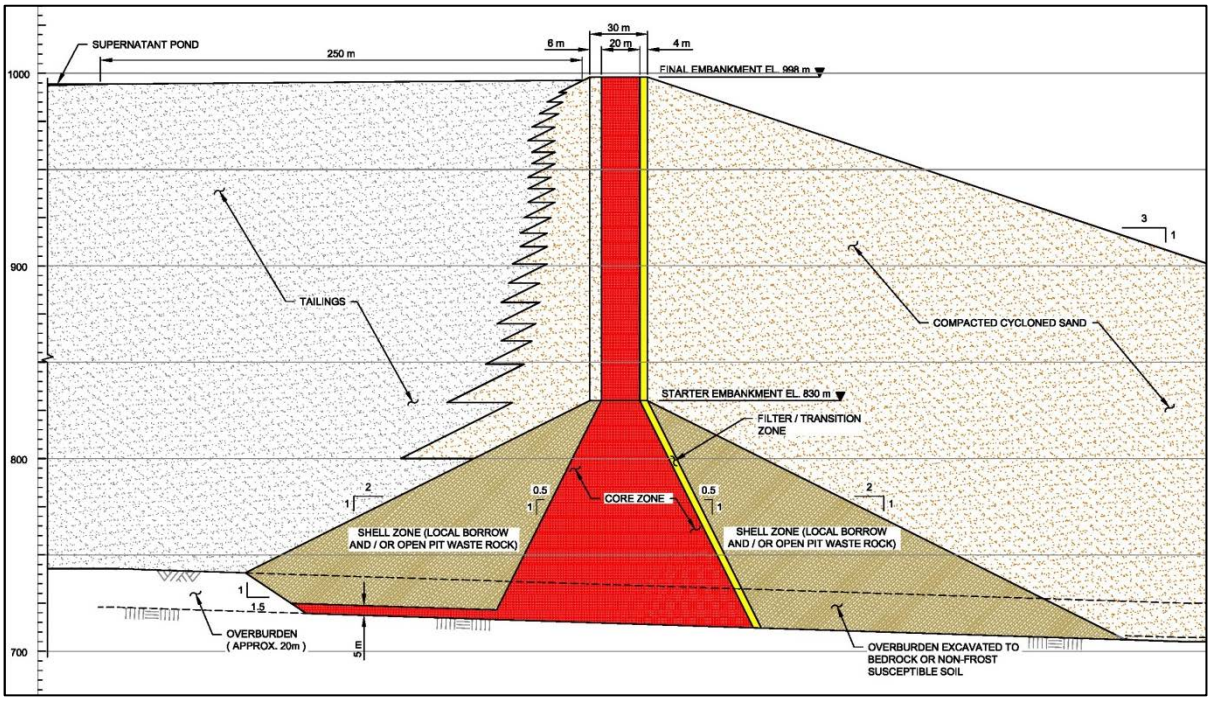

Figure 1: Cross-section of TMF main embankment showing the dam core

Notes: Dimensions and elevations are in metres unless noted. General topography shown.
(Casino Mine Project Proposal – Knight Piésold Ltd., Report on Feasibility Design of the Tailings Management Facility (VA101-325/8-10), p 53)

2.8.7 Use of Cyclone Sand in Embankments

The Proponent proposes to use cyclone sand for use in embankment construction. The Proponent proposes a limit of 12 percent fines for embankment material. This represents about 50 percent by weight of the tailings stream. This ratio is important for meeting embankment material requirements. The properties of embankment sand must be understood to properly assess potential implications of its use.

The Executive Committee notes that embankment construction material with a fines content upwards of 12 percent may result in relatively poor drainage characteristics for the downstream shell of the main embankment. Furthermore, that materials with as few as 10 percent fines may be frost susceptible (Chamberlain, 1981). The potential for frost susceptibility could affect embankment stability and long-term performance.

LSCFN's consultant, BGC Engineering, questions the use of cyclone sand and its suitability for the construction of a dam so large. Given the dam's height there will be immense pressure on sand near the foundation. BGC Engineering states:

> the tests at the two highest confining pressures – 1370 kPA and 2760 kPa, which are at about a quarter and a half of the ultimate vertical pressures under the dam – show contractive behaviour in which the steady state strength decreases from the peak strength due to shear-generated pore pressures. Unless these shear-generated pore pressures are properly accounted for, limit equilibrium stability analyses using peak effective stress friction angles will over-predict the factor of safety. CMC should be asked to provide details on the use of these shear-generated pore pressures in the analysis. (YOR 2014-0002-274-1)

BGC Engineering also notes that permeability and drainage properties of the cyclone sand has not been proven through testing but rather through the application of empirical evidence from "much smaller" projects. Furthermore, the size of the embankment, as noted previously, is beyond the state of practice and it remains unclear if the pressures of the embankment will reduce permeability and drainage. BGC Engineering asserts that the Leps paper (1970) may not be appropriate for determining the properties of cyclone sand without additional test results, "[t]he use of the Leps function for sand is not common; although the measured friction angles fit near the lower Leps curve, the degree of stress-dependency is likely different for a milled sand than for blasted rockfill."

Section 2.2 of the TMF feasibility report indicates a specific gravity of 2.7 for tailings but 2.71 for tailings overflow and 2.8 for cyclone underflow. BGC Engineering notes, "It is not clear how the specific gravidities of both constituent parts can be greater than the specific gravity of the whole." Clarification on specific gravities is required to ensure that calculations on available volumes are correct.

Cyclone sand for embankment construction is to be compacted in lifts ranging from 0.5 to 2.0 m. BGC Engineering expresses concern with the upper limit of this range, especially as conditions drop below freezing. The Executive Committee requires more information regarding the use of cyclone sand within the TMF. Therefore, please provide the following:

R83. Rationale for the ceiling of 12 percent fines in cycloned sand to be used in embankment construction including a discussion of frost susceptibility and drainage characteristics.

R84. Provide testing or analyses to demonstrate that pore pressures, shear strength, angles of friction, and contraction of cyclone sand is acceptable at all pressures found in the TMF embankment.

R85. Clarification on the specific gravities of cyclone overflow and underflow.

R86. Justify the upper range of 2.0 m for proposed lift heights of cyclone sand.

2.8.8 Faults and Shear Zones

The “Report on Feasibility Design for the Tailings Management Facility” highlights several studies and geotechnical investigations used to characterize foundation conditions and inform TMF embankment design. These previous investigations are summarized and drill hole/test pit locations are shown in figure 4.1 of the feasibility design report (YOR 2014-0002-171-1).

Faults or sheer zones under the TMF embankments pose a number of potential problems including increased potential for excessive seepage and increased risk to structure stability through seismic events.

The TMF feasibility report identifies two “narrow zones of low velocity” in the area of the main embankment that are “consistent with zones of highly fractured and weathered grandoriorite, and likely indicate shear or fault zones within the bedrock.”(YOR 2014-0002-171-1) Despite this finding, the proposed TMF embankment design does not account for possible faults and/or shear zones extending beneath the dam. EcoMetrix and LSCFN’s consultant BGC identify the need for further investigations in this regard.

EcoMetrix asserts that the number of drill holes in the embankment area, for feasibility design purposes, appears to be insufficient to determine hydraulic conductivity and identify fault/shear zones. With a hydraulic head of nearly 300 m, there is the potential for higher than anticipated seepage which could lead to serious seepage management issues. EcoMetrix further states:

> faults and shear zones under a dam as large as the proposed main tailings dam need be accounted for from the perspectives of dam stability, flow capacities and containment of reactive minerals and/or soluble contaminants. The presence or absence of local faults must be addressed for the project to be determined feasible. (YOR 2014-0002-235-1)

Natural Resources Canada also raises concern with embankment stability with regard to faults and seismic potential. They state it is important from a seismic perspective to assess the impacts of smaller nearby events that can still generate significant shaking that could impact the tailings facility” (YOR 2014-0002-245-1).

The Executive Committee requires additional information with respect to faults and fractures at the TMF embankment in order to assess project effects in relation to TMF seepage and stability; therefore, please provide the following:

R87. Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity.

2.8.9 Hydraulic Conductivity of Bedrock and Overburden

The "Report on the Feasibility Design of the Tailings Management Facility" (YOR 2014-0002-0176-1 through 179-1) indicates a cut off trench for the TMF embankment at an average of 3 m. However, Section 4 of the proposal indicates a trench depth of 10 m. The depth to bedrock under the embankment varies from 2 to 23 m.

EcoMetrix and LSCFN's consultant, BGC Engineering, identify a number of concerns with the cut off trench as proposed. BGC Engineering expresses concern regarding the permeability of the weathered and fractured bedrock on which the embankments will sit. It is "about seven times more permeable than the overburden soils, with the most permeable measurement in weathered bedrock about 700 times higher than the most permeable measurement in the overburden soils" (YOR 2014-0002-274-1). Furthermore, BGC Engineering states that weathered bedrock extends as far as 40 m below ground level that may require the use of a grout curtain. EcoMetrix expresses concern regarding the potential for seepage and the possibility that blasting for the trench could cause further fractures in the underlying bedrock (YOR 2014-0002-235-1).

It is important that the proposal provide clear descriptions of measures to control seepage to provide confidence in their effectiveness to mitigate potential adverse effects. The Executive Committee requires further information on the cut off trench and the potential implementation of a grout curtain in relation to the TMF embankment. Therefore, please provide the following:

R88. Additional drill results, with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification fault/shear zones within the embankment foundation.

R89. Details regarding the cut off trench and seepage control for the TMF embankment including:

a. clarification on the depth of the cut-off trench and justification based on the depth of overburden and fractured bedrock;

b. an updated cross section of the TMF embankment that includes the cut off trench and associated seepage barrier;

c. a profile diagram of the cut off trench showing its depth across the dam core, along with available information on the depth of overburden and fractured bedrock;

d. a discussion of measures to address fractured bedrock; and

e. a discussion on the use of a grout curtain to control seepage

2.8.10 Presence of Frost-Susceptible or Frozen Materials During Construction

The proposal states that the main embankment construction will require non-frost susceptible soil foundations. However, the proposal does not outline how the Proponent will determine if the overburden at depth is frost susceptible or if frozen overburden is acceptable, for construction purposes. If incorporated into the embankment foundation, frozen overburden may result in higher than anticipated seepage in the event that these materials thaw, which may cause deformation or weakening of the embankment.

Ice rich foundation soils will likely thaw over time due to the presence of the tailings impoundment and retained materials, and due to increased ambient temperatures associated with climate change predictions. Consequences of a delay in thawing until project operations have concluded may result in structural risks after closure.

The feasibility design of the TMF embankment should include details about the presence and distribution of frozen and/or frost susceptible materials in order to determine the actual amount of excavation required to construct the embankment. The Executive Committee requires more information regarding the characterization of the embankment foundation regarding ice rich soils and frost susceptible soils. Therefore, please provide the following information:

R90. Further characterization of the dam foundation materials to confirm the presence and distribution of permafrost.

R91. Details regarding plans to ensure embankment foundations do not incorporate frozen and/or frost susceptible soils during construction.

2.8.11 Cold Weather Construction of the Embankments

The proposal notes that the TMF embankments will be built using the centerline method in stages over several seasons with hydraulically discharged cyclone tailings. Construction of the embankments would occur over nine months each year, from March through November.

Climate presents a potential risk factor to embankment construction. SFN's consultant, Northland Earth and Water Consulting, expresses concerns regarding the ability to construct cyclone sand based dams in such a climate. The buildup of ice or snow in hydraulically discharged tailings may lead to instabilities during construction or prevent the proper vibratory compaction of each lift. Furthermore, as LSCFN's consultant, BGC Engineering, points out the proposal suggests that it may be necessary to cap the embankments during winter months to control erosion due to wind and water. This would present additional challenges associated with the incorporation of annual covers into the embankment structure or the removal of cover.

Should cold weather limit embankment construction to less than nine months per year the embankment will take longer than expected to construct. The Executive Committee requires more information regarding the cold weather construction of the TMF embankments. Therefore, please provide the following:

R92. 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.

R93. Implications of scheduling delays or suspension of dam construction during the nine month construction period.

R94. A review of relevant examples of sand embankment dams constructed in cold weather environments. This review should identify challenges, potential issues, and solutions surrounding sand placement and QA/QC.

R95. Methods of erosion control during dam construction.

2.8.12 Surface Preparation

While the TMF embankments will require excavation, the extent of ground preparation for the area underneath the TMF pond is unclear. Natural Resources Canada expresses some concern over the lack of details on ground preparation in this regard (YOR 2014-0002-245-1). For example, it is not clear if vegetation or soils will be left in place or cleared prior to construction. Ground surface characteristics prior to construction may affect hydrological properties and ground water flows. Furthermore, placement of tailings on overburden may lead to changes in thermal conditions that change the hydrological regime over the project life.

The Executive Committee requires additional information with respect to ground surface preparation below the TMF in order to assess potential effects. Therefore, please provide the following information:

R96. Description of ground surface conditions currently in relation to overburden and vegetation and any modification in preparation for the construction and filling of the TMF.

R97. Discussion on any hydrological changes expected from changing ground thermal conditions and any monitoring to this effect.

Natural Resources Canada notes that similar facilities “frequently incorporate natural and/or artificial liners in order to limit seepage losses” (YOR 2014-0002-245-1). However, the ‘Report on the Feasibility Design of the Tailings Management Facility’ does not clearly specify any liners beyond a low permeability blanket under the stage one embankment. The Executive Committee requires clarification on the use of liners. Therefore, please provide the following:

R98. Confirmation that natural or artificial liners are not included as part of the technical design of the TMF embankment.

2.8.13 Quality and Quantity of Borrow Source Materials

The Project proposes the use of borrow materials to construct core, filter and transition zones and the rockfill shell zones. Borrow materials may also be required if there are insufficient quantities of cyclone sand available for embankment construction.

The proponent anticipates that rockfill will be easy to source on site, and will be partly sourced from non-reactive materials from the pit walls. Core zone borrow must be non-frost susceptible and have more than 20 percent fines; however, soils containing over 20 percent fines are typically frost susceptible. Natural Resources Canada notes that "non-frost susceptible soils might be in contradiction with the 20% or more fines (YOR 2014-0002-0245-1)" and dam core borrow material requirements may be difficult to meet.

LSCFN's consultant, BGC Engineering, raises concerns regarding the potential volumes required for the core, noting that nearly 10 million cubic metres of core material may be needed (YOR 2014-0002-274-1). BGC Engineering continues by noting pre-production excavations total 3.9 million cubic metres and fills total 12.2 million cubic metres but borrow sources are not identified. Furthermore, it is unclear if fill material can be sourced from areas that are not frozen. If frozen materials will be used, it may be a challenge to thaw excavated material in the summer prior to use in the embankment. The storage of frozen material as it thaws may also present issues relating to containment and drainage.

Government of Yukon comments that, aside from potential borrow locations for the tailings embankment core, the proposal does not provide details on borrow locations or volumes (YOR 2014-0002-252-1). The 2013 Geotechnical Site Investigation Data Report – Mine Site, references a Mine Site Borrow Materials Assessment Report (YOR 2014-0002-171-1). This report was not provided. Natural Resources Canada notes the importance in detailed borrow assessment information that includes conclusions regarding the quality and quantity of the borrow source materials.

The Executive Committee requires clarification regarding the suitability of proposed core construction materials. Therefore, please provide the following information:

R99. Confirmation of the availability of non-frost susceptible materials for the construction of the dam core. Include a discussion that demonstrates that the material with a 20 percent or more fines is not a frost susceptible material.

R100. Please provide the Mine Site Borrow Materials Assessment Report (VA101-325/16-3). If not part of the assessment report, include detailed information about:

- a. the locations of borrow sources;
- b. description of dimensions of borrow source excavations including area and depth of excavations;
- c. the estimated quantities of suitable borrow material available;
- d. the quantity of borrow material required for engineered mine components;
- e. proposed mitigation measures to minimize potential adverse effects associated with the development and use of the proposed borrow sites; and,
- f. alternatives in the event that dam core material cannot be sourced at the site in sufficient quantities.

R101. A discussion on the thawing and containment of borrow and embankment excavations.

2.8.14 Starter Dam and Tailings Interface

The starter dam, on which the final embankments will be built, will include borrow materials and, where appropriate, non-reactive rock from the pit walls. These materials will form the shell of the starter embankment. EcoMetrix notes a concern that the larger particle size of this shell may allow gradual infiltration of cyclone sand into the shell of the starter dam, which could lead to deformation of the tailings shells (YOR 2014-0002-235-1).

The Executive Committee requires more information on the design of the TMF starter dam. Therefore, please provide the following:

R102. Clarification on the use of filter-graded zones between the waste rock shells (if selected) of the starter dam and the overlying tailings shells (e.g. to prevent possible future deformation of the tailings shells).

2.8.15 Missing Information

Environment Canada noted that footnote No. 6 on p. 4-54 of the proposal related to Table 4.3-7 (Inflow Design Flood and Earthquake Design Ground Motion) is missing (YOR 2014-0002-249-1). Please provide the following information to ensure the Executive Committee has the correct understanding of these items in the proposal. Therefore, please provide the following information:

R103. The missing information referenced in footnote No. 6 on p. 4-54 of the proposal related to Table 4.3-7 (Inflow Design Flood and Earthquake Design Ground Motion).

2.9 LIQUEFIED NATURAL GAS AND DIESEL

2.9.1 Description of LNG Facilities

In the Project description, Section 4, the proposal provides details about Project design and scheduling; describes the activities that would take place during the construction, operation and closure/decommissioning phases of the Project; discusses the viability of the proposed mining technologies in northern environments; and evaluates the alternatives that were examined in determining the preferred Project configuration.

A considerable amount of pertinent information is provided on the conceptual design of mining-related aspects of the project and the types of activities that would occur during the construction, operation and closure\decommissioning phases of the mine. However, few details were provided on the design and operation of systems for:

- transportation, handling and storage;
- regasification, fueling, and mobile refueling stations;
- design and operation of generating facilities; and
- design and operation of mining equipment powered by LNG.

Moreover, it is difficult to gauge the firmness of the proponent's LNG supply arrangements, and whether fallback strategies might have to be considered in the event that the required quantities of LNG cannot be secured from the two identified potential sources.

All of this makes it difficult for the Executive Committee to evaluate the choice of LNG as the preferred energy option, and to assess the economic, public safety and occupational safety considerations important to Yukon residents that pertain to choosing that particular option.

Section 20.3.1.2 describes the potential effect and consequence of the predicted magnitude of the potential seismic event is predicted as minor displacement of surface facilities. Because of LNG's unique characteristics, LNG facilities and LNG transportation systems warrant special consideration in relation to their design to withstand environmental influences. For example, CSA Z726 requires that a Safe Shutdown Earthquake of (SSE) with a return period of 1 in 10 000 years be considered in the design of LNG facilities.

The Executive Committee requires more information on the design, location and operation of LNG components of the Project. Therefore, please provide the following:

R104. For the LNG storage facilities, regasification facilities, and mobile fueling stations, provide:

a. a detailed description for all facilities related to LNG including location, design, construction, operation and closure;

b. measures for the safety of Project personnel including separation distances from office and living areas;

c. design measures and operating procedures to prevent a cascading accident; and

d. a list of standards and codes that will apply to design and operation of the each component identified above.

R105. Identification of potential hazards to LNG facilities at the Casino Mine site associated with seismic activity, extreme weather events, wildfire, unstable terrain, and degradation of discontinuous permafrost, and a quantitative assessment of the related risk to those facilities

R106. Identification of the potential supplier of LNG from British Columbia and the established supplier of LNG from Alaska. Indicate the nature of any supply agreements that are in place. Indicate the nature of any uncertainties about the LNG facility in British Columbia being operational by the time LNG is required at the Casino Mine site. Provide documentation to confirm that the facility in Alaska will be able to supply LNG in sufficient quantity to meet the needs of the Casino Mine, should LNG not be available from the proposed facility in British Columbia. Describe the Casino Mining Corporation's fallback plan in the event that LNG is unavailable from either identified source, or is not available in sufficient quantity. Indicate whether an alternative source of electrical power might be required in such a case. Assess the effect of the above scenarios on the project's economic feasibility.

R107. The earthquake design basis for the LNG storage tank at the mine site

2.9.2 Description of Diesel Facilities

Section 4.1.1.2.4 describes diesel as the primary fuel for the Project prior to the construction of the LNG facility. Diesel will be used throughout the Project's lifetime for a range of uses such as vehicles, portable generators and back-up generators. In Section 4.3.3.5, the proposal states that during the construction phase 10 days of diesel fuel consumption will be stored on-site near the supplementary power plant. Appendix 5A describes diesel storage as containing six 50 000 L storage tanks near the truck shop, this does not appear sufficient enough to include power generation for 10 days. It is not clear how much fuel will be stored on-site in quantitative terms during construction or operations. The Executive Committee requires more information on the use of diesel fuel within the Project's footprint. Therefore, please provide the following:

R108. A description of diesel storage facilities along with anticipated rates of use and storage volumes for each stage of the Project.

2.10 CONCEPTUAL CLOSURE AND RECLAMATION PLAN

2.10.1 General Concerns

Selkirk First Nation's consultant, Kuipers and Associates, notes that "Critical information for assessment of the effects of the proposed reclamation and closure plan is either missing from the plan or difficult to obtain from the referenced documents" (YOR 2014-0002-254-1). The Executive Committee requires additional details to understand to potential adverse effects of proposed activities over the lifetime of the project. Therefore, please provide the following:

R109. A table or tables that summarize the following information for each major mine component:

a. where appropriate, dimensions, mass, volume, centroid and elevation;

b. reclamation characteristics (slope aspects, cover type and depth, volume required, re-vegetation type);

c. source controls (e.g. liners, compacted graded drained foundations, and covers over reclaimed features) and any features associated with fluid management and stabilization and/or water management and treatment; and

d. geotechnical protocols and results (e.g. FOS).

Kuipers and Associates also note a general lack of details regarding long-term operational and maintenance requirements. This lack of detail may underplay the potential challenges that the proposed reclamation and closure activities will have in accomplishing "passive care" for the site. The Executive Committee requires additional information to better understand the risks associated with long-term management of the site. Therefore, please provide the following:

R110. Conservative considerations for the long-term operational and maintenance requirements for the site.

2.10.2 Long-Term Closure and Ongoing Monitoring and Maintenance

CMC indicates that long-term passive care will not require year-round presence, power, or chemical water treatment. However, it is unclear how much of a site presence will be required. Government of Yukon (YOR 2014-0002-252-1), Environment Canada (YOR 2014-0002-249-1), and SFN's consultant, Kuipers & Associates (YOR 2014-0002-254-1), expressed concerns over the level of detail in the proposal with regard to on-site requirements during post-closure.

CMC states "the closure strategy is to achieve long-term passive care, which is defined as regular or infrequent site presence for monitoring and maintenance, as necessary" (CMC 2014, p 4-92). Regular site presence suggests a scheduled or repetitive presence which could be considered at odds with an infrequent site presence and the strategy of long-term passive care. Furthermore, Kuipers & Associates notes that all passive treatment systems require some monitoring and maintenance. While CMC recognizes a true walk-away solution is not possible, they have provided little detail on what monitoring and activities will be required to maintain the long-term passive treatment system.

Section 4.2 of the proposal outlines project phases and scheduling. CMC identifies a three-year active closure and decommissioning phase where surface facilities will be removed and the site will be fully reclaimed. This phase will be followed by a five-year post-closure phase where CMC will conduct monitoring and follow-up inspections to ensure physical and chemical stability of closure components. CMC states "[a] final post-closure monitoring program will be compliant with the applicable guidelines and regulations will be implemented to ensure the reclamation measures remain effective and continue to provide a high level of protection for the public and the environment" (CMC 2014, p 4-105). In the Conceptual Closure and Reclamation Plan, CMC states that "[a] second active-post closure phase may occur beginning when the Open Pit Lake is nearing discharge, to ensure that the Open Pit lake water quality is suitable for release and treatment by the North TMF Wetland" (Appendix 4A, p8).

Government of Yukon, Department of Energy Mines and Resources, also expresses concern with the ongoing seasonal management of water release by way of solar powered remote sensors. Given that this type of water management will be required long-term post-closure, it appears that it is not consistent with the intent of the *Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance* (Government of Yukon, 2013). Government of Yukon has suggested the conceptual closure and reclamation plan be updated taking into account the guidance.

Environment Canada expresses concern with the five-year period for the post-closure phase. It is uncertain how five years will allow for appropriate monitoring and follow-up given the extended time required for closure activities to take effect. For example, CMC predicts that the pit lake will take approximately 95 years to fill at which point the overflow and discharge will be treated by the north TMF wetland. In addition, five years of monitoring seepage from areas such as the TMF and low-

grade ore stockpiles may not be enough time to detect whether these areas are contributing to decreased water quality.

While CMC indicates a final post-closure monitoring program will be implemented and that a second active-post closure phase may be implemented, no detail has been provided. The Executive Committee requires additional information regarding monitoring and maintenance requirements of the long-term passive treatment system and post-closure monitoring. Therefore, please provide the following information:

R111. 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.

R112. Discuss and if necessary update 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).

R113. Clarify what is meant by regular or infrequent site presence or what degree of on-site presence is envisioned (e.g. yearly during summer, once every 10 years, or site presence in step with closure stage).

R114. Justification and clarification of the proposed five year post-closure monitoring period given that actual closure conditions will not be established for about 95 years (pit discharge) and other closure conditions are not fully known or presented here (e.g. time for contaminated groundwater sources to report to TMF/seepage).

2.10.3 Design and Operation of Wetland Water Treatment System

At closure, a water treatment system is proposed to capture and treat water from the tailings management facility (TMF), the open pit, and the heap leach facility (HLF). This system will consist primarily of two wetlands. The south wetland will treat water TMF discharge while the north wetland will treat open pit discharge into the TMF. A bioreactor will also be built to treat HLF draindown water prior to its discharge into the open pit. The wetlands are primarily designed to remove metals while the bioreactor is designed to remove mercury and selenium. The wetlands are designed to handle flows upwards of 220 L/s. While the south wetland is expected to be operational on a year round basis, the north wetland will operate only seasonally. Discharge from the open pit to the TMF will correspondingly be on a seasonal basis. Treatment of mine discharge is required to meet standards for aquatic life as set by the Canadian Council of Ministers of the Environment (CCME).

Several comments received during the adequacy review voice concern over the predicted performance of the treatment system. Selkirk First Nation's consultant, Kuipers & Associates indicates that pilot studies would help verify the predicted effectiveness of the treatment system (YOR 2014-0002-254-1). Environment Canada adds that the long term sustainability of the system is unclear (YOR 2014-0002-249-1). The primary source of concern is uncertainty and a lack of confidence in the proposed treatment system.

The design of the treatment system provided in the Conceptual Closure and Reclamation Plan is necessarily conceptual in nature; however, the implications of its effectiveness are critical to understanding potential effects to a wide range of values.

The Proponent indicates that field studies will be completed to demonstrate the effectiveness of the design; however, it is precisely this data that the Executive Committee needs to complete a valid assessment. Without this data, and thus reduced uncertainty, a range of potential outcomes must be addressed including the potential that the treatment system does not meet requirements. Therefore, alternative or contingency treatment systems must be considered as part of this assessment. For example, Environment Canada indicates that conventional treatment systems should be considered in the event that wetlands do not perform as expected.

Uncertainty is compounded by the length of time before the open pit fills and begins to discharge water to the TMF north wetland. This is expected to be 95 years after the end of the operational phase of the Project. SFN and its consultants, Northland Earth & Water Consulting Inc. and Kuipers & Associates, note that the treatment system may not be able to properly treat pit discharge. Pit discharge is also difficult to predict given the number of contributing factors and the long period until discharge. They further state that this long period may also mean that liability for the site may rest with government at that time.

SFN's consultant, Macdonald Environmental Sciences Ltd., asserts that CMC should conduct pilot studies early during operations to ensure the anaerobic bioreactor proposed to treat HLF draindown functions as proposed (YOR 2014-0002-256-1).

EcoMetrix suggests that water quality assessment consider the water quality in the event of a worst case scenario for treatment system effectiveness (YOR 2014-0002-235-1).

The Executive Committee requires more information regarding the design, feasibility, predicted effectiveness, and contingencies related to the water treatment system proposed for the Project. Therefore, please provide the following:

R115. Examples of successful similar treatment systems with similar contaminant loads, flows and climate.

R116. Initiation of laboratory studies to confirm the effectiveness of the wetlands as a water treatment system for the purpose of closure and to inform future field studies. The Executive Committee expects that results from these studies will be provided throughout the assessment process.

R117. Detailed plans on field studies to support and refine the effectiveness of the wetland water treatment system. Details should include:

a. a preliminary schedule for studies;

b. location and sequencing of field scale studies; and

c. any required activities, such as earthworks, required for field studies.

R118. Details on any proposed pilot studies for the bioreactor system associated with the HLF.

R119. An assessment of uncertainty associated with the performance of the proposed passive treatment system.

R120. 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).

R121. A discussion of contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required.

R122. A discussion of the requirements and merits for conventional treatment as the treatment method.

During post-closure, once the open pit has filled, water from the pit lake will discharge to the TMF wetland at the north end. This discharge will be controlled using a decant control valve. This system will discharge pit water during the summer months, when the TMF wetlands are biologically active, and store pit water during the winter months. EcoMetrix identifies concerns that the design measure will not maintain flows from the pit at the design discharge rate given that flow rate will vary in relation to changes in the pit lake water level. Therefore, EcoMetrix notes that the north end of the TMF wetlands will need to be designed to accommodate a range of possible flows.

In addition, Environment Canada expresses concern that insufficient detail has been provided regarding the managing flows through the remote operation of valves (YOR 2014-0002-249-1). The proposal indicates that gravity flows from the open pit, winter seepage mitigation pond, and possibly the HLF and TMF, will not require pumping and can be managed by remotely operating solar powered valves (Casino 2014, p 4-105). However, details such as design considerations and contingency planning related to malfunctions of valves or power sources were not provided.

The Executive Committee requires additional information regarding operation of the pit lake discharge and remote operation of valves. Therefore, please provide the following information:

R123. 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.

R124. Details and design considerations for the remotely operated solar powered decant valves. Details should include:

a. infrastructure requirements;

b. monitoring and maintenance requirements, including an estimated timeframe;

c. contingency planning related to malfunctions, inappropriate feedback and interaction; and

d. case studies where such systems are effectively used;

2.10.4 Open Pit and Low Grade Ore Stockpile Water Quality

Closure and reclamation of the open pit and low grade ore stockpiles is described in Section 4.5 of the proposal and Appendix 4A (Conceptual Closure and Reclamation Plan). At closure, it is assumed that approximately 8.8 Mt of marginal grade ore and 7.3 Mt of low grade ore and foundation material will placed into the open pit. The open pit will fill with water from natural sources including seepage, surface run-off, and precipitation, and from mine sources including water from the TMF pond and HLF during closure of those facilities. It is expected that the open pit will fill with water in approximately 95 years. Filling the pit with water is intended to minimize oxidation of the pit walls. Likewise, flooding potential acid generating (PAG) marginal and low grade ore will further reduce oxidation of those materials.

Selkirk First Nation's consultants, Northland Earth & Water Consulting (YOR 2014-0002-257-1) and Kuipers & Associates (YOR 2014-0002-254-1), and Environment Canada (YOR 2014-0002-249-1) express concerns concerning the information provided and rational for disposal of marginal and low grade ore in the pit.

The proposal indicates that low grade ore will be characterized for potential acid rock drainage and metal leaching (ARD/ML) prior to placement in the open pit to determine whether it will have adverse effects on pit water quality at closure. If results indicate adverse effects, CMC proposes to add lime to the low grade ore during disposal in the open pit. ARD/ML characterization and prediction of potential effects related to this disposal option should be completed in order to address the feasibility of this disposal method. In addition, Environment Canada notes that, although the addition of lime may reduce address some concerns related to acid rock drainage, it may not control metal leaching (YOR 2014-0002-249-1). In addition, it is uncertain which parameters may be controlled through the addition of lime.

As indicated in the proposal, approximately 8.8 Mt of marginal grade ore will be stockpiled on the surface, and finally disposed of the open pit at closure. This material will be stockpiled near the open pit over a six- year period starting two years prior to operations. The stockpile will remain on the surface until it is disposed of starting in year 23. Surface water will be diverted around the stockpiles during operations. Appendix 4A identifies this ore as "[a]cidic supergene waste rock that cannot be disposed of in TMF without adversely affecting TMF water quality" (p 14). Environment Canada stresses concern that little detail is provide on the effects of leaving this material on the surface during operations (YOR 2014-0002-249-1). In the report titled "Casino Waste Rock and Ore Geochemical

Static Test Assessment" (Appendix 7D, Geochemistry Reports), "the majority of the supergene waste rock is expected to become acidic shortly after exposure" (Executive Summary). As the marginal grade ore stockpile will be exposed on the surface for 19 to 25 years, it will become begin oxidizing and lead to ARD/ML. Little discussion or rationale has been provided to support leaving this stockpile on surface for sub-aqueous disposal at closure rather than alternative disposal or means or reducing ARD/ML potential.

Kuipers & Associates have expressed concerns about seepage through the low grade ore stockpile (YOR 2014-0002-254-1). The Conceptual Closure and Reclamation Plan (Appendix A) indicates that seepage will be collected through a groundwater collection or infiltration suppression system. The effectiveness of seepage collection or infiltration suppression cannot be evaluated as little information has been provided to support these strategies.

CMC anticipates that the open pit will fill in approximately 95 years. Filling the pit with water is required to minimize ARD/ML from exposed pit walls. Northland Earth & Water Consulting suggest that CMC provide an analysis of the advantages or disadvantages to using water from the Yukon River to fill the open pit and reduce the time the pit walls are exposed to weathering processes (YOR 2014-0002-257-1). The Conceptual Closure and Reclamation Plan states "[a]ccelerated filling of the pit by pumping from the Yukon River was evaluated as a potential closure strategy. Analyses showed that this would not materially affect the pit water quality at the time of overflow and is therefore not planned for closure" (Appendix 4A, p 11). Details on the analysis were not provided to substantiate this claim.

In addition, Northland Earth & Water Consulting expresses concerns with assumptions made by CMC with regard to the open pit lake water quality at closure. The Water Quality Model Report states that "Water quality in the Pit Lake was calculated as the cumulative mass of a given substance in the Pit Lake water, divided by the water volume stored in the Pit Lake over a given time step interval" (Appendix 7A, p 32). Based on this assumption, water in the open pit at closure is expected to be fully mixed with uniform quality. However, water quality in pit lakes is often variable and can be affected by factors such as thermal stratification, pit depth, and fresh water input. Variable water quality in the open pit may have effects on pit discharge water quality and therefore implications to the tailings management facility wetland requirements.

The Executive Committee requires additional information regarding the open pit and low grade ore stockpiles. Therefore, please provide the following information:

R125. Details and rationale on the proposed storage and disposal of low-grade ore. Details should include:

a. detailed geochemical characterization of material in the low-grade ore stockpile; and

b. supporting evidence and rationale as to why leaving this material on surface to continue to generate acid and metal contaminants before much later disposal in the pit is any more beneficial than disposing same under water in the TMF when this material is first encountered.

R126. Details and discussion on groundwater collection and/or infiltration suppression to manage seepage through the low grade ore stockpile.

R127. A detailed discussion on lake stratification or mixing in relation to discharge including:

a. any evidence or assumptions for lake mixing or stratification; and

b. stratifications or mixing impacts to discharge water quality and the tailings management facility wetlands.

2.10.5 Open Pit Stability

Selkirk First Nation's consultant, Kuipers and Associates, note that the Conceptual Closure and Reclamation Plan (CCRP) "does not address pit stability other than to suggest the pit walls will be steep and unsafe to access and suggest construction of a berm to prevent human and wildlife access" (YOR 2014-0002-254-1). SFN raises several concerns associated with the uncertainty regarding pit wall stability post-mining, including potential overflow of contact water due to high wall failures, which could have implications for both down gradient values and other mine infrastructure. The Executive Committee requires additional information to understand the risk associated with potential pit instability in post-closure. Therefore, please provide the following information:

R128. Additional analysis to inform and update the Conceptual Closure and Reclamation Plan to address potential pit wall instability in post-closure.

Northland Earth & Water Consulting Inc. observes that "[a] significant factor in the development of the volume waste rock for the project will be the ultimate configuration of the pit walls. If the walls will require more relaxed slopes than anticipated a greater volume of waste would be produced" (YOR 2014-0002-257-1). The ultimate volume of waste rock that will be produced could have implications for other mine infrastructure (e.g. size and configuration of tailings/waste rock management facility), which could change the project scope in terms of waste rock management. The Executive Committee requires additional information to understand open pit stability and contingencies for greater-than-expected waste rock volumes. Therefore, please provide the following information:

R129. A sensitivity analysis examining the effect of less stable pit walls and show how the additional waste rock would be managed if the wall slopes had to be relaxed.

2.10.6 Open Pit and Wildlife

The proposal indicates that a berm will be constructed to prevent wildlife access to pit walls. Pit walls may act as an attractant to wildlife depending on wall properties and composition. LSCFN's consultant, ElknWillow Environmental Consulting, raises concerns that wildlife may be attracted and possible entrapped within the open pit, "as seen at the Faro Mine Complex" (YOR 2014-0002-282-1). The Executive Committee requires more information regarding the potential of pit walls to act as an attractant. Therefore, please provide the following:

R130. A description of the barrier to prevent access to pit walls.

2.10.7 HLF Closure and Cyanide

The heap leach facility (HLF) will contain approximately 157.5 million tonnes of spent ore. At closure, CMC will rinse the HLF with treated solution and/or freshwater for five years. Water will be treated using the Inco-SO_2/Air process to reduce levels of weak acid dissociable cyanide (WAD CN) prior to being recirculated back onto the HLF for rinsing. After five years, water will be allowed to drain down and be discharged to the open pit. Draindown water will flow through an anaerobic bioreactor primarily to remove mercury and selenium prior to discharge.

Environment Canada (YOR 2014-0002-0249-1), SFN's consultants, Kuipers & Associates, (YOR 2014-0002-254-1) and Northland Earth and Water Consulting Inc. (2014-0002-257-1) expressed similar concerns with rinsing and detoxification of the HLF.

Both Environment Canada and SFN question the efficiency of rinsing and detoxifying the HLF due to concerns such as preferential flow pathways, channelization, and friability of ore. In addition, they have expressed concern that CMC did not conduct detoxification testing to determine whether the HLF could be treated and detoxified as proposed. While CMC did conduct detoxification, testing was completed by R&C Environmental Services, 2010 (Appendix 4A, p 19), it appears that these tests were done to support detoxification of solution rather than the HLF itself.

Little Salmon Carmacks First Nation's consultant, BGC Engineering, raises a concern that the HLF will retain fluids during closure necessitating the embankment of the HLF act as a dam in perpetuity. Clarification on fluid retention in the HLF during closure is required.

The Executive Committee requires additional supporting test work to confirm that the HLF can be rinsed and detoxified as proposed. Therefore, please provide the following information:

R131. Results and analysis of testing of heap leach facility detoxification using samples and conditions similar to an exhausted heap of friable ore approximately 150 m high.

R132. A discussion on alternative mitigation measures that may be required if heap leach facility rinsing and detoxification is not successful. The discussion should include examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.

R133. Describe how fluid impoundment behind the HLF embankment will be prevented at closure.

2.10.8 HLF and Cover Material

Once the HLF has been rinsed and detoxified CMC will install a cover to reduce infiltration into the HLF. The cover is discussed in Section 4.5.2.2 of the proposal and the Conceptual Closure and Reclamation Plan (Appendix 4A). The cover is a critical component to closing the HLF. However, little detail was provided on the design basis for the cover.

Section 3.4.3 of the Conceptual Closure and Reclamation Plan (Appendix 4A) indicates that the cover will have a soil thickness of approximately 0.75 m (p 18). However, Section 3.7 indicates an average

soil thickness of 0.5 m (p 25). In addition, Section 3.4.3 states the cover will reduce infiltration to 80 percent while table 3.4-1 states the cover will reduce infiltration to 20 percent (p 18 and 19).

Environment Canada and SFN's consultant, Kuipers & Associates indicate that additional details should be provided on the HLF cover. Details should include the design basis for the cover as well as supporting evidence that the cover will perform as expected.

The Executive Committee requires additional information to determine potential effects related to the cover for the HLF. Therefore, please provide the following information:

R134. Additional details on the design basis and requirements for cover materials. Details should include:

a. cover modeling and assessment including validation of assumed infiltration rates;

b. availability and location of sufficient construction materials to meet the design requirements;

c. composition of materials to be used for the cover system including mineral soil, topsoil, and vegetation;

d. range of expected performance of proposed cover systems; and

e. long-term monitoring and maintenance requirements.

2.10.9 TMF Winter Seepage Mitigation Pond

The Proponent indicates, in Section 4.5.1.6 of the proposal, that a winter seepage mitigation pond (WSMP) will be constructed during project closure "downstream of the TMF facility but upstream of the closure spillway discharge location. The WSMP will include an upstream cut-off wall keyed into bedrock, which will intercept all seepage from the dam and force it to surface where it will drain by gravity into the lined storage pond."

EcoMetrix raises concern that the WSMP does not include a description of the cut-off barrier construction considering its placement in both overburden and bedrock (Figure 3.5-1 in YOR 2014-0002-126-2). Furthermore, there are limited details on the nature of the overburden and bedrock. These details are important to understand the effectiveness of the WSMP in capturing seepage from the tailings management facility.

Furthermore, the conceptual closure and reclamation plan (CCRP) provides a general overview of the WSMP including the requirement for an approximately 10 m high earthen dam. Few details are provided about this dam beyond capacity requirements. Information on this dam is essential to understanding potential effects and risks from the WSMP pond that will contain contaminated TMF seepage.

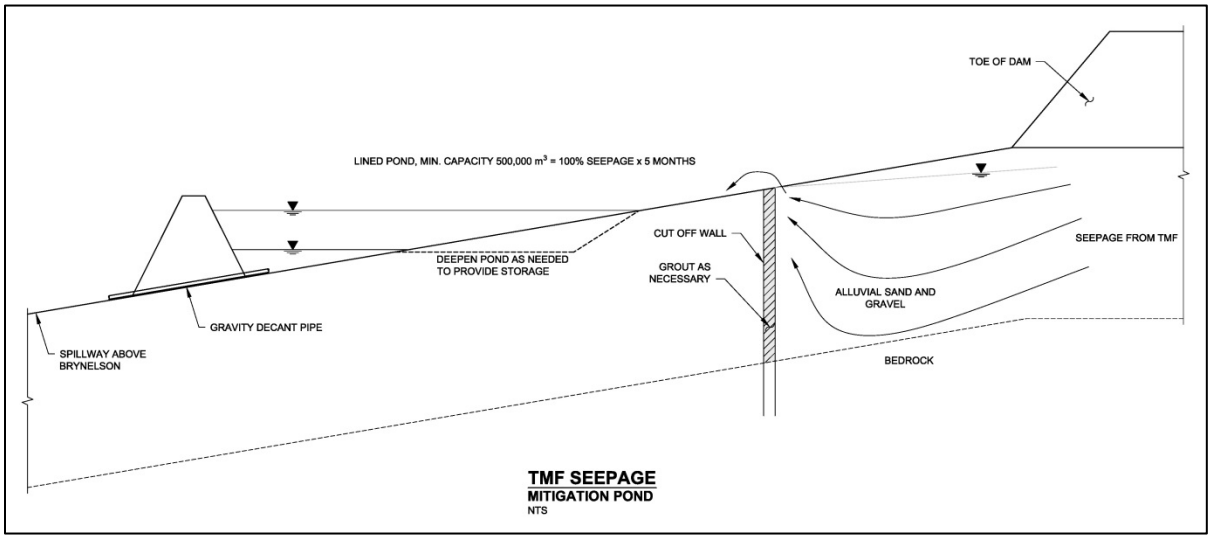

Figure 2: Conceptual design for the winter seepage mitigation pond

(Casino Mine Project Proposal – Appendix 4A, Conceptual Closure and Reclamation Plan, p 22)

Natural Resources Canada notes in its adequacy period comments that the WSMP proposed for closure would appear to be more effective at the collection of TMF seepage than the water management pond proposed for operations due to the use of a cut-off barrier (YOR 2014-0002-245-1). The rationale for the use of a cut-off wall only after operations for seepage collection is unclear.

The Executive Committee requires more information on the construction of the WSMP including the cut-off barrier intended to collect TMF drainage and the WSMP dam. Therefore, please provide the following:

R135. Feasibility level design details for the winter seepage mitigation pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed.

R136. Rationale for the construction of a cut-off barrier only after operations.

R137. Additional details about the winter seepage mitigation pond dam should include:

a. proposed design standards (e.g. Canadian Dam Association Safety Guidelines);

b. cross-sections;

c. construction materials;

d. consequence of failure classification;

e. detailed foundation characterization; and

f. monitoring and maintenance requirements.

The CCRP notes that the WSMP “will collect seepage from December through April and then discharge at a rate of approximately 130 L/s beginning in May after the onset of the spring freshet” and “that this could be done remotely using solar power to operate the valve and monitor flows”

(YOR 2014-0002-126-2). However, it is not clear how CMC will control the rate of discharge in response to flows within Casino Creek. Assuming that there may be times when the flows within Casino Creek are reduced due to natural factors, releasing water from the pond at a rate of 130 l/s may overwhelm the dilution capacity of the creek such that downstream water quality objectives are exceeded.

The Executive Committee requires additional information in order to determine the feasibility of the WSMP to control winter seepage and discharge from the TMF. Therefore, please provide the following information:

R138. Demonstrate that the rate of discharge from the proposed winter seepage mitigation pond can be controlled in response to downstream flow rates within Casino Creek in order to meet downstream water quality objectives. Details should include WSMP capacity to handle excess water that is not discharged due to low flow conditions in Casino Creek.

2.10.10 TMF Embankment Vegetation

The CCRP proposes establishing vegetation on the downstream slopes of the TMF embankments. Considering the final downstream slope of the dam (3H:1V) and the climatic conditions of the site, re-establishing strong and self-sustaining vegetation over the slope may be very difficult. As noted in EcoMetrix's review, evidence from other Canadian sites indicates that successful re-vegetation of 3:1 slopes is challenging and long-term maintenance is often required (YOR 2014-0002-235-1).

It is difficult to evaluate the performance of proposed vegetation covers prior to conducting on-site studies. The Executive Committee requires additional information to support rationale for the proposed closure and reclamation of the TMF embankments. Therefore, please provide the following information:

R139. Detailed plans for establishing vegetation on the downstream slope of the tailings management facility west and main embankments. Details should include:

a. examples of successful projects where vegetation was established on similar slopes under similar climatic conditions as supporting rationale for the proposed closure and reclamation plan;

b. a conceptual schedule for the site vegetation studies and feasibility level site vegetation designs, including the maintenance expectations; and

c. a description of the estimated feasibility level costs of site vegetation upon mine closure account for the site-specific conditions.

2.10.11 Climax Vegetation in Reclaimed Areas

The CCRP states "[t]he re-vegetation plan for the Casino mine is to control erosion of reclaimed areas and to initiate the transition to long-term or climax vegetation" (YOR 2014-0002-126-2). Climax vegetation may not be conducive to the long-term integrity of some site infrastructure (e.g. cover systems, TMF embankments, etc.) due to the introduction of infiltration pathways, metal uptake by

vegetation and/or impacts to stability. As noted in the Mine Environment Neutral Drainage Program (MEND) report titled Mine Waste Covers in Cold Regions,

> Due to concerns about root penetration through the barrier layer, which may lead to increased hydraulic conductivity and/or preferential flow through the cover, many barrier covers are therefore designed with the explicit understanding that vegetation is not allowed, or with certain shallow rooted species only. Another reason vegetation is often discouraged is the potential for roots to penetrate the underlying waste, which could entrain metal uptake by vegetation.
>
> Another potential concern with vegetation is cracks associated with root holes located at the toe of a sloped cover system. Downslope movement of water infiltrating could result in aufeis formation, especially if there is a defined underdrain design (SRK Consulting, 2009).

The Executive Committee requires additional information to determine the effectiveness and appropriateness of proposed re-vegetation measures for closure. Therefore, please provide the following information:

R140. Further discussion regarding site infrastructure that may not be conducive to climax vegetation in closure. Include measures that you will implement to ensure long-term integrity of this reclaimed infrastructure.

2.10.12 Temporary or Early Closure

Sections 4.5.1.2 and 4.5.1.3 of the proposal and sections 8.1 and 8.2 of Appendix 4A (Conceptual Closure and Reclamation Plan) speak to activities that will be done in the event of temporary or early closure (CMC, Casino Mining Corp, 2014). CMC states that “a detailed temporary closure plan will be submitted in the Quartz Mining License and/or Water License application” (Appendix 4A, p 35).

Selkirk First Nations (SFN) consultants, Kuipers & Associates (YOR 2014-0002-254-1) and Northland Earth & Water Consulting (YOR 2014-0002-257-1) express concern with the level of detail provided in the event of temporary or early closure. CMC expects the operation phase of the Project to be 22 years. As indicated by SFN, during this time the Project is reliant on commodity prices for both outputs (e.g. mineral concentrates) and inputs (e.g. liquefied natural gas, diesel fuel, mill reagents). In addition, the Project will rely on a remote labour force and contractors. These factors are variable over time and cannot be controlled by CMC. While some of the factors may be predicted and accounted for, there is uncertainty as to the likelihood of temporary or early closure.

Environment Canada also expresses concerns about water treatment requirements in the event of temporary closure (YOR 2014-0002-249-1). Throughout various stages of construction and operation it is uncertain what measures will be implemented to manage or treat and discharge mine site contact water. For example, it is not known how long the project could be temporarily closed before treatment and discharge would be required. In addition, it is uncertain what contingency measures would be in place to treat water if water quality is different than predicted or field scale trials of the passive treatment system are unsuccessful.

Additional details regarding temporary or early closure would allow the Executive Committee to assess the potential effects associated with such a scenario. SFN's consultant, Kuipers & Associates, suggest CMC prepare an Interim (Emergency) Fluid Management Plan to prevent the release of contaminated water in the event of unplanned closure. The Executive Committee requires additional information regarding temporary or early closure within the Conceptual Closure and Reclamation Plan. Therefore, please provide the following information:

R141. Additional details in the Conceptual Closure and Reclamation Plan with regard to temporary or early closure. Details should include:

a. water and solution management and any requirements for water treatment;

b. infrastructure requirements (e.g. ability of heap leach facility or tailings management facility to accommodate temporary or early closure);

c. identify critical points in the project life cycle where temporary or early closure is most probable and most challenging; and

d. length of time project could remain in temporary closure before discharge would be required.

R142. 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.

2.10.13 Mine Reclamation and Security

The proponent has estimated that closure costs of $125.9 million will be required and as such, provided as financial security (CMC, Casino Mining Corp, 2014) Appendix 4A, Conceptual Closure and Reclamation Plan). Appendix 4A references the 2006 Yukon Mine Site Reclamation and Closure Policy and the 2008 Financial and Technical Guidelines. In their comment submission, Government of Yukon indicates that the Financial and Technical Guidelines were amended in 2013 (YOR 2014-0002-252-1). These amendments included minor changes to guidance on forms of security acceptable to Government of Yukon. Substantive changes were made to the technical guidelines which were replaced by the *Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance* (Government of Yukon, 2013). Government of Yukon suggests mine reclamation and securities should be updated using the new guidance.

Environment Canada (YOR 2014-0002-249-1) and SFN's consultant, Kuipers & Associates (YOR 2014-0002-254-1) express concerns with regard to details associated with mine reclamation and security. While CMC states that $125.9 million will be required, there is little detail as to how this as determined.

The Executive Committee recognizes that security for mine closure will be refined and updated as the licensing and permitting process advances. In addition, final mine reclamation security will be determined with Government of Yukon. However, security provided by a proponent is a key measure that mitigates potential adverse effects associated with emergency closure scenarios. Information on how security requirements are estimated for a project is critical in reviewing potential adverse

environmental and socio-economic effects in the event of unintended circumstances such as early closure or abandonment. The Executive Committee requires additional information regarding mine reclamation and security within the CCRP. Therefore, please provide the following information:

R143. 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).

R144. Additional justification and discussion on security estimates. 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; and

e. consideration of effects of the environment.

2.10.14 Missing Information

Section 3.4.3.1 of the Conceptual Closure and Reclamation Plan (Appendix 4A) discusses detoxification of the HLF. CMC referenced some in this Appendix but was not provided for review (R&C Environmental Services, 2010, and a professional opinion (pers.comm. J. Marsden, 2013).

The Executive Committee requires this information in order to fully review the detoxification of the HLF. Therefore, please provide the following information:

R145. The following documents referenced in the Conceptual Closure and Reclamation Plan (Appendix 4A):

a. R&C Environmental Services, 2010

b. pers.comm. J. Marsden, 2013

2.11 WASTE MANAGEMENT

Details on waste management are provided in Section 4.3.1.5, 4.4.1.4, and 4.5.1.7 of the proposal. The proposal outlines minimal details on overall waste management including types of waste and waste management facilities. CMC proposes to deal with solid waste through a waste management facility, incineration and landfilling. No details have been provided on the location, size, and methods of disposal. CMC proposes to handle sewage from the camp using a packaged sewage treatment plant system. No system has been selected. Additionally, no details such as location, size and capacity, or discharge water quality, have been provided. CMC proposes to remediate hydrocarbon contaminated materials in a land-farm treatment facility. While they indicate the facility will be bermed and lined and will have several cells to handle waste, no other substantial details have been provided. Table 4.3-3 summarizes the waste types that may be generated for the Project, there are no estimates of volumes.

Section 22 of the proposal outlines conceptual environmental management plans. This includes the Waste Management Plan in Section 22.3.1. Table 22.3-1 of the proposal outlines the contents of the Waste Management Plan, when it is developed.

The Executive Committee requires additional information on waste management for the Project in order to assess potential effects associated with waste disposal methods proposed. Therefore, please provide the following:

R146. A detailed description of waste management for the Project including:

a. location and size of all facilities associated with waste management;

b. detailed description of waste storage facilities including the waste management facility, landfill, incinerator, land treatment facility, and sewage treatment plant;

c. detailed description of waste management at the various facilities;

d. anticipated volumes of waste at various stages of the Project;

e. details on special waste and hazardous waste handling including anticipated volumes; and

f. a more detailed waste management plan.

3.0 TERRAIN FEATURES

3.1 PERMAFROST

The Climate Change Report (Appendix 20) acknowledges that warmer temperature associated with climate change "could substantially alter the permafrost conditions in the Casino Project area, most notably affecting the extent of the seasonally thawed permafrost layer (active layer) and thereby altering the foundation conditions of civil infrastructure works, including buildings, roads, railways, airstrips, and pipelines" (YOR 2014-0002-015-1). The tailings management facility (TMF), which includes infrastructure, standing water, and potentially reactive waste rock and tailings, may also reduce the extent of permafrost beneath and/or surrounding the facility.

The reduction of the extent of permafrost due to the presence of the TMF and to climate change could affect the stability of the upper Casino Creek valley slopes as well as some of the mine infrastructure. It is not clear if the effect of a reduced permafrost extent on slope stability within the upper Casino Creek valley and the potential effects on the Project were considered during the preparation of the Project Proposal. The Executive Committee requires additional information to determine potential effects related to stability due to permafrost degradation. Therefore, please provide the following information:

R147. A detailed discussion on the short and long-term stability of mine infrastructure and surrounding slopes in the upper Casino Creek watershed due to permafrost degradation. Consideration should be given to the effects of permafrost degradation related to site infrastructure and climate change.

Natural Resources Canada also expresses concerns regarding permafrost degradation in the project area due to its role in slope instability (landslide and soil creep) and in differential or localized settlement. They note that, "[w]hen the ground is subjected to a thermal change induced by anthropogenic or climatic factors, the presence of ice-rich soils is often the key element leading to permafrost degradation, because of its presence at the permafrost table and the thawing" (YOR 2014-0002-245-1). There are several documented examples of both natural and anthropogenic permafrost degradation in the project area.

The Proponent's terrain hazard classification system applies only to slope detachments (e.g. landslides) and does not consider soil displacements (e.g. soil creep) nor impacts from thermal erosion. However, the Proponent acknowledges that, "the dominant terrain instability hazard for the Project is the permafrost degradation because landslide and snow avalanche are less likely to occur" (YOR 2014-0002-016-1). The proposal does not specify

> … under which form the permafrost degradation would be observable, although thaw settlement has been recognized by the proponent for potential likelihood of occurrence or could be deduced because of the presence of ice-rich soils for infrastructures such as the air strip, Freegold Road Upgrade and Extension, HLF and TMF. In many cases, for example in the organic swamps or for the airstrip, the slope angle is small or inexistent so thaw settlement and creep settlement will be the primary displacement mechanism. Based only on landslide susceptibility, the terrain hazard maps for the more or less flat areas have not been provided (YOR 2014-0002-245-1).

Maps that show ice-rich areas (including slopes and flat areas, as well as ice depth) are important to understand the potential for permafrost degradation due to proposed activities. The Executive Committee requires additional information to understand the extent of permafrost in the project area as well as clarification regarding the role of permafrost in the development of terrain hazard mapping. Therefore, please provide the following:

R148. Maps and relevant references showing permafrost distribution within the mine site as well as the Freegold Road, the airstrip and the airstrip access road.

3.2 THERMAL EROSION MODELING

The Report on Feasibility Design of the Tailings Management Facility acknowledges that thawing of ice-rich soils from proposed activities (e.g. disturbance/removal of vegetation, tailings/water storage) may result in long-term creep displacements. The report also recognizes the need for additional investigations to confirm overburden and bedrock characteristics and extent of the permafrost within the TMF embankment area. This is potentially a concern with other site infrastructure such as the HLF. Proposed infrastructure may substantially alter foundation conditions in the project area, which, in turn, could affect the integrity/stability of mine components (e.g. TMF embankment).

Natural Resources Canada notes that small changes in ground temperature in areas of discontinuous and warm permafrost "can lead to important change in its properties, behaviour, and characteristic (e.g. change in the active layer depth) that will impact the performance of the infrastructure" (YOR 2014-0002-245-1). The proposal presents examples of anthropogenic-induced permafrost

degradation in the project area. Rising temperatures associated with climate change models may exacerbate project-related effects to ground temperatures. Natural Resources Canada state:

> Although the proponent has provided information on embankment heights and other design parameters (e.g., width of right of way, distance of ditch and channels from roads, thickness of ice-rich soil to be removed at channel sites) or mitigation solutions, it is not clear how these values were determined or how climate change may have been incorporated other than by professional judgment (YOR 2014-0002-245-1).

The Proponent acknowledges that predicting effects of the proposed TMF on foundation conditions will require thermal analysis. Natural Resources Canada also highlights that Transportation Association of Canada Guidelines for the Development and Management of Transportation Infrastructure in Permafrost Regions (2010) require thermal analysis for construction of road embankments over areas of warm permafrost. The Executive Committee requires additional information regarding proposed measures to consider and address thermal erosion from both project activities and climate change. Therefore, please provide the following:

R149. A detailed thermal modeling analysis of the proposed TMF and associated infrastructure on foundation conditions to support engineering design (including determination of embankment height, width of right of way, safety margin, etc.) and to assess the effects of the Project on the ground thermal regime. Include a detailed discussion and analysis about potential impacts to mine infrastructure from altered foundation conditions.

R150. An analysis of how climate change has been incorporated into the thermal erosion analysis to support Project design and the impact assessment.

3.3 GROUND THERMAL CONDITION AND PERMAFROST TEMPERATURE MONITORING

As noted in Natural Resources Canada's review, "[i]nformation on ground thermal conditions is required for adequate infrastructure design, the impact of the infrastructure on the stability of the ground, and to assess the impacts of climate change on the project" (YOR 2014-0002-245-1). However, the Proponent did not submit reports for past ground thermal investigations (although Appendix C includes some ground temperature and depth data for thermistor cables installed in 1994, 2009 and 2011 in Appendix C).

Appendix A includes 1994 thermistor data, but the depths of readings are unknown, which makes comparison to more recent ground temperature readings impossible. Natural Resources Canada notes that the proposal does not indicate whether "thermistor cables will be installed under proposed road alignments (e.g. the Freegold Road extension) in order to assess the pre-construction thermal conditions in area of known permafrost and ice-rich ground and the impacts of the infrastructure on the permafrost" (YOR 2014-0002-245-1).

The Executive Committee requires additional details to understand thermal change of permafrost conditions under recent air temperature increases as well as to assess future changes. Therefore, please provide the following:

R151. The depths at which ground temperatures have been measured for each cable installed in 1994.

R152. The ground temperature readings for all thermistor cables (from 1994 to 2013) in the same format (graphs of ground temperature with depth at a given time) which will allow an assessment of the impacts of recent climate warming (from 1994 until now) on permafrost.

R153. A discussion of whether ground temperature monitoring is planned for the proposed alignment of the Freegold Road Extension.

Natural Resources Canada questions the Proponent's inference that permafrost in some project areas will be dry or have low ice content. They note that the hypothesis of dry permafrost or low ice content "needs to be justified because ice content cannot be inferred simply by comparing the depth of the permafrost and the depth to groundwater" (YOR 2014-0002-245-1). Natural Resources Canada includes further details in their review that challenge the Proponent's characterization of water content within the active layer/top of permafrost and note that, "Inferring low ice content can have implications for the disposal procedure of the overburden (containment and sediment control)" as well as implications for "design solutions and construction methodologies" (YOR 2014-0002-245-1). The Executive Committee requires additional information on the ice content of permafrost. Therefore, please provide the following:

R154. Please clarify the assumption that permafrost might have low ice content based on the comparison between depth of permafrost and depth to groundwater.

3.4 SURFICIAL GEOLOGY AND TERRAIN MAPPING METHOD AND MAPS

Natural Resources Canada notes that "[b]aseline surficial geology information is critical for identifying terrain that can be sensitive to infrastructure development such as mining facilities and roads" (YOR 2014-0002-245-1). However, they also noted that the surficial geology maps included in the proposal contain unclear and complicated legends, which do not conform to Howes and Kenk's (1997) method as stated by the proponent. As such, there is uncertainty regarding the Proponent's surficial geology and terrain mapping method and associated maps. The Executive Committee requires clarification of the baseline terrain maps. Therefore, please provide the following:

R155. Clarification of the legends used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers. This will help establish the baseline surficial geology (terrain).

3.5 TERRAIN HAZARDS ASSESSMENT

Natural Resources Canada notes that the Proponent's terrain stability mapping methodology used "combined slope angle (as shown on the series of maps), slope aspect, surficial geology, permafrost conditions and presence of gullied terrain" (YOR 2014-0002-245-1). However, it is not clear from proposal documents whether the method is qualitative or quantitative. The method does not delineate ranges or values between stable, potentially unstable, and unstable terrain nor does it clarify "if a

landslide susceptibility index was determined to establish the three categories" (YOR 2014-0002-245-1).

Natural Resources Canada has indicated the terrain stability methodology may not accurately characterize hazards and "[a]s a result there are areas that are considered stable, e.g., 132.6 km - 128 km (colluvium and weathered bedrock, Fig. 23), which would be expected to be unstable given the steepness of the terrain and the material it will be built on" (YOR 2014-0002-245-1).

Natural Resources Canada also observes that, "[i]t is important for all of the local study area to include an interpretation of the surface sediments (terrain) and the unstable terrain up to height of land (crest) because that will include all of the potential areas where a landslide can be triggered and will provide a better assessment of terrain hazards" (YOR 2014-0002-245-1).

The Terrain Hazards Assessment for Proposed Mine Site (Appendix D, Part 1) acknowledges that there is significant uncertainty regarding "baseline rate of permafrost degradation and the extent to which it is anticipated to be affected by anthropogenic processes" (YOR 2014-0002-097-1). Nevertheless, the hazard assessment identified conditions beneath the foundation of the TMF embankment, reservoir and other site infrastructure that included:

- colluvial apron deposits which are expected to be susceptible to long-term thaw and/or creep settlements and displacements associated with the presence of ice-rich soils and massive ground ice;
- silt-rich soils which could contribute to an increased risk of soil piping if the permafrost degrades;
- soils rich in silt, organics and ice that are expected to be especially prone to erosion and instability, upon disturbance; and
- evidence of thaw flow from previous anthropogenic disturbances.

The Proponent adapted a classification scheme for the site based on the Terrain Classification System for British Columbia (Howes & Kenk, 1997). The results of this initiative indicated that approximately 13 percent of the study area comprises 'potentially unstable' terrain and less than 0.5 percent 'unstable' terrain. Reconnaissance terrain stability mapping was undertaken to a Terrain Survey Intensity Level 'C' with approximately 25 percent of the 2221 polygons field-inspected.

As stated in Appendix 6D (Terrain Hazards Assessment for Proposed Mine Site), the Terrain Classification for British Columbia is a classification scheme where 'terrain stability' refers to "the likelihood of a landslide initiating in a terrain polygon following road construction activities and timber harvesting" (Appendix 6D, p 10). Given that the BC classification scheme was developed for timber harvesting activities, it may not be appropriate for characterizing terrain hazards at a mine site. The inappropriateness of this classification scheme for northern regions has been noted in the past where, "[e]xcept for road safety considerations, mapping and assessments used in the forest sector were not meant to assess the suitability of sites for infrastructure" (Geertsema, 2006).

The classification scheme does not consider other potential contributing factors that may initiate landslides such as loads associated with massive site infrastructure (e.g. TMF embankment, HLF,

and ore stockpiles). The classification scheme also does not incorporate thermal erosion, which, as stated in Appendix 6D: "has been observed to occur in gently sloping ice-rich terrain that is classified as 'stable' in the terrain stability mapping" (Appendix 6D, p 15). Thermal erosion from past anthropogenic disturbance (e.g. access construction) is evident on-site. It is further stated in Appendix 6D that:

> It is emphasized that the terrain stability classification scheme applies to the likelihood of slope detachments (e.g. slides and flows) as opposed to slope displacements (i.e. soil creep), and that soil creep can be anticipated to occur, locally, at significantly shallower slope angles than slope detachments. (p 15)

Soil creep has potential to affect the stability and performance of proposed infrastructure (e.g. TMF) and, since soil creep is likely to occur, it is an important factor to consider in terrain hazard assessments.

The Proponent acknowledges that several activities could lead to permafrost degradation, including:

- removal of vegetation;
- alteration to surface water drainage;
- creating standing bodies of water that are in direct thermal contact with the surficial soils;
- implementing inadequate road drainage;
- stockpiling or placement of fill;
- uncontrolled placement of Potentially Acid Generating (PAG) Waste – pyrite oxidation is an exothermic reaction;
- stream avulsions resulting from placer mining;
- man-made fires; and
- climate change.

The Proponent also acknowledges that thawing permafrost may affect the TMF impoundment in several ways, including:

- increased pore water pressure and seepage;
- enhanced settlement with differential settlement being likely;
- increased potential for piping; and
- increased susceptibility of liquefaction of the foundation soils during an earthquake.

The terrain classification scheme undertaken by the Proponent does not include consideration of thermal erosion, nor does it consider soil creep a 'failure'. In addition, the model used to develop the classification scheme was designed for identifying hazards for road construction and forest resource harvesting (i.e. it does not contemplate potential landslide initiating factors such as loadings from massive site infrastructure nor from the degradation of permafrost). Considering the known risk factors at the site and the importance of ensuring the stability of proposed infrastructure such as the

TMF in perpetuity, the terrain hazard classification scheme presented by the Proponent is not appropriate.

The Proponent's terrain stability mapping for the Freegold Road indicates approximately nine percent of the proposed road alignment to be within 'potentially unstable' terrain and approximately three percent within 'unstable' terrain (YOR 2014-0002-111-1). However, Natural Resources Canada notes that it is not clear if the Proponent's assessment "includes all of the terrain that is found uphill from the road (on both sides) that can also be potentially unstable and can impact the road or only the terrain it will cross" (YOR 2014-0002-245-1).

Considering the information above, the hazard ratings identified for many of the polygons may not be accurate and, in fact, may overestimate the stability of the locations identified for mine infrastructure. The Executive Committee requires additional information to determine potential effects related to the mine infrastructure stability. Therefore, please provide the following information:

R156. Develop and present a site-specific terrain hazard classification scheme for the mine site, the Freegold Road, and the airstrip and airstrip access road, consistent with the YESAB draft guidance document titled *Geohazards and Risk: A Proponents Guide to Linear Infrastructure* (YESAB, 2014).

R157. Clarification of whether an ice-rich permafrost distribution map has been considered in the terrain hazard classification scheme

4.0 WATER QUALITY AND QUANTITY

4.1 AVERAGE HYDROLOGIC CONDITIONS AND NORMAL OPERATING/CLOSURE SCENARIOS

Potential effects to water quality are presented in Section 7.4 of the proposal and Appendix 7G (Water Quality Model Report). Predictions are made assuming average hydrologic conditions and normal operating/closure scenarios. The predictions do not account for uncertainties such as abnormal operating conditions or operating/closure scenarios as well as a broader range of hydrological conditions.

Selkirk First Nation's consultant, Macdonald Environmental Sciences Ltd. (YOR 2014-0002-256-1), and Environment Canada (YOR 2014-0002-249-1) indicate that water quality predications should account for wet and dry periods. In addition, EcoMetrix notes that wet periods, when the site may have a significantly greater volume of water to manage, and dry periods, when the receiving environment may have limited assimilative capacity, should be considered (YOR 2014-0002-235-1). In addition, scenarios such as a wet year followed by a dry summer, where high volume of water needs to be managed at a time when the assimilative capacity in the receiving environment is limited, should be considered. The magnitude and extend of potential WQG exceedances will be greater under extreme hydrologic conditions and/or atypical operating/closure scenarios.

The Executive Committee requires additional information in order to predict potential effects to water quality under abnormal conditions. Therefore, please provide the following information:

R158. An assessment of potential water quality under a broader range of hydrologic conditions, including:

a. the ability to manage waters during wet, dry and average years;

b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and

c. the water storage and receiving water effects during freshet and event flow.

R159. An assessment of the potential effects of climate change on source loadings and receiving water effects.

R160. An assessment of potential water quality under a broader range of operating/closure scenarios, including permit limits, atypical operations, accident scenarios, with and without passive treatment.

4.2 WATER AND SEDIMENT QUALITY BASELINE

4.2.1 Water Quality

Water quality baseline data are provided in Appendix 7A (Water and Sediment Quality Baseline). Water quality sampling studies were conducted at the project area from 1993 to 1995 and 2008 to 2012. Between 2008 and 2012 CMC conducted sampling at 26 stations concentrated in the Casino Creek and Britannia Creek watersheds shown in Figure 3. Raw data of sampling efforts was provided in Appendices A1 to A5 of Appendix 7A.

Section 4.1.1 of Appendix 7A speaks to seasonable variability and seasonal sampling efforts conducted by the proponent. In addition, Table 2 summarizes the number of samples for each sampling station by date. YESAB's *Proponents Guide: Water Information Requirements for Quartz Mining Project Proposals* directs proponents to "[p]rovide measurements of water quality parameters relevant to the project on a minimum monthly basis for a minimum period of one year to estimate seasonal variability" (YESAB, 2011, p. 9). In addition, this guide suggests proponents consider multi-year sampling and conduct sensitivity/uncertainty analysis in order to estimate inter-annual variability.

CMC made an effort to obtain monthly samples for a period of one year between August 2009 and October 2010. While 23 stations were actively sampled during this period, only two stations (W3 on Canadian Creek and W9 on Dip Creek) were sampled over consecutive months during this period. Although not continuous, samples were collected for each month at four stations (R2 on Victor Creek, W20 and W21 on Klotassin River, and W15 on the Yukon River) between 2008 and 2012. Most of the remaining stations have incomplete full calendar monthly datasets.

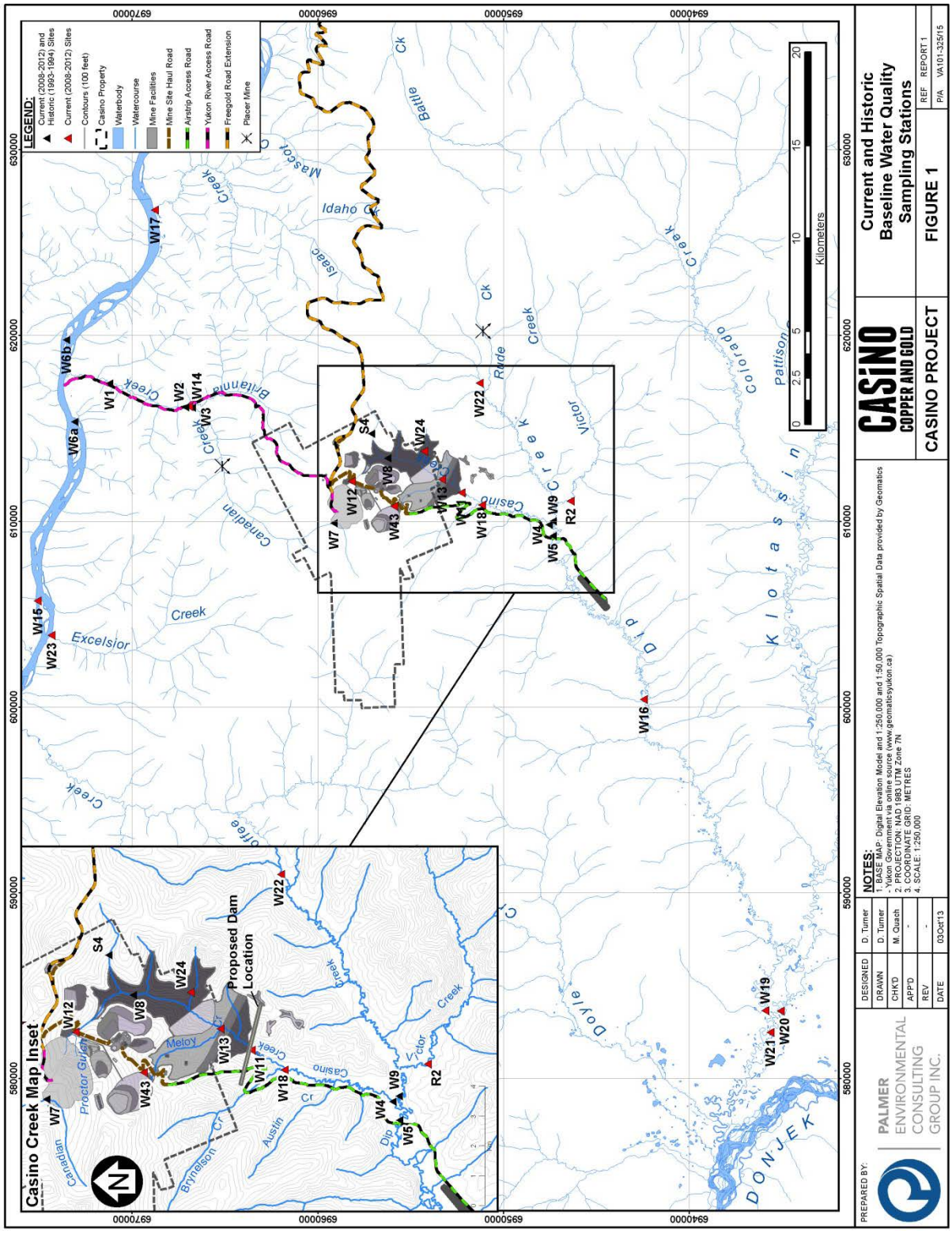

Figure 3: Water quality baseline sampling locations

(Casino Mine Project Proposal – Appendix 7A, Water and Sediment Quality Baseline, p 3)

Numerous comments received during adequacy indicate concerns regarding the water quality baseline data collected by CMC. Environment Canada notes that there are no samples collected in the Casino Creek Watershed during the months of January and February for any of the sampling years (YOR 2014-0002-0249-1). In addition, many stations in other watersheds also have incomplete datasets. Government of Yukon also notes concern that no samples were collected for sites W4 and W5 during the months of January of February (YOR 2014-0002-252-1). This is of particular concern given that CMC used sites W4 and W5 in developing their SSWQO. Other concerns raised by Environment Canada include:

- lack of results for statistical analysis, referenced in Section 3.4.2 of Appendix 7A, used to understand data distribution;
- lack of detail on water sampling protocols and field sampling methodologies;
- uncertain whether elevated metals are a result of additional metals associated with higher suspended sediments;
- loadings from the existing adit are characterized by only two data points; and
- unclear whether the proponent is drawing conclusions using total or dissolved metal concentrations/loads.

Selkirk First Nation's consultant, Macdonald Environmental Sciences Ltd, notes that at a minimum three years of monthly sampling data should be required to characterize baseline conditions (YOR 2014-0002-256-1). This would allow adequate evaluation of short-term variability in water quality. In addition, they suggest that for stations that may be affected by mine effluent discharge should be sampled each year using at least two 5-in-30 day sampling events. SFN further indicates that toxicity needs further documentation using early-life stages of salmonid and non-salmonid fish species, invertebrate species, and aquatic plant species. Appendix 7A indicates that "[t]oxicity sampling was completed once, on July 13, 2011, at the historical adit (W43)" (p 8). This sample found that there was 100 percent mortality for *daphnia magna*. CMC concludes that this confirms toxicity due to ARD from the historical adit. However, no further toxicity tests were completed for other sites.

Selkirk First Nation's consultant, Northland Earth & Water Consulting, also indicates that little baseline information has been provided (YOR 2014-0002-257-1). In particular, they questioned the characterization of Brynelson Creek as it will provide the majority of dilution required in Casino Creek to meet WQO downstream.

Clarification is also required on the use of water monitoring sites H18 and M18. At times within the proposal and various appendices it appears these sites are used interchangeably. Furthermore, Appendix 7G (Water Quality Model) states background water quality at site H18 "was assumed to be equal to baseline water quality from Brynelsen Creek (W18) monitoring station because W18 makes up approximately 90% of the H18 background drainage basin" (p 60).

The Executive Committee requires additional information regarding water quality baseline data in order to predict potential effects. Therefore, please provide the following information:

R161. Additional baseline water quality data for key water sampling locations on a minimum monthly basis for a minimum period of one year to estimate seasonal variability. The Executive Committee expects that results from ongoing water quality data collection will be provided throughout the assessment process.

R162. An analysis regarding dataset robustness, which should at a minimum include additional analysis of central tendency (i.e. standard deviation) and could include better description of data distribution, data variance and other summary statistics where data is not normally distributed to aid in understanding the robustness of the present water quality dataset.

R163. Additional details on water sampling protocols and field sampling methodologies. Details should include:

a. filtration protocol/methodology (e.g. field filtered, filtered in lab);

b. sample handling and preservatives protocol; and

c. analytical hold times, chain of custody, etc.

R164. Clarify whether water quality parameters being monitored and conclusions are being drawn from total metals content, dissolved metals content, or both. Discuss whether elevated metals were a result of additional metals associated with higher suspended sediments.

R165. Further discussion and clarification on baseline data from the existing adit. Details should include:

a. rationale as to the limited amount of data from the adit; and

b. an analysis for loadings (mass-balance) at additional points along the pathway from the adit to site W4.

R166. Toxicity testing and evaluation on water quality samples using early-life stages of salmonid and non-salmonid fish species, invertebrate species, and aquatic plant species.

R167. Clarify and provide further justification for the use of water monitoring stations W18, M18, and H18.

4.2.2 Sediment Quality

Sediment quality baseline data are provided in Appendix 7A (Water and Sediment Quality Baseline). Sediment quality samples were taken from eight locations in 1993 and 1994. In 2008, samples were taken from 12 additional stations. Throughout 2009 and 2012 a sediment quality sample was taken from almost all water quality sampling locations. Samples were analyzed for percent moisture, pH and total metal concentrations.

Selkirk First Nations consultant, Macdonald Environmental Sciences Ltd., indicates concern with the sediment quality baseline data presented (YOR 2014-0002-256-1). SFN notes that simultaneously extracted metals, acid volatile sulfides and total organic carbon should be included as parameters

analyzed. In addition, toxicity and bioaccumulation testing using sediment samples should be conducted and results provided. SFN suggests:

- toxicity testing by conducting 10-d toxicity tests with midge and 28-d toxicity tests with amphipods with sieved sediment samples (< 2.00 mm); and
- bioaccumulation testing by conducting 28-d bioaccumulation tests with oligochaetes with sieved sediment samples (< 2.00 mm).

The Executive Committee requires additional information regarding sediment quality baseline data in order to predict potential effects. Therefore, please provide the following information:

R168. Toxicity and bioaccumulation testing and evaluation on sediment quality samples.

4.3 HYDROLOGY BASELINE

Hydrology baseline data are provided in Appendix 7B (Baseline Hydrology Report). Hydrology sampling has been collected at various times since 2008 at 10 hydrometric monitoring stations. Currently, nine are being monitored actively.

The Baseline Hydrology Report provides information on flow characteristics for streams located in the Local Study Area (LSA). The baseline flow characteristics are derived from:

- data collected from 10 hydrometric monitoring stations that have been operating in the Local Study Area at various times since 2008; and
- generation of synthetic flow series by transfer and correlation of data from an adjacent regional hydrometric monitoring station with a longer period of record.

Seven of the monitoring stations were located in the Casino and Dip Creek catchments (south facing aspect) while three were located in the Canadian and Britannia Creek catchments (north facing aspect). The monitoring stations were distributed throughout the LSA and represented sub-basins with drainage areas ranging from approximately 25 to 384 square kilometers. With respect to the generated synthetic flow series, the Baseline Hydrology Report notes that the regional hydrometric station at Big Creek has a larger drainage area (1 750 square kilometres) and the procedure may tend to underestimate the unit runoff generated from a convective rainstorm event on the smaller basins associated with the LSA. Notwithstanding this point, and with the potential exception of high flow conditions, the approach appears to yield reasonable results and provides a reliable indication of mean flow conditions and typical range of monthly unit runoff. Field data from the both the local and regional study areas is considered sufficient to make a determination of baseline stream flow characteristics. However, the reliability of hydrologic estimates would benefit from additional data collection and a longer period of record.

The Water Survey of Canada (WSC) branch of Environment Canada has operated nine stream flow gauging stations at different periods over the past few decades within a radius of 150 km of the Project site. All gauging stations were operated within the Dawson Range and Klondike Plateau. Five of the stations are currently active and all monitor catchment areas much larger than the Project site catchment areas. Big Creek was determined to be the most representative of Project site catchments

and was used as a regional surrogate for modeling stream flow at the Project gauging stations. A synthetic daily flow series was determined for each of the Project stream flow gauging stations using 33 years of the Big Creek data. Regional stream flow is normally highest when the snowmelt occurs in May. On small streams, summer convective rainstorms may result in annual peak instantaneous flows or rain on snow events in the spring may result in large flows.

The accuracy of the measured high flow discharges is of concern to the Executive Committee. The British Columbia stream flow gauging station guideline (BC MoE, 2009) of measuring stream flows up to a maximum of two times the largest rating curve value must be used with caution. If the stream cross-section above the highest measured elevation of the rating curve is significantly different than the cross-sections used in the rating curve the peak flow calculated with the rating curve will not be representative of the true flow.

There is minimal information provided for streams and rivers downstream of W1 on Britannia Creek and W16 on Dip Creek. CMC has indicated that station W1 was deactivated in 2011 due to beaver dam interference. Government of Yukon, Department of Environment, indicates that station W1 should be re-established as it measures flows directly into the Yukon River (YOR 2014-0002-252-1). During operations, CMC proposes to source fresh and make-up water from the Yukon River. Make-up water requirements will range from approximately 11.5 Mm^3 per year at the start of operations to 0.2 Mm^3 per year at the end of operations. This water will be withdrawn from a riverbank caisson and radial well system, with a capacity to withdraw approximately 3 400 m^3 per hour, located near the confluence of Britannia Creek and the Yukon River. No flow data was provided for the Yukon River at the point of withdrawal.

Section 3.2 of Appendix 7B outlines data correction and stream flow record development required to develop rating curves. It appears that only measurements taken during 2011 and 2012 were surveyed to local benchmark datum. Government of Yukon, Department of Environment, notes the lack of benchmarks for pre-2011 data brings into question the rating curves developed using this data. Subsequently, they recommend that stage-discharge measurements taken prior to 2011 are not used to develop rating curves.

CMC estimated peak and low flow statistics for the area using synthesized annual maximum and daily maximum discharge. Government of Yukon, Department of Environment, asserts that the approach taken by CMC is outdated and encompasses a larger region than the project area. The Department of Environment recommends that CMC develop a more focused regional relationship using the larger and more current data set. Appendix 7B states that “[a] detailed description of the methodology used to select an appropriate regional surrogate watershed was undertaken for the 2010 Hydrometeorology Report (ref: VA101-325/3-1), issued on June 15, 2010 (KPL, 2010)” (p 20). However, this report was not provided. In addition, Government of Yukon express concern that values presented in table 5.2-1 and 5.3-1 of Appendix 7B are high and should be reassessed.

The Executive Committee requires additional information regarding the Baseline Hydrology of the Project area in order to determine potential effects related to surface water. Therefore, please provide the following information:

R169. Baseline hydrological information for streams and rivers downstream of W16 on Dip Creek and the Yukon River (e.g. Klotassin River and White River), inclusive of the Yukon River at the respective point of confluence.

R170. Provide estimates of flow rates for the Yukon River either at the point of confluence with Britannia Creek or at the point of planned water withdrawal from the Yukon River;

R171. Confirm whether on-going hydrometric monitoring will continue to improve the reliability of described baseline flow characteristics.

R172. Survey cross-sections of the stream gauging stations as well as an assessment of the accuracy of the measured peak flows considering the rating curve data.

R173. Confirm whether hydrometric monitoring station W1 that was discontinued in 2011 will be re-established. If not, provide rationale as to chosen approach.

R174. Discuss the use of stage-discharge measurements prior to 2011 (measurements which did not include benchmarks) in developing rating curves. Discuss the implications of only using data from 2013 and onwards in developing rating curves.

R175. A detailed description of the methodology used to select the Big Creek drainage as a regional surrogate watershed to develop the synthetic flow series. Consideration should be given to developing a focussed regional relationship using the larger and more current data set.

R176. Update tables 5.1-2, 5.2-1, and 5.3-1 in Appendix 7B, Hydrology Baseline Report to include discharge estimates (e.g. cubic meters per second or liters per second.

R177. A discussion on, and if necessary reassess, the values identified in Tables 5.2-1 and 5.3-1 of Appendix 7B (Hydrology Baseline Report) given that a comparison with regional hydrometric data suggests that values presented are higher than regional values.

R178. The following referenced report: Knight Piésold Ltd. 2010 Hydrometeorology Report (Ref. No. VA101-325/3-1, June 2010)

4.4 HYDROGEOLOGY BASELINE

Baseline hydrogeology data is provided in Appendix 7C (2012 Baseline Hydrogeology Report) while groundwater modeling is presented in Appendix 7E (Numerical Groundwater Modeling). Boreholes and data were collected at various times from 1993 through 2012 at various sites within the study area. Figure 1.2 of Appendix 7C shows 16 drill holes in the immediate vicinity of the TMF main embankment, one borehole in the TMF west embankment area, and seven at other locations in the TMF area (p 3).

EcoMetrix argues that the number of drill holes in the embankment area appears to be insufficient in respect of hydraulic conductivity determinations as well as the identification of possible fault/shear zones (YOR 2014-0002-235-1). The height of the TMF Main Embankment and associated differential hydraulic head of nearly 300 m could lead to serious seepage management issues.

Hydraulic conductivity (K) testing at the Casino Mine project consisted of Packer (Lugeon) tests in specific sections of drillholes while drilling, falling head response tests in open holes while drilling, falling or rising head tests in monitoring wells and piezometers and two short duration pump tests. All testing completed provided estimates of the K values of the rock or unconsolidated material in the immediate vicinity of the drillhole. No testing was completed that would allow the calculation of storage within the units. A total of 229 K tests were conducted in fresh bedrock and 57 tests in weathered bedrock. Mean arithmetic and mean geometric K values of the fresh rock were 1.1E-06 and 1.0E-07 m/s, respectively. Similarly mean K values of the weathered rock 7.9E-07 and 1.3E-07 m/s, respectively. The K values of the rock tested at individual test locations vary by several orders of magnitude. Further testing of rock at critical seepage zones, such as the TMF embankments are required.

Environment Canada also expresses concern that there is a lack of drill holes and hydrogeology baseline data (YOR 2014-0002-249-1). No drill holes were placed in eastern areas or the south-western area (around Meloy Creek) of the TMF. In addition, there are no drill holes outside the immediate footprint of the open pit nor within the footprints of the various ore stockpiles (i.e. gold ore, supergene oxide/low grade ore, and low grade ore stockpiles).

The north end of the open pit overlaps with Canadian Creek that flows north away from the project area. During operations, groundwater infiltrating into the open pit will be actively de-watered and directed to the TMF. At closure, water from Canadian Creek, upstream from the open pit, will be directed into the pit. Appendix 7C indicates that there is a surface and inferred groundwater flow divide overlapping with the open pit area. Groundwater flows either south and east towards the Casino Creek drainage or north to the Canadian Creek drainage (Appendix 7C, p 36). Environment Canada expresses concern that insufficient detail has been provided on groundwater flows to the Canadian Creek drainage from the open pit area. Base flows in Canadian Creek could be affected during operations while the open pit is being de-watered. Once the open pit has filled, groundwater seepage from the open pit may affect water quality in Canadian Creek.

The Executive Committee requires additional information regarding the baseline hydrogeology of the Casino Mine proposal. Therefore, please provide the following information:

R179. An update and overview of current hydrogeology baseline information. Details should be provided for the following:

   a. whether additional conductivity studies are being done in the TMF Main Embankment area and rationale for the selected approach;

   b. characterization of hydrogeology in the open pit area outside the immediate footprint; and

   c. characterization of hydrogeology in the gold ore, supergene oxide/low grade ore, and low grade ore stockpile areas.

R180. Additional discussion and supporting rationale on groundwater seepage from the open pit area to the Canadian Creek drainage. The discussion should include implications to base flows during operations and water quality during closure and post-closure.

R181. The following document for review: Knight Piésold Ltd. Revised Tailings Management Facility Seepage Assessment (Ref. No. VA101-325/8-13, December, 2012).

4.5 GEOCHEMISTRY AND SOURCE TERM PREDICTIONS

4.5.1 Geochemical Characterization of Ore, Waste Rock and Tailings

Geochemical characterization of various sources of material that will be exposed by the project are summarized in several reports found in Appendix 7D (Geochemistry Reports). While a significant amount of information has been provided in the reports to review and confirm geochemistry values and source term predictions, Environment Canada notes in their comments several areas where additional information is required (YOR 2014-0002-249-1).

The report titled Casino Waste Rock and Ore Geochemical Static Test Assessment (Appendix 7D, Lorax, Dec 3, 2013) outlines geochemical sampling program conducted from 2008 through 2012. This reports states: "[a]ccording to Price and Errington (1998), the recommended number of samples required to characterize the geochemical properties of the Casino waste rock is in excess of 6,000 samples. Given the number of geochemical tests involved, a phased approach was implemented" (p 3-1). CMC collected and conducted static test-work on 1 444 samples.

While a phased approach may be appropriate to characterize all types of materials, CMC has not provided sufficient information to indicate that the samples collected provide a statistically representative dataset. Environment Canada also expresses concerns concerning the phased approach to sampling as well as the representativeness of samples collected (YOR 2014-0002-249-1). For example, it appears that CMC collected and characterized only two or three samples of overburden material. According to guidance from Price and Errington (1998), based on the estimated tonnage of overburden, 80 samples should have been collected and analyzed.

The Executive Committee requires additional information regarding the representativeness of samples collected for geochemical characterization of ore, waste rock, and tailings. Therefore, please provide the following information:

R182. Additional detail and rationale to indicate that samples collected for geochemical characterization of ore, waste rock, and tailings, provide a statistically representative dataset. Details should include:

a. results of sensitivity analysis and gap analysis of geochemical characterization program;

b. summation of geochemical sampling program relative to rock lithology and alteration types; and

c. if current sampling is found to be incomplete, please update accordingly with a suitable number of samples for ABA, as well as appropriate kinetic testing.

Lorax, Dec 3, 2013 indicates that a series of cross-sections through the open pit are provided to illustrate sample locations. However, these cross-sections cannot be found. As cross-section and long-sections are the primary visual means of communicating geological information, these diagrams

are important in determining the spatial representativeness of the geochemical sampling. In addition, Lorax, Dec 3, 2013 references two prior reports (Lorax (2009) and Lorax (2010)) which provide results of Phase I and Phase II sampling. Although the results of these reports are likely incorporated into the proposal, Environment Canada indicates that it may be beneficial to review the original reports.

Environment Canada notes several other concerns related to Lorax, Dec 3, 2013 including (YOR 2014-0002-249-1):

- table 3-2 provides a breakdown of the distribution of static testing samples by both major lithology and alteration type; yet, the ensuing discussion is mainly relegated to discussing test results according to alteration only;
- an additional lithology ("FZ") is listed in Table 3-2 for which there is no discussion;
- in Section 3.2.3, shake flask extractions were performed on 12 HYP samples of 104 total samples. Meanwhile, HYP makes up almost 37 percent of the alteration types there are only about 12percent of HYP samples included in the shake flask extraction testwork; and
- in Table 5-5, there are no values presented for U and F despite these two parameters being identified as parameters of interest (water quality objectives in v.II, s.7). In Table 5-8, there is no value for number of samples (n) represented by the dataset.

The Executive Committee requires additional information regarding samples collected and results from analysis for geochemical characterization of ore, waste rock, and tailings. Therefore, please provide the following information:

R183. Complete cross-section and long-sectional diagrams of the open pit. Diagrams should include:

  a. all sample locations;
  b. all geologic units and lithologies;
  c. ore body outline; and
  d. any other data that will increase understanding of the deposit geology.

R184. The following referenced reports:

  a. Lorax Environmental Service Ltd. (2009) Casino Phase I Geochemical Assessment Report prepared for Western Copper Corporation, January, 2009.
  b. Lorax Environmental Services Ltd. (2010) Casino Phase II Geochemical Assessment Report, prepared for Western Copper Corporation, January 2010.

R185. Describe or otherwise comment upon the added dimension of lithology in their analysis.

R186. Information on and description of the "FZ" lithology listed in Table 3-2 report titled Casino Waste Rock and Ore Geochemical Static Test Assessment (Appendix 7D, Lorax, Dec 3, 2013).

R187. Clarify why there are only about 12 percent of HYP samples included in the shake flask extraction testwork when the HYP type makes up almost 37 percent of the alteration types.

R188. Rational as to why there are no values presented for uranium and fluoride despite having identified them as parameters of interest.

The report titled Casino Kinetic Testwork Update for Ore, Waste Rock and Tailings (Appendix 7D, Lorax, Dec 11, 2013) indicates that mineralization zones including the oxide leach cap (CAP) and supergene (SUP) may exhibit the highest metal leaching rates due to that material becoming acidic prior to submersion. The report goes on to say that those materials can be mixed with hypogene (HYP) material that contains carbonate neutralization potential and thus neutralize the acid generating potential. Environment Canada expresses concern that there is no information to support the feasibility of mixing material as a mitigation measure (YOR 2014-0002-249-1).

The Executive Committee requires additional information regarding the CAP, SUP and HYP materials and the effectiveness of mixing these materials as a mitigation measure. Therefore, please provide the following information:

R189. Details on: mining sequence; production of ore and waste types relative to lithology and alteration; and blending schedule. Details should include:

a. an ore/waste production schedule (tables and figures) broken down by lithologic/alteration units and tonnages mined; and

b. demonstration that the mixing CAP and SUP material with HYP material could be implemented and will be an effective mitigation.

Section 9.2 of Casino Kinetic Testwork Update for Ore, Waste Rock and Tailings (Lorax, Dec 11, 2013), indicates that new kinetic tests have been initiated – results of which have not been provided in the proposal. These tests included kinetic tests on heap leach residue, tailings, and waste rock. Environment Canada has indicated that results from these tests should be provided for the assessment (YOR 2014-0002-249-1).

In addition, Natural Resources Canada voices concern that only one of two column leach tests using CAP material was presented in Appendix 7D (YOR 2014-0002-245-1). Section 10 of the report titled Feasibility Design of the heap leach facility (Knight Piésold Consulting, 2012) recommends numerous testwork to be carried out. Natural Resources Canada indicates that this information would allow for evaluation of the design of the HLF.

The Executive Committee requires additional information regarding the ongoing kinetic testwork. Therefore, please provide the following information:

R190. Update and provide a discussion of on-going kinetic testwork. Provide any results and demonstrate how those results may inform the Project. Details should include:

a. discussion on whether any of the tests recommended by Knight Piésold have been conducted or initiated;

b. any additional laboratory reports that are available; and

c. discussion on what experiments/test work will be conducted prior to starting construction of the heap.

Environment Canada expresses concern with the geochemical characterization through bench-scale testing of prepared tailings samples (YOR 2014-0002-249-1). Appendices A1 and A2 of Casino Kinetic Testwork Update for Ore, Waste Rock and Tailings (Lorax, Dec 11, 2013) indicate that additional testing would be required to ensure an appropriate milling and flotation circuit for the Project. Without a defined process, the composition of the final tailings and waste rock are uncertain. Environment Canada also notes that there are no reports detailing bench-scale testing of SUP oxides/sulphides and HYP sulphides nor a description of the final process design.

The Executive Committee requires additional information regarding the ongoing characterization of prepared tailings samples. Therefore, please provide the following information:

R191. Details demonstrating the ore beneficiation process proposed to produce suitable concentrate. Details should include the process steps, reagents to be used, and resulting concentrates and wastes generated.

4.5.2 Geochemical Characterization of Borrow Sources and Access Road

There is a considerable lack of information surrounding the ARD/ML potential of the access road and borrow sources for the mine site. Environment Canada (YOR 2014-0002-249-1) and Little Salmon Carmacks First Nation's consultant, Rob Walker Consulting (YOR 2014-0002-281-1), have expressed concerns with the information provided.

The report titled Site Access Road ML/ARD Risk Assessment – Update (Appendix 7D, Lorax, November 5, 2013) provides general information on the level of risk associated with ARD/ML along the Freegold Road and Extension. A preliminary assessment of the ARD/ML potential of the access road was conducted prior to 2012. This included collecting and analyzing 60 sediment and rock samples from surface outcrops along the last 14 km of the Freegold Road Upgrade and the entire length of the Freegold Road Extension. This assessment, although referenced, has not been provided for review. In 2013, 22 additional samples were collected along the entire Freegold Road upgrade and 13 additional samples were collected along the extension. The report provides recommendations for more detailed investigations in areas of moderate or high risk. Specifically, additional studies and sampling are recommended for quarry locations and rock cut areas once they are identified.

The majority of the samples collected to characterize the potential for ARD/ML along the access road consisted of potentially weathered material from surface outcrops and materials. These samples are likely not representative of un-weathered bedrock, which may be disturbed during construction. In addition, there is no indication in the proposal of the potential volumes of material, weathered or un-weathered, that will be excavated, cut, or placed during construction.

Section 4.3.1.9 of the proposal outlines borrow sources for construction material at the mine site, Freegold Road extension, airstrip, and airstrip access road. Figure 4.3-3 identifies potential borrow

material at the mine site. No information has been provided on the ARD/ML potential for the airstrip, airstrip access road, or mine site borrow materials.

The Executive Committee requires additional information regarding the geochemical characterization for the site access road, airstrip, airstrip access road, and mine site borrow materials. Therefore, please provide the following information:

R192. For the Freegold Road upgrade and extension, access road borrow sources, airstrip, airstrip access road, and mine site borrow sources, 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;

c. consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.

R193. The following referenced report: Lorax Environmental Services Ltd. (2012) Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage.

4.5.3 TMF Embankment Loadings

CMC proposes to use de-sulphurized tailings (cyclone sand) to construct the unsaturated downstream portion of TMF embankment (as discussed above in Section 2.4). This material, which will remain unsaturated in perpetuity, will be exposed to oxygen and water leading to the potential of ARD/ML. To ensure that ARD does not occur, CMC proposes to construct this portion of the TMF embankment with non-acid generating materials. Predictions of contaminant loadings from the TMF embankment are described in Casino Geochemical Source Term Development (Appendix 7D, Lorax 2013).

To calculate and predict the thickness of oxygen ingress into the tailings embankment, CMC uses a general-purpose numerical model for reactive transport problems in variably saturated media (MIN3P). The model simulated oxygen concentration, pyrite volume fraction, and oxidation rate with depth for 20, 50, and 100 years of simulation times. Results indicate that oxidation will increase over time.

Based on results, CMC set the thickness of the oxidizing tailings embankment was set at 2.0 m. However, EcoMetrix has noted concerns that evidence has not been provided to show that leaching is a function of sulphide oxidation (YOR 2014-0002-235-1). In addition, CMC has not discussed the effects of leaching and oxidation within the embankment in terms of pore water that will infiltrate the embankment and will eventually become seepage.

Similarly, EcoMetrix raises concerns that CMC assigned a depth of oxidation of 0.5 m to the tailings beach based on results from the analysis of the TMF embankment. While this depth may be appropriate to estimate loadings in runoff from the beach it may underestimate the loadings that are

associated with tailings pore water that will infiltrate the tailings and eventually daylight as tailings seepage.

EcoMetrix indicates that the selected thickness of the oxidizing tailings embankment and tailings beach may underestimate contaminant loadings from the TMF embankment and tailings beach over the long-term. In order to assess effects of contaminant loadings on the receiving environment, the Executive Committee requires additional information. Therefore, please provide the following information:

R194. Details and justification on the depth of reaction and loadings source of 2.0 m for the face of the embankment when the active oxidation zone will initially be over a much deeper zone and will evolve downward over time. Justify the loading rates in the source term as a function of the oxidation zone only.

R195. Clarify the loadings as either runoff on the embankment slope and/or the downward infiltration that will eventually daylight as seepage from the embankment.

R196. Justify the depth of oxidation on the tailings beach and show the effect and implications of oxidation on the loadings associated with the infiltrating porewater and tailings seepage.

4.5.4 Missing Information

Appendix 7D (Geochemistry Reports), provides information on geochemical characterization and source term predictions for the Project. Some information that was referenced in this Appendix was not provided for review.

Section 7.3.3 of the proposal references a report titled *The effect of natural acid rock drainage on Casino Creek* by Himmelright (1994). This report discusses natural sources of ARD in the project area and notes significant natural ARD in Proctor Gulch. Environment Canada has indicated that "Given the importance of potential natural sources of ARD to the understanding of project water quality and impact, the proponent should provide a copy of the report for assessment review." (YOR 2014-0002-249-1) Therefore, please provide the following information:

The Executive Committee requires this information in order to fully review the geochemical characterization and source term predictions. Therefore, please provide the following information:

R197. The text on page 4-66 refers to Figure 4.1.4 yet this could not be found, or appears to be mislabelled. Please provide this figure for review.

R198. Casino Cross Sections (Appendix A2 – in LORAX (2013) Casino Geochemical Static Test Assessment, 3-Dec-13, J862-5).

R199. Supplemental Unsaturated Kinetic Test Results (Appendix B – LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5).

R200. The following referenced report: Himmelright, J. R., 1994: The effect of natural acid rock drainage on Casino Creek. Prepared for Pacific Sentinel Gold Corp. August 1994.

4.6 NUMERICAL GROUNDWATER MODEL

The Numerical Groundwater Modeling Report is in Appendix 7E (Numerical Groundwater Modeling). The modeling was based on a clearly defined conceptual model, modeling assumptions, and model components. The model was calibrated appropriately with good agreement with available data. A base case was developed for pre-mine conditions and the model was modified to include the effects of the mine components for different years during the operation and for post-closure conditions. The focus of the modeling exercise included flows into and out of the pit during different phases of the mine life and seepage from the TMF. The model assessment included a sensitivity analysis for TMF seepage flows based on ranges of hydraulic conductivity for the various hydrogeologic units. Overall the analysis was thorough. Some residual uncertainties may be associated with the presence of fractures in the bedrock near or below the TMF as discussed below.

Upon closure, the Open Pit will be flooded to maintain a pit lake. The Numerical Groundwater Modeling report indicates that the majority of seepage from the pit lake is expected to feed into the upper Casino Creek groundwater system. The report also indicates that seepage from the pit lake is expected to discharge within the upper Casino Creek valley upslope of the TMF facility. However, it is unclear if all of the pit water seepage is assessed in the overall loadings of the TMF.

A sensitivity assessment of seepage from the TMF was performed by considering differences in hydraulic conductivity in the foundation and in the embankment core. Structural features, such as faults, in the foundation of the TMF represent zones of higher hydraulic conductivity. Fault zones can result in higher than anticipated groundwater flow rates. However, there was no discussion of the potential influence of regional fault zones with respect to the TMF seepage.

The groundwater modeling assumes that ground water moves within a uniform and non-directional medium (i.e. the hydrostratigraphy layers are homogeneous and isotropic). This is a reasonable assumption at this stage of the Project development considering the available field measured hydraulic conductivity values. However, after further assessment of the hydrologic characteristics of the faults in the footprint of the project further modeling may be required.

The calibration method of the groundwater flow model using hydraulic head values in monitoring wells and stream base flow rates is suitable for calibration of the near surface layers of the model (alluvial and alluvial deposits as well as weathered rock). However, of a total of 17 piezometers installed on the site, seven are at a depth greater than 100 m and only three at a depth greater than 300 m. This may be sufficient coverage of hydraulic head data if the assumption of rock hydraulic conductivity being homogeneous and isotropic is true. However, if further information shows that faults are major conduits of water on the site, then additional piezometers may be required.

The groundwater model consists of four layers with cell sizes of 100 by 100 m within the mine footprint area and at 200 by 200 m at the edges of the model. Within areas of interest, such as mine infrastructure, the grid is refined for more accuracy. This appears to be a reasonable approach to the setup of the model. However, it is uncertain how well the cell sizes of 200 by 200 m will function in areas of steep topography where groundwater gradients will be considerable.

The groundwater model assumes all hydrostratigraphic layers of the model are unconfined. However, artesian groundwater flow conditions have been observed at drillholes located in the Casino Creek valley and in the Proctor Gulch located west of the open pit. Artesian groundwater hydraulic heads cannot be generated without confining hydrostratigraphic layers. It is uncertain, without further study, how reasonable the assumption that all hydrostratigraphic layers are unconfined is and what the effect would be on the modeling results. Additional field data may be required to assess the extent of known confining units.

Natural Resources Canada notes that the numerical groundwater model does not include the seepage recovery pond (YOR 2014-0002-245-1). The model provided by CMC estimates fluxes between all the various hydrostratigraphic units (elements of the TMF). However, the model uses a one-dimensional estimate of flow beneath the seepage recovery pond to calculate its recovery efficiency. This assumes that all other flow is captured in the seepage recover pond. Natural Resources Canada observes that this may not be the case when considering three-dimensional flows, stating:

> "In order to ensure consistency with the measurements in the model, it is recommended that the recovery pond be explicitly included in the model and that the estimates of recovery efficiency be determined by modeling fluxes into the recovery pond (in the manner all the other fluxes were calculated). Given the importance of the recovery percentage on the fluxes of contaminants that are not recovered and their downstream effects, it is necessary to determine the recovery fluxes and the fluxes bypassing the pond as accurately as possible." (YOR 2014-0002-245-1)

The Executive Committee requires additional information regarding the numerical groundwater modeling to understand potential effects related to seepage. Therefore, please provide the following information:

R201. Re-run the numerical groundwater model with updated groundwater baseline data.

R202. A copy of the updated Modflow numerical groundwater model and all input data used in the modeling runs including:

- a. a copy of all model outputs as summary tables and figures; and
- b. further discussion of assumptions used in the modeling.

R203. Discuss whether the open pit lake seepage predicted by the numerical model, to Casino Creek after closure, is assessed in the overall loadings to the TMF and the downstream environment. If not, provide rationale for its exclusion.

R204. If the majority of the predicted seepage, from the open pit lake, of 12 L/s will report to the upper groundwater system in Casino Creek:

- a. identify what the predicted magnitude of the remaining seepage will be; and
- b. identify where the remaining seepage is predicted to report to and what the effect of that seepage will be.

R205. Discuss whether the potential for preferential flow through faults below the TMF were considered and if not, discuss why and if so, discuss what were the results and implications for water quality downstream of the TMF.

R206. Clarify whether hydraulic conductivity values of the tailings and embankment materials are estimates or laboratory measured values. If they are estimates, please indicate if, and when laboratory testing will be conducted.

R207. Update the numerical groundwater model to specifically include the seepage recovery pond and calculate the seepage recovery pond's efficiency including the flux of untreated water that will bypass the pond.

CMC chose to model groundwater by developing a series of steady state models of the entire modeling period. Natural Resources Canada indicates that groundwater may be more appropriately modeled using a transient model (YOR 2014-0002-245-1). While steady state models provide snapshots of groundwater flows at defined times, transient models can predict groundwater flows at any time during the modeling period.

The Executive Committee requires additional information regarding the use of steady state modeling rather than transient modeling to predict groundwater flows. Therefore, please provide the following information:

R208. Justification for using a series of steady state models rather than one transient model to predict groundwater flows.

R209. A description of how the numerical groundwater model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

Permafrost in the Project area may have effects on or influence groundwater flows. Permafrost degradation either due to the presence of project components or climate change may lead to increased groundwater flows. Additionally, permafrost can alter groundwater flows so that they do not conform to the surface topographic divides. Both Natural Resources Canada (YOR 2014-0002-245-1) and Environment Canada (YOR 2014-0002-249-1) express concerns regarding permafrost considerations in the numerical groundwater model.

The numerical groundwater model includes permafrost but only in relation to groundwater recharge estimates. The groundwater under the footprint of all mine facilities was modelled as non-permafrost. Appendix 7E states "[a]reas beneath the proposed ore stockpiles, Open Pit and TMF embankment that were classified as regions of permafrost in the baseline model were reclassified as 'non-permafrost' to account for anticipated degradation of permafrost beneath major mine facilities" (p26).

Environment Canada states "[t]he impact of mine components on permafrost is likely to be much more than what is suggested by the model scenario as the degradation only mimics the footprint of the mine components. The areal extent of groundwater impact will likely be much greater than suggested by the proponent. The impacts of degraded permafrost on groundwater will impact the groundwater flow regime, and hence the groundwater quality" (p19). Environment Canada

recommends that a numerical permafrost model be developed and incorporated into the numerical groundwater model.

Additionally, the numerical groundwater model does not account for permafrost degradation beneath the TMF outside of the embankment areas. Natural Resources Canada raises concerns that the long-term degradation of permafrost and its effects to groundwater has not been modeled for areas below the TMF. Figure 2.3, Inferred Spatial Distribution of Permafrost, of Appendix 7C (Baseline Hydrogeology Report) indicates that, in the TMF area, much of the south-east facing slopes along Dip Creek are no permafrost areas while the north-west facing slopes contain permafrost areas. Natural Resources Canada comments that degradation and thawing of permafrost could increase hydraulic and groundwater flows towards Dip Creek. In addition, in areas of permafrost, subpermafrost flow systems could develop that do not conform to surface topographic divides. Natural Resources Canada also notes that permafrost data is only available from shallow test pits.

The Executive Committee requires additional information regarding permafrost and its effects to the groundwater regime. Therefore, please provide the following information:

R210. Groundwater level data between the proposed TMF and the Dip Creek watershed. The area of greatest concern is along the watershed divide just beyond the eastern end of the main embankment.

R211. A NW-SE geological cross-section (same approximate orientation as the main embankment) from the TMF to Dip Creek since this could demonstrate potential groundwater flow pathways across the topographic divide.

R212. Numerical groundwater flow modeling that extends into the Dip Creek watershed and eliminates the assumption of a no-flow boundary. Modeling should consider the potential for subpermafrost groundwater flow across the topographic divide. Modeling the seepage from the TMF should consider three dimensional flow from the TMF in order to consider not only vertical flow through or beneath the dam but also horizontal flow around the dam and potentially into Dip Creek tributaries.

R213. Map of the elevation of the base of permafrost and data on deep permafrost conditions east of the proposed tailings management facility.

R214. Justification for not including the subsurface distribution of permafrost (in particular lower hydraulic conductivity of frozen ground as a barrier to groundwater flow) in the numerical groundwater flow modeling.

R215. A discussion of the effect of permafrost distribution on the observed and modelled patterns of groundwater flow.

R216. Discussion of hydraulic conductivities of frozen and unfrozen hydrostratigraphic units. Details should include:

a. estimates of frozen and unfrozen hydraulic conductivities of all rock materials subject to permafrost; and

b. how thermal changes (due to facility construction and climate change) will affect the groundwater regime.

R217. A discussion and consideration of a numerical permafrost model to assess the effects of the mine components on permafrost distribution in the mine footprint

Natural Resources Canada has identified discrepancies between the following figures:

- Appendix 7C, Baseline Hydrogeology Report, Figure 2.3 – Inferred Spatial Distribution of Permafrost; and
- Appendix 7E, Numerical Groundwater Model, Figure 3.4 – Groundwater Recharge Zones

For example, Figure 3.4 – Groundwater Recharge Zones, shows significant areas of recharge (non-permafrost zones) in the area between the headwaters of Casino, Canadian, Meloy, and Brynelson Creek. In contrast, Figure 2.3 – Inferred Spatial Distribution of Permafrost, shows that these same areas are permafrost and should therefore be areas of zero recharge in Figure 3.4.

The Executive Committee requires clarification regarding permafrost distribution. Therefore, please provide the following information:

R218. A discussion on the discrepancies between the Inferred Spatial Distribution of Permafrost (Figure 2.3 of Appendix 7C) and the Groundwater Recharge Zones (Figure 3.4 of Appendix 7E).

R219. A discussion of how recharge distributions were modified and their potential effects on the numerical groundwater flow model.

R220. A new figure combining both the recharge and permafrost distributions so that it is possible to identify where the distributions overlap and differ.

Environment Canada stresses that the groundwater should be modeled for the time period that the TMF wetlands are being constructed. Currently groundwater was modelled post-closure, however, the TMF will be dewatered over a period of approximately five years to allow for the construction of the TMF wetlands.

The Executive Committee requires additional information regarding groundwater modeling during the construction of the TMF wetlands. Therefore, please provide the following information:

R221. Complete groundwater modeling on the period of time that the TMF is dewatered to allow construction of the TMF wetlands.

Appendix 7B, numerical ground water modeling, notes, “90-95% of the TMF seepage is predicted to be recovered by the water management pond. Calculation of this recovery efficiency assumes that the pond is maintained with as low of a water level as possible. Environment Canada asserts that

> modelling for seepage flow rates should also be provided for those periods where/if water levels in the water management pond exceed the desired levels. Environment Canada also questions how seepage values can be verified during operation, and reminds the proponent that as per s.19(3)(a) of the MMER that seepage flow rates are required to be measured within 15% accuracy. (YOR 2014-0002-249-1)

The Executive Committee requires more information regarding water seepage and the water management pond. Therefore, please provide the following:

R222. Modeling for seepage flow rates from the water management pond if the water level exceeds desired levels.

R223. Verification methods for seepage flow not captured by the water management pond.

4.7 WATER BALANCE MODEL

The Water Balance Report is presented in Appendix 7F (Water Balance Report). The water balance was completed as a deterministic model based on average monthly climate conditions using the GoldSim modeling software. This approach is an industry standard method and is highly suitable for operations planning of the mine and in many cases is also suitable for the environmental assessment of a proposed mine operation.

With respect to water management, several models were used to predict and assess impacts, including the site water balance model and the HLF water balance model. The results of water balance modeling are affected by the manner in which the models are set-up, how they represent features of the Project, the assumed values of model parameters and model inputs, and the range of scenarios evaluated.

It is important to understand the sensitivity of water balance modeling results to variations in the assumed values of key water balance model parameters and model inputs. This plays a key role in developing the site water management plan, and in understanding the potential implications of the site water management plan (water withdrawals, projected temporal changes in flow regime, and potential impacts of projected effluent discharges, as applicable) to the environment. In addition, the determination of an accurate water balance is a key part of the design process for both HLF and TMF.

EcoMetrix notes that a sensitivity analysis of the water balance model is required to identify the potential impact of variation in key model parameters or key model inputs (YOR 2014-0002-235-1). This is important as the “Report on Feasibility Design of the Tailings Management Facility” states “it should be noted that the water balance results are very sensitive to the input values, which are best estimates based on currently available information, so changes to the inputs could result in substantial changes to the results.” (Knight Piésold Ltd. December 20, 2012, p 67) In addition, as indicated in the Water Balance Report, the water balance provided the platform for the water quality modeling.

The Executive Committee requires additional information regarding water balance modeling conducted to understand potential effects related to on-site water balance. Therefore, please provide the following information:

R224. An assessment of potential water quantity under a broader range of hydrologic conditions, including:

a. the ability to manage waters during wet, dry and average years;

b. the receiving water effects during typical and extreme summer and winter low flows (7Q20 and 7Q10); and

c. the water storage and receiving water effects during freshet and event flow.

R225. An assessment of the potential effects of climate change on water balance.

R226. An assessment of potential water quantity under a broader range of operating/closure scenarios, including permit limits, atypical operations, and accident scenarios.

R227. Provide sensitivity analysis for the site water balance model identifying:

a. the potential impact of variation in assumed values for key water balance model parameters; and

b. the potential impact of temporal change in the assumed distribution of precipitation and snowmelt.

R228. Identify if the results of the sensitivity analysis materially affect the Water Management Plan for the project proposal, and if yes, update the Water Management Plan.

R229. A description of how the water balance model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

The potential effects on water quantity are presented in Appendix 7H (Project Effects on Water Quantity). Regional stream flow is normally highest when the snowmelt occurs in May. On small streams, summer convective rainstorms may result in annual peak instantaneous flows or rain on snow events in the spring may result in large flows.

The baseline hydrology assessment consisted of stream gauges at 10 hydrometric stations on the Project site. The amount of data available for each hydrometric station varies from three to five years of daily stream flow data with two or three annual low flow measurements taken in March at each hydrometric station. A Water Survey of Canada (WSC) hydrometric station located at Big Creek was determined to be the most suitable long-term regional hydrometric station available for generating synthetic stream flow data for the site. The Big Creek data was used to generate 37 years of synthetic flow series for each of the 10 project hydrometric stations. These 37 years of synthetic flow series data were used to generate a mean monthly hydrograph for each of the Project hydrometric stations.

The Executive Committee requests the following information on the project effects on water quantity. Therefore, please provide the following:

R230. Provide the reasoning for selecting Big Creek as the most representative long-term hydrometric station for generating site synthetic stream flow data.

4.8 WATER QUALITY MODEL REPORT

4.8.1 Transparency of Water Quality Predictions

CMC developed a site wide water quality model for the project. The model is summarized in Section 7.4.1 of the proposal and Appendix 7G (Water Quality Model Report). The model is a mass load balance model developed in the commercially available modeling software, GoldSim.

The model was developed by integrating baseline water quality, geochemical source terms, and the water balance model to predict surface water quality within the project area and the downstream receiving environment.

While GoldSim is a recognized and commonly used modeling software to predict water quality, it is necessary to ensure transparency of the model assumptions, inputs, and parameters. Transparency of the model would provide the Executive Committee with greater confidence in the predictions and allow for an accurate assessment of potential effects in the assessment. It would also allow reviewers to test assumptions and uncertainties with the model.

Selkirk First Nation's consultant, Macdonald Environmental Sciences Ltd., also notes that insufficient information has been provided with regard to the water quality model (YOR 2014-0002-256-1). Macdonald Environmental Sciences concerns include:

- Additional information must be provided to evaluate the potential effects of major ions on water quality conditions and associated water uses.
- The suite of parameters modeled must be expanded to include other parameters such as TDS, nitrate, and ammonia.

CMC has provided certain details regarding the water quality model in the form of tables, figures, and summaries. However, it may not be possible to reproduce model predictions based on the information provided. The Executive Committee requires additional information in order to have a clear understanding of the predicted water quality from the Project. Therefore, please provide the following information:

R231. Re-run the water quality model with updated water quality baseline data.

R232. A copy of the GoldSim model and all input data used in the assessment.

R233. A copy of all model outputs as summary tables and figures.

R234. A discussion of assumptions used in the modeling.

R235. Any additional information that the Proponent may have used in their assessment so as to facilitate an independent calculation of potential water quality effects by reviewers.

R236. A description of how the water quality model is to be used and updated during the mining process in order to improve mine management and predictions for closure. Indicate when any updates would be released during operations.

4.8.2 Source Term Loading from TMF Seepage

In developing the source terms and water quality model, CMC conducted a seepage assessment for the TMF using the mine effects model. This seepage assessment was summarized in Appendix 7E, Numerical Groundwater Modeling (CMC, Casino Mining Corp, 2014). CMC provides a conceptual diagram of the TMF sub-components and seepage flows as reproduced in Figure 4 below.

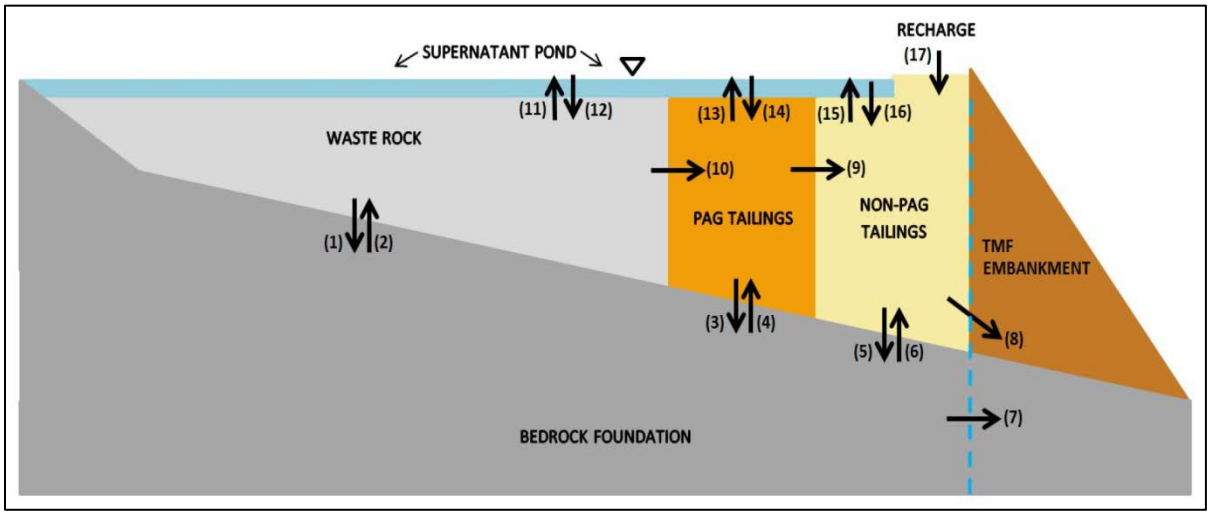

Figure 4: TMF conceptual model flux pathways

Notes: Flux Pathway (7) is calculated as the sum of terms (1), (3), and (5)
(Casino Mine Project Proposal – Appendix 7E, Numerical Groundwater Modeling, p 32)

Overall, this conceptual diagram clearly outlines the general flow of water and therefore the transport pathways for contaminants of potential concern within and from the TMF. However, EcoMetrix notes some pathways that are discussed in the Geochemical Source Term Development (Appendix 7D, Lorax 2013) and the Water Quality Model Report (Appendix 7G, Source Environmental Associates 2013) reports are not included in this diagram (YOR 2014-0002-235-1).

The Executive Committee requires additional information in order to have a clear understanding of the TMF sub-components and seepage flows including run-off from the TMF embankment. Therefore, please provide the following information:

R237. An explanation of how loadings from embankment runoff and embankment seepage relate to the conceptual flow diagram in Figure 7-2 in LORAX (2013) Casino Geochemical Source Term Development, 4 December, J862-5. In addition, please confirm that those loadings were included in the water quality model.

4.9 WATER QUALITY OBJECTIVES

4.9.1 Site Specific Water Quality Objectives

CMC predicts that water quality values for copper, cadmium, molybdenum, selenium, uranium, sulphate, and fluoride, will exceed CCME WQG for the protection of aquatic life in the downstream receiving environment. As such, CMC proposes to use site specific water quality objectives (SSWQO) for water quality in the downstream receiving environment. They outline rationale for selecting, and potential effects of using, SSWQO in sections 7.4.3.1 and 10.4.1.3 of the proposal. The Proponent proposes the SSWQO outlined in Table 3 (reproduced from Table 7.4-7, CMC 2014).

The proponent indicates that they evaluated the applicability of the CCME WQG for each contaminant of concern that exceeded those guidelines to determine whether alternative guidelines are more appropriate (CMC, 2014, p 7-33). Other guidelines reviewed came from the British Columbia Ministry of Environment (BC MOE) and the United States Environmental Protection Agency (US EPA). In addition, the Proponent used the Background Concentration Procedure outlined in by the BC MOE, Lands and Parks (BC MoE LP 1997) to calculate SSWQO.

In their comments, Environment Canada (YOR 2014-0002-249-1), Selkirk First Nation (YOR 2014-0002-256-1), and Government of Yukon (YOR 2014-0002-252-1), express concerns that SSWQO should be developed in accordance with CCME criteria. Environment Canada further comments that WQO should be based on guidelines developed in Canada, representing chronic/long term acceptable limits.

Environment Canada also notes that table 7.4-3 (Water Quality Model Parameters and CCME and BC MOE Guidelines) and Tables 7.4-8 through 7.4-10 (Summary of Predicted Water Quality in Casino Creek at M18 and W4 and Dip Creek at W5) should include pH as a parameter. Predictions of pH are important given that it could cause potential effects and also modify the toxicity/effects of other parameters of interest.

Surface water quality objectives provide the basis by which effects to the aquatic environment can be assessed. In Canada, CCME WQG for the protection of aquatic life or Yukon WQG tend to apply unless there is sufficient justification to use SSWQO. Justification and rationale should demonstrate that aquatic life in the receiving environment remains protected. EcoMetrix has indicated that the proponent has generally not demonstrated that the proposed SSWQO protect aquatic life to the same degree as the CCME WQG (YOR 2014-0002-235-1). Most merely demonstrate differences between regulatory jurisdictions.

For example, CMC proposes to use a BC MOE value of 1 mg/L for molybdenum rather than the CCME value of 0.073 mg/L. CMC states “British Columbia is currently the only province in Canada where [molybdenum] is mined, and consequently is also the only province with an approved molybdenum guideline” (CMC 2014, p 7-35). CMC rationalizes the use of the BC MOE guideline because the Project will also produce molybdenum concentrate. No further rationale is provided. Environment Canada seeks clarification as to the proposed use of the BC MOE guideline and notes that the Ontario Ministry of Environment also has an approved molybdenum water quality guideline of 0.040 mg/L (YOR 2014-0002-249-1).

Table 3: Proposed site specific water quality objectives

Creek	Parameter	CCME WQG (mg/L)	Proposed WQG (mg/L)	Source
Casino	Copper	0.003	0.025	BCP based on the 95th percentile
Casino	Cadmium	0.000036	0.00027	US EPA chronic dissolved (baseline hardness)
Casino	Molybdenum	0.073	1.0	Approved BC MOE 30-day average
Casino	Selenium	0.001	0.002	Approved (Interim) BC MOE 30-day average
Casino	Uranium	0.015	0.019	BCP based on the maximum
Casino	Fluoride	0.12	1.4	Approved BC MOE maximum
Casino	Sulphate	None	309	Approved BC MOE 30-day average (baseline hardness)
Dip	Copper	0.0022	0.0065	BCP based on 90th percentile
Dip	Cadmium	0.000030	0.00023	US EPA chronic dissolved (baseline hardness)
Dip	Iron	0.30	0.78	BCP based on the 95th percentile for Construction, Operations, and Closure/Decommissioning
			0.71	BCP based on the 90th percentile for Post-Closure
Dip	Fluoride	0.12	1.3	Approved BC MOE maximum

Notes:
BC MOE: British Columbia Ministry of Environment
US EPA: United States Environmental Protection Agency
BCP: Background Concentration Procedure

In order to assess effects to the aquatic receiving environment, the Executive Committee requires additional information and rationale in selecting and determining proposed WQO. Therefore, please provide the following information:

R238. Additional details and rationale supporting the use of site specific water quality objectives (SSWQO) for certain contaminants of concern. Details should include:

a. justification for not using CCME guidelines to develop SSWQO;

b. demonstration that aquatic biota remain protected to the same degree as provided by the CCME guidelines;

c. how SSWQO account for chronic/long-term acceptable limits; and

d. consideration for the new, hardness-dependent, long-term limit for cadmium now available from CCME.

R239. Predictions for pH in table 7.4-3 (Water Quality Model Parameters and CCME and BC MOE Guidelines) and Tables 7.4-8 through 7.4-10 (Summary of Predicted Water Quality in Casino Creek at M18 and W4 and Dip Creek at W5).

4.9.2 Metal Mining Effluent Regulations

Effluent will be discharged from the TMF spillway and the WSMP. These points of control must meet the metal mining effluent regulations (MMER). Section 7.4.1.3.3 identifies maximum annual concentrations of Arsenic, Cyanide (total), Copper, Lead, Nickel and Zinc relative to MMER limits (Casino 2014, p 7-23). In addition, Table 7.4-4 (Water Quality of TMF Pond during Typical Operations and Post-Closure Years) predicts water quality for various parameters in water that will be discharged through the spillway (Casino 2014, p 7-21). Environment Canada notes that toxicity, pH, and radium 226 are also parameters regulated by the MMER (YOR 2014-0002-249-1). However, no predictions were made for these parameters.

In order to ensure that effluent meets the legislative requirements under the MMER, the Executive Committee requires additional information on predicted water quality in the TMF pond and the WSMP. Therefore, please provide the following information:

R240. Predictions for toxicity, pH, and radium 226 in the tailings management facility pond and the winter seepage mitigation pond. Provide a discussion on how these parameters address the limits under the Metal Mining Effluent Regulations.

4.10 DOWNSTREAM EXTENT OF WATER QUALITY EFFECTS

Section 7 of the proposal provides predictions of water quality in mine water discharge and receiving water bodies. Predictions were made for different phases of the Project for middle Casino Creek (H18), lower Casino Creek (W4), and middle Dip Creek (W5). The water quality model predicts mine water discharge will contribute to exceedances of CCME WQG for several parameters at each of these three locations. In addition, for constituents that naturally exceed CCME WQG, the predictions show prolonged exceedances of the 90th percentile of background concentrations.

It is not clear how far downstream that predicted exceedances would persist. The Executive Committee requires knowledge of how far downstream potential effects may be expected. EcoMetrix also questions the extent of downstream effects, especially within the context of uncertainty regarding

water treatment. White River First Nation (WRFN) questions not only the lack of modeling for the lower portions of Dip Creek but also the exclusion of water bodies further downstream, including the White River, from the water quality study area (YOR 2014-0002-279-1).

The Executive Committee requires additional information in order to properly delineate the downstream extent of potential water quality effects. Therefore, please provide the following information:

R241. An assessment of potential water quality effects extending downstream to include water monitoring station W16 and, if necessary, as far downstream 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). The assessment should consider scenarios both with and without use of the passive treatment system.

In addition, Environment Canada raises concerns related to the use of water monitoring station M18 as the receiving environment (YOR 2014-0002-249-1). The applicability of this site is uncertain, as it is downstream of the confluence of Casino Creek with Brynelson Creek.

The Executive Committee requires more information on the use of water monitoring stations. Therefore, please provide the following:

R242. Additional rationale supporting the use of station M18/W18 as the receiving environment for the Project. Consideration should be given to:

a. how this site fits within the intent of CCME; and

b. to what degree does contribution of water from Brynelson Creek provide a buffer for the project meeting CCME or site specific water quality objectives for the protection of aquatic resources.

4.11 SUBMERSION OF PAG MATERIALS

To reduce acid generation and metal leaching, the TMF is designed to saturate potentially acid generating (PAG) material. Continued saturation of PAG materials requires sufficient water inflows to make up for any evaporative and seepage losses. This also requires maintenance of TMF dam integrity in perpetuity. PAG material, if not saturated quickly, may also present a water quality risk during operations.

Section 5.4.5 of the TMF feasibility report indicates that PAG materials will be deposited above the TMF water level for an inflow design flood at the time of deposition. The last PAG materials deposited will take approximately one year to be submerged suggesting there may be a one-year delay between deposition and flooding for successively deposited PAG materials. BGC Engineering notes that it is unclear if any acid generation may begin within that time period and also what would ensure submersion of PAG materials in the event of temporary or early closure (YOR 2014-0002-274-1).

Considering both weather variability and the potential for climate change in the region over the long term, continued saturation of PAG materials within the TMF could be a challenge during period of low

precipitation. The sensitivity of the TMF water level to variations in TMF seepage, evapotranspiration, precipitation, temperature and other meteorological parameters is unclear. Modeling of the TMF water balance should include conditions in which the TMF may not contain enough water to saturate PAG materials and overall water balances for varying climatic conditions.

The Executive Committee requires more information on the submersion of PAG materials during operation and closure. Therefore, please provide the following:

R243. Expected length of time PAG materials will be exposed to oxygen and water before submersion in the TMF and any expected resulting acid generation.

R244. An analysis of scenarios that may cause exposure of PAG materials considering variation of meteorological factors, vegetative interception, and seepage losses. Details should include:

a. an analysis of successive dry years on TMF water balance and its implications on PAG tailings and waste rock oxidizing due to low water levels;

b. the minimum annual precipitation required to maintain PAG materials below the water table in the TMF;

c. scenarios during closure that would cause the water table in the TMF to be low enough to allow oxidation of the PAG materials; and

d. the potential effects associated with metals mobilization under these scenarios.

4.12 Open Pit Water Quality

Section 4.3.1.4 of the proposal indicates water required during construction will be sourced from open pit dewatering, among other sources (p 4-37). During open pit construction, water collected in the pit footprint will be collected and either used in the process plant or treated and released. Environment Canada notes, as indicated in other sections of the proposal, water that contacts the ore body results in elevated metal concentrations (YOR 2014-0002-249-1). It is uncertain whether water quality from pit dewatering will allow for use without treatment. In addition, it is uncertain whether water treatment capacity will be on-site during the construction period.

The Executive Committee requires additional information to clarify water use during construction, in particular from pit dewatering. Therefore, please provide the following information:

R245. A plan describing mitigations in case unsuitable (e.g. elevated metal concentrations) water is encountered via pit dewatering (i.e. prior to sufficient storage developed on-site).

4.13 Historic Adit

The proposal notes an historic adit on the project site is discharging water to Casino Creek via surface runoff to Meloy Creek. The water has elevated levels of silver, lead, cadmium and zinc. The proposal indicates that CMC will consider permanently sealing the adit pipe, potentially during the construction of the heap leach facility (HLF). The Executive Committee notes that plugging an adit has risks which may affect the adjacent HLF. For example, groundwater pressure could increase

underneath the HLF, causing stability issues. It is important to characterize the groundwater and flow patterns near the adit to adequately assess the potential effects of plugging it. The Executive Committee requires additional information regarding the plans for the adit, and whether the Proponent has characterized the groundwater and flow patterns near the adit. Therefore, please provide the following information:

R246. Details on the characterization of groundwater and flow patterns near the adit.

R247. A comprehensive description of the adit including:

a. physical characteristics (e.g. incline or decline, dimensions, length); and

b. extent of fracturing.

R248. How and when the adit will be reclaimed. Describe implications of reclamation on surrounding groundwater and infrastructure such as the HLF.

5.0 BASELINE CLIMATE REPORT

The proposal presents climate baseline information primarily in Appendix 8A of the proposal. The Casino site itself has limited climate data, with the exception of snowpack data for which the Government of Yukon has recorded 34 years of data. Because climate data from the Project site is limited, it was supplemented with data from other sources and nearby sites, primarily Pelly Ranch climate station data. Pelly Ranch climate station is the nearest climate station with long-term data available. It was established in 1951 by the Meteorological Service of Canada.

The Project area ranges from an elevation of 650 to 1 400 m and is located within the boreal cordillera ecozone and the Klondike Plateau ecoregion. The region is characterized by several mountain ranges that trend north-westerly and consist of large plateaus. These plateaus are generally flat or gently rolling and are separated by wide valleys. The region has long, cold, and dry winters. Summers are short, warm and relatively wet with precipitation falling by convective rain showers and thunderstorms. The local climate conditions vary according to elevation and slope aspect.

The Proponent completed a long-term precipitation record for Pelly Crossing by conducting a regression analysis with nearby climate stations. Then, the Proponent determined rainfall data for the Project site using limited on-site data the Pelly Ranch Data. By comparing rainfall, when data existed for each location, the Proponent derived an orographic factor to build a long-term synthetic precipitation baseline for the Project site. This orographic factor assumes that site rainfall will be 1.07 times greater than rainfall at Pelly Ranch with every 100 m increase in elevation.

The Proponent uses Environment Canada predicted return periods to justify using the orographic factor for extreme events:

> the maximum daily rainfall recorded at the Project site from 2009 to 2012 was 31.5 mm, which corresponds to a return period of 2 years according to site estimates. The maximum daily rainfall recorded at Pelly Ranch according to the 1971-2000 climate normal is 34.8 mm. Scaled by an orographic factor of 1.076 to the Project site, this would equate to 58 mm at the Project site, or a 25-year return period. Both of the

> above comparisons are taken to indicate that the extreme 24-hour rainfall estimates are reasonable and appropriate. (Appendix 7B, 2.3.2.3)

The 25-year estimate at the Project location is not validated as it is only compared against a two-year estimate, which itself relies heavily for verification on the assumption that a one in two year event occurred over three years of observation. The use of an orographic factor for rainfall is not clearly appropriate for extreme events, which are outliers by definition in a regression analysis. Nor is it clear that a linear orographic factor is appropriate for extreme events. Furthermore, given that CMC in its analysis only considered site precipitation records from May through September, it is not clear that this factor represents snowfall accurately. Records for snowfall at the site are absent, as the rain gauge is unable to account for snow.

Temperature was modelled with a regression analysis similarly to temperature. Temperatures in summer were approximately 5° C colder at the Project location when compared to Pelly Ranch, consistent with a (wetter) adiabatic lapse rate. During winter, temperatures will slightly warmer at the Project site, this was attributed to "the settling of cold air in valley bottoms during the winter and the consequent temperature inversions that are often experienced…" (Appendix 7E, Numerical Groundwater Modelling). Extreme temperatures are assumed to follow this trend, the maximum and minimum site estimates are 30° C and -50° C respectively.

Climate variables are also derived for wind and wind direction, humidity, sublimation, snow melt and accumulation and evapotranspiration. Evapotranspiration is critical due to its centrality in any water balance calculations. The Proponent uses Thornthwaite (1948) for estimating potential evapotranspiration. Government of Yukon, Department of Environment, (YG) considers Thornthwaite rather rudimentary as it only considers one variable: air temperature. The simplicity of this approach is often seen as its main advantage; however more detailed methods exist. YG states "more robust methodology using air temperature, relative humidity, wind speed, and solar radiation are available and should be employed to develop estimates of evaporation and evapotranspiration" (YOR 2014-0002-252-1). YG also notes that anemometer and wind direction sensor parameters, such as location and height, are not presented.

YG also notes that "it is not clear what climate variables have been considered in project safety and design" and "it appears that the proponent utilized mean projections rather than extreme projections when considering climate change variability" (YOR 2014-0002-252-1). The use of means rather than extreme events in climate projections dampens confidence in how climate change may be incorporated into Project safety and design.

In building baseline climate data for the Project site, it is not clear why additional data from other nearby climate stations was not used to elaborate on the potential variability of climate in the region due to elevation, aspect, and the orographic effects of mountains. The absence of a discussion of the effects of aspect is particularly concerning as the proposal explicitly states its importance as a factor in climate.

The Executive Committee requires more information on climate baseline data. Therefore, please provide the following:

R249. Reasons for missing data at regional climate stations (i.e. was the station not operated for budget considerations or did an extreme weather event destroy the station).

R250. Rationale for a linear orographic factor at the Project site for 24-hour extreme events considering available data and any terrain effects.

R251. Additional rationale for developing the precipitation return period events (e.g. extreme rainfall). Details should include the methodology for developing the 200 and 1 000-year return period events as well as rationale for using the Gumbel distribution.

R252. Discussion of the role of aspect in relation to climate variables at the Project site.

R253. Justify the use of only Pelly Ranch in building climate baseline data at the Project site for periods where data are unavailable for the Project location.

R254. Confirm that on-site meteorological data collection is ongoing. Provide raw and processed data and recalculate precipitation estimates and measures of variability.

R255. Clarification regarding the climate variables that have been utilized as part of project safety and design as well as an explanation for why those climate variables have been chosen.

R256. Clarification regarding the values used when considering climate change projections and their interactions with the project.

R257. Additional information on wind speed/direction sensor position and height.

R258. Develop a more robust estimate of evaporation and evapotranspiration using air temperature, relative humidity, wind speed and solar radiation.

6.0 CLIMATE CHANGE REPORT

Appendix 20A, Climate Change Report, predicts the effects of climate change for locations in the general region of the Project Site. The report includes:

- a review of relevant climate change literature in Yukon;
- prediction of climate trends (i.e. temperature and precipitation) and stream flow trends (i.e. annual runoff, stream flow patterns, and peak flows);
- climate model predictions; and
- climate cycles.

Government of Yukon, Department of Environment, has indicated that it is unclear how the variability and uncertainty associated with climate change has been considered and incorporated into the Project design (YOR 2014-0002-252-1). The conclusions of Appendix 20A states:

> There is substantial uncertainty associated with predictions of future climate patterns in the Yukon, and though it is believed that available climatic and hydrologic records provide an appropriate basis for generally assessing conditions in the Project area

> over the expected life of the mine, it is recommended that potential changes be considered in climatic and hydrologic assessments, when appropriate (p 27).

There is no discussion or details to indicate when it would be appropriate, or where CMC has considered climate change in the climatic and hydrologic assessments.

CMC applied a +15 percent climate change factor in developing the peak discharge design values and after considering peak flows for the Yukon River and Big Cree (Appendix 20A, Section 2.2.3). Government of Yukon has noted that CMC has been too conservative by using a value of +15 percent (YOR 2014-0002-252-1). Appendix 20A did not provide a value for annual historical increase in flow for Big Creek. A review of flow data for Big Creek conducted by Government of Yukon, Department of Environment, has shown an increase in flow of 2 m^3/s per year when all data is considered and an increase of 1.9 m^3/s per year when all peak rainfall events were dropped from the data set. Considering this historical trend, Government of Yukon has estimated flow increase over time would result in a +45 percent increase in flow of Big Creek by 2050.

The Executive Committee requires additional information to understand how climate change was considered. Therefore, please provide the following information:

R259. A discussion on how variability and uncertainty associated with the impacts of climate change was considered in Project safety and design and how those impacts will be mitigated, particularly with respect to permafrost thaw and hydrological changes.

R260. In planning the design and construction of the mine, a greater range of potential change should be considered (and not just the mean). For example, if the range of precipitation change is projected to be between 5 and 25 percent, design considerations should not be limited to a mean (15 percent) but should address the potential maximum (25 percent). Please clarify what values were used when considering climate change projections and their interactions with the Project.

R261. Clarification on the calculations related to the projected rate of increase of flow, including details on how historical trends for Big Creek have been taken into consideration in the projection as well as how the potential maximum increase has been addressed.

7.0 AIR QUALITY

7.1 AIR QUALITY MODELING

Section 8 of the proposal provides an air quality baseline data and an analysis of air quality during construction and operation of the Project. Results of air quality modeling were compared to the Yukon Ambient Air Quality Standards, the Canadian Air Quality Objectives as well as the BC Air Quality Objectives.

7.1.1 Model Inputs

The Executive Committee retained SENES to help inform them regarding information gaps for the Project. SENES notes that modeling results provided are difficult to interpret as not all supporting

data was supplied (YOR 2014-0002-248-1). This included an analysis of wind directions, method of data collection for on-site climactic variables, and a detailed emission inventory for construction and operational activities. Furthermore, the results of the model could be more clearly examined with the provision of model outputs. The Executive Committee requires more information to better understand the modeling done by the Proponent. Therefore, please provide the following:

R262. The CALPUT and CALMET input files such that a recreation of the model is possible.

R263. Details on the specifications of ambient air monitoring and meteorological equipment.

R264. An analysis of wind directions compared to other regional sites.

R265. A detailed emission inventory for construction and operational activities.

7.1.2 Mitigations

The primary mitigation provided in the proposal for air quality is the adherence to existing legislation. While adhering to existing legislation may mitigate potential effects to air quality there are no details on how CMC will achieve this. Furthermore, it is unclear if provided mitigations were incorporated into air quality predictions. For example, Table 8.4-7 of the proposal predicts a high effectiveness for the identified mitigations in relation to sulphur dioxide; however, sulphur dioxide exceedances are still predicted in model results that would indicate mitigations have not been modeled. Government of Yukon, Environment Yukon, also expresses concern regarding the effectiveness of proposed mitigations (YOR 2014-0002-252-1). The Executive Committee requires more information regarding mitigations in relation to air quality. Therefore, please provide the following:

R266. Clarification if mitigations, such as ultra-low sulphur fuel, proposed for air quality were reflected in model parameters. If not, results of the air quality model with the mitigations reflected in model parameters.

R267. If predicted air quality, after mitigations, results in exceedances, provide mitigations for identified exceedances.

7.1.3 Exceedances

Table 8.4-4 of the proposal highlights air quality predicted exceedances; however, the nature of exceedances are not expounded upon. In addition, Environment Canada requests the actual concentrations modelled (YOR 2014-0002-249-1). Clarification of exceedances is required to better understand their significance. The Executive Committee requires more information regarding the nature of exceedances predicted at the Project site. Therefore, please provide the following:

R268. The raster data generated from the CALPUFF model in a standard GIS format.

R269. A description of predicted exceedances including concentrations and predicted frequency.

7.2 DUST AND DUSTFALL

Dustfall was modeled for two years of the Project, during construction and operation, along with other air quality parameters. The composition of dustfall and particulate matter generated by the Project is unclear as are the nature of mitigations for dust and particulate matter management. Government of Yukon raises concerns about the composition of dust that may be generated (YOR 2014-0002-252-1). The potential for dust from crushing and conveying operations may lead to dust with a more hazardous nature as well. The Executive Committee requires more information on dustfall and particulate matter. Therefore, please provide the following:

R270. Details on the compositions of dust generated by the mine and how this is expected to compare with the proposal's baseline data.

R271. Details on volumes of water required for dust management and clarification if this water was accounted for in overall water use requirements.

7.3 AIR QUALITY MANAGEMENT PLAN

Section 22.3.8 outlines the principles of the yet to be developed Air Quality Management Plan. The section references relevant guidance documents as well as best management practices and mitigation measures recommended by the documents. Table 22.3-2 summarizes proposed mitigation measures for potential project effects on air quality. The table does not contain all of the measures listed (in the text of the section) as recommended by the guidance documents. The Executive Committee requires a conclusive list of proposed mitigation measures to confirm the Proponent's intent. Therefore, please provide the following information:

R272. Update to Table 22.3-2 to include a conclusive list of proposed mitigation measures for potential project effects on air quality.

8.0 FISH AND AQUATIC RESOURCES

8.1 FISHERIES ACT – FISHERIES PROTECTION PROVISIONS

The introduction to Section 10 of the proposal acknowledges the recent changes to the federal *Fisheries Act*, which received Royal Assent in 2012 and came into force on November 25, 2013. The proposal notes that the fish and aquatic resources effects assessment section of the proposal was developed to correspond with the old version of the Act. The amendments establish the focus of Fisheries and Oceans Canada's new Fisheries Protection Provisions as the sustainability and ongoing productivity of commercial, recreational and Aboriginal fisheries. The proposal discusses the new provisions, noting that they have yet to be widely implemented, and discusses how they will generally affect the proposal. EcoMetrix (YOR 2014-0002-235-1) and the Department of Fisheries and Oceans (YOR 2014-0002-251-1) note the need to update the proposal to reflect the changes in the Act. Department of Fisheries and Oceans (DFO) also comments on the importance of the proposal clearly outlining "which project components are likely to require a paragraph 35(2)(b) *Fisheries Act* authorization (i.e. to carry on a work undertaking or activity that will result in serious harm to fish)" (YOR 2014-0002-251-1). The Executive Committee requires Section 10 of the proposal

be updated to reflect the changes in the *Fisheries Act* (Fisheries Protection Provisions) that are now in force. Therefore, please provide the following information:

R273. An updated Section 10 of the proposal which reflects the current *Fisheries Act* (Fisheries Protection Provisions). This updated section should include the identification of project components likely requiring a paragraph 35(2)(b) *Fisheries Act* authorization.

8.2 CHARGE WEIGHTS

Section 10.4.1.2 of the proposal indicates that drilling and blasting will be required for the construction of infrastructure and notes that "shock waves from drilling and blasting activities greater than 100 kPa can rupture the internal organs of fish…." Wright and Hopky (1998) also note shock waves of these magnitudes may also kill or damage fish eggs and larvae, but that the "degree of damage is related to the type of explosive, size and pattern of the charge(s), method of detonation, distance from the point of detonation, water depth, and species, assize and life stage of fish" (p.3).

The proposal notes that most blasting sites will be in or near fish-bearing waters, and that there is a risk of causing stress or avoidance behaviours in fish. Drilling and blasting near fish habitat may also affect the habitat in terms of sedimentation or by-products (Wright and Hopky, 1998).

The proposal notes that Wright and Hopky (1998) identify setbacks for avoiding fish and embryo death, but that such guidelines for avoiding sub-lethal effects are not available. The proposal identifies the minimum distance from the Casino pit to fish-bearing waters as 1.2 km. Explosives will also be used for infrastructure site pads and access roads, and the proposal indicates that fish will be moved the appropriate setback distances, and site-specific mitigation will be used.

The Proponent uses equations from Wright and Hopky (1998) to determine the charge weight threshold for impacting fish downstream, which determined that charge weights of 6 300 kg and 57 000 kg would be required to yield lethal impacts on incubating fish eggs and fish, respectively. The proposal then states that these weights "far exceed anything that would be used in the Casino pit" and that as a result the blasting activities will have no anticipated impacts on fish or eggs. This section of the proposal does not indicate, however, what the charge weights to be used will be. In addition, the charge weights used for construction of infrastructure site pads and access roads near fish-bearing waters are not addressed. As a result, the Executive Committee cannot confirm the calculations or verify the statements that activities will have no impact on fish or eggs.

The Executive Committee requires additional information regarding the charge weights to be used in drilling and blasting activities for the Casino mine pit as well as the setback distances and charge weights identified for the infrastructure site pads and access roads near fish-bearing waters in order to assess potential effects to fish and eggs. Therefore, please provide the following information:

R274. Proposed charge weights to be used for different project activities including the operation of the mine pit, and construction of infrastructure site pads and access roads. Indicate setback distances from fish-bearing waters for each activity and an analysis of potential effects based on this information.

8.3 BASELINE DATA

The proposal presents baseline data for fish in the Freegold Road and the airstrip in Appendix 10B, the Freegold Road Baseline Aquatic Report. Fish and aquatic life baseline data is presented for areas around the mine site itself in Appendix 10A, the Fish and Aquatic Resources Baseline Report.

The Executive Committee received several comments regarding the spatial extent and organization of results. For example, DFO requests "a more comprehensive overview description of the existing baseline conditions, supported by explanatory maps and summary tables" (YOR 2014-0002-251-1).

The LSA used for the collection of baseline data does not include all fish and aquatic resources potentially affected by the Project. It does not include downstream water bodies, the airstrip, or the portion of the unnamed creek affected by the construction of the airstrip as shown in the Figure 4.3 from Appendix 10C of the proposal.

White River First Nation, Little Salmon Carmacks First Nation, EcoMetrix, Environment Canada and DFO question the study area used for baseline studies, noting that lower Dip Creek, the Klotassin River, and further downstream water bodies are excluded from baseline data collection. The potential for water quality effects to these water bodies is not yet clear; however, the effectiveness of water treatment, erosion, seepage, or "run-off distances from a potential dam breach" could lead to downstream effects (YOR 2014-0002-283-1).

The edge of the study area used for baseline data collection bisects the airstrip. Baseline data is required for the watercourse that requires modification for airstrip construction. DFO notes that:

> The proposed diversion channel will reroute the flow of an unnamed tributary of Dip Creek from its existing channel into a new channel that will discharge back into Dip Creek approximately 1 km farther downstream than the existing channel. It will potentially affect the entire unnamed tributary, the area where the new diversion channel will be constructed, and Dip Creek from the confluence with the unnamed tributary to a point downstream from the outlet of the proposed diversion channel. (2014-0002-252-1)

Within the study area, EcoMetrix notes that it is not clear why Taylor Creek and other tributaries of Casino Creek were omitted from baseline data collection. Clarification, in a map, on what stream reaches were not tested for fish presence would also help in understanding the baseline data contained in the proposal. The assumption of fish absence is also a concern along the Freegold Road. In the stream crossing maps, streams where CMC assumed fish are absent are not clearly differentiated from those where fish absence was confirmed. LGL Limited requests "a summary table that identifies those non-fish bearing streams where a barrier was determined, as well as the type of barrier found (e.g., gradient >20%, perched culvert, natural barrier, etc.)" (YOR 2014-002-255-1)

Baseline study results are not presented in a clear manner. DFO requests a map to denote named stream segments (i.e. "middle Casino Creek"). DFO and EcoMetrix both request the clearer presentation of baseline study results in figures and tables. EcoMetrix requests a series of figures showing project interaction with Casino Creek and its tributaries and fish-bearing status.

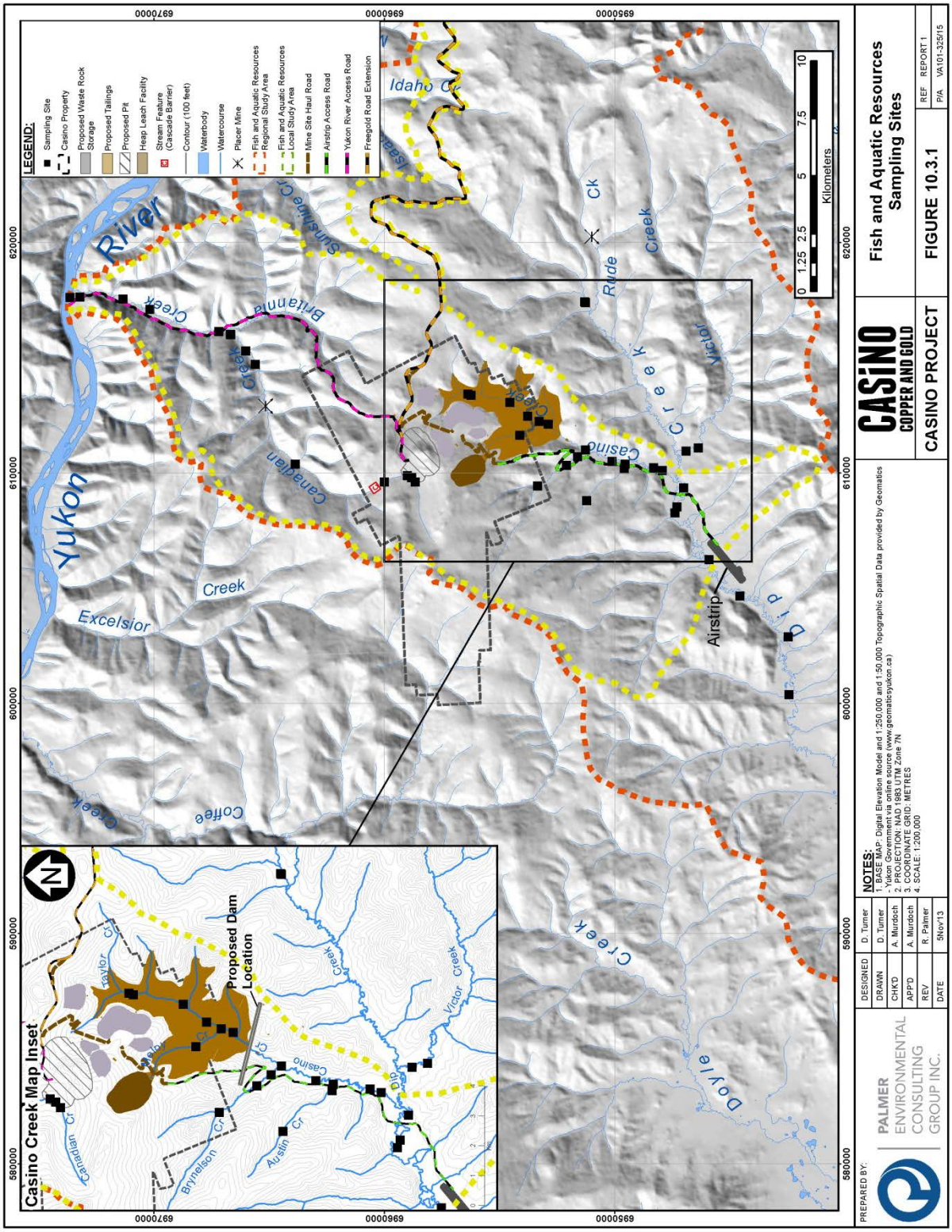

Figure 5: Fish and aquatic resources sampling sites

Notes: local study area boundary is represented by the yellow dotted line
(Casino Mine Project Proposal, p 10-7)

SFN's consultant, LGL Limited, notes that more "detailed habitat and fish population information for the study streams should be provided in tables or appendices to better understand the length of fish bearing reaches, fish distribution, habitat type, and characteristics within each reach" (YOR 2014-0002-255-1). DFO and EcoMetrix both request overview maps showing fish distribution as well.

The Executive Committee requires more baseline information on fish and aquatic life. Therefore, please provide the following:

R275. Baseline data for the creek intersected by the proposed airstrip, Taylor Creek, and other Casino Creek tributaries lacking baseline data including:

a. the existing condition, including quality and relative abundance, of the fish habitat; and

b. the species and life stages of fish present.

R276. A discussion of fish populations, densities, and diversity in downstream watercourses including lower Dip Creek and the Klotassin River.

R277. Maps demonstrating fish presence, assumed absence, or observed absence by stream segment. Include the stream channel intersected by the proposed airstrip, Casino Creek tributaries such as Taylor Creek, and the Freegold Road. Where fish are assumed as absent, provide rationale.

R278. Maps demonstrating fish habitat quality and fish distribution by species for watercourses including Casino Creek and its tributaries, Dip Creek downstream of its confluence with Casino Creek, and Britannia Creek and its tributaries. Include any seasonal barriers to movement.

R279. A table or other tool identifying the location in the proposal of supporting baseline information for each of the potentially impacted watercourses.

R280. Information on the time of year each of the water bodies potentially affected by the Project are likely to be used by the various life stages of each fish species.

8.3.1 Missing Appendices Documenting Baseline Data

In Section 1.5.1, the proposal notes that specific sampling dates and methodologies are further detailed in the annual aquatic studies reports (Appendices A-F), but Appendices A-E, Aquatic Studies Reports (years 2008-2012) are not included. The Executive Committee requires these appendices to conduct an assessment of the effects to aquatic resources. Therefore, please provide the following information:

R281. Appendices A through E for Appendix 10 A – Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.

8.4 HABITAT LOSS, ALTERATION AND COMPENSATION

8.4.1 Flow and Wetted Area Reduction

The proposal provides estimated reductions in flow and wetted area from baseline conditions during all project phases for lower Canadian Creek, Britannia Creek, Lower Casino Creek and Dip Creek (Section 10.4.1.1, Table 10.4-5). The predictions for stream flow during summer and winter show a large reduction in relative flow; however, the predicted changes in total wetted area appear to be low considering the high reduction in year-round flows. For example, the following flow calculations are taken from Lower Casino Creek during the Construction phase (from Table 10.4-5 of the proposal):

- Mean Peak Flows (May): -44 percent
- Mean Summer Flows (June to October): -60 percent
- Mean Winter Flows (November to April): -68 percent
- Mean Change in Total Wetted Area: -5 percent

These calculations appear to underestimate the potential long-term loss in habitat (flow and wetted area). As the proposal contains insufficient information regarding the data and methods for these calculations, the Executive Committee is unable to evaluate the estimated reductions from baseline conditions. The footnotes of Table 10.4-5 note the change in flow data is from KPL 2013 and the wetted dimension estimates are based on in-stream flow data provided by Normandeau, November 2013, yet these documents have not been provided for review. The Executive Committee requires additional information to evaluate the conclusions presented and the effects assessment, and that any proposed mitigations are sufficient in addressing uncertainties in the estimated reductions in flow and wetted area. Therefore, please provide the following information:

R282. A description of the detailed methods used to calculate the estimated reductions in flow and wetted area from baseline conditions in all watercourses affected. (EcoMetrix)

R283. An indication of and rationale for the selected minimum in-stream flow threshold. (EcoMetrix)

R284. The full documents cited as KPL 2013 and Normandeau, November 2013. (EcoMetrix)

The Department of Fisheries and Oceans (DFO) notes: “The effects assessment outlined that flow reductions in lower Casino Creek may greatly increase the chance of winter kills, are likely to eliminate overwintering habitat for Arctic grayling, and will reduce the available spawning habitat in Casino Creek by 78.4% during mine operations” (YOR 2014-002-251-1). DFO raises a concern that the predicted flow changes may have an effect on the populations of Arctic grayling in the Dip Creek and Casino Creek watersheds. The Executive Committee requires more information regarding potential effects to fish and fisheries from predicted flow changes. Therefore, please provide the following information:

R285. A discussion of the extent to which the identified overwintering and spawning habitat in the affected portion of Casino Creek is actively used by Arctic grayling for these stages, and the potential effects of the Project to this habitat.

8.4.2 Tailings Management Facility Fish Barrier

Section 10.4.1.2 of the proposal discusses lethal effects on fish and aquatic organisms. Operations of the tailings management facility has the potential to cause reduced flows in Casino Creek, potentially stranding or killing fish. The proposal suggests a physical fish barrier could be installed as a mitigation measure directly above the confluence of the Casino and Brynelson Creeks to prevent fish from accessing the section of Casino Creek immediately downstream of the TMF. There are no details provided regarding the fish barrier, although the barrier itself may have adverse effects to fish and fish habitat. The Department of Fisheries and Oceans also raise this concern in its comment submission to the Executive Committee (YOR 2014-002-251-1). Further, there are no details regarding the level of risk for fish stranding to occur. The Executive Committee requires more information on the proposed fish barrier and its installation. Therefore, please provide the following information:

R286. A discussion of the potential fish barrier proposed to be installed above the Casino-Brynelson Creek confluence. This discussion should include:

a. a description of the barrier proposed, and details regarding its installation; and

b. identification of alternative mitigations to the physical fish barrier in this location to prevent winter kill and fish stranding.

R287. The degree of risk for fish stranding to actually occur in Casino Creek due to low water flow attributed to the operation of the tailings management facility.

8.4.3 Airstrip Diversion Channel

Section 10.4.1.1 of the proposal indicates that the construction of the airstrip will require the diversion of a small fish-bearing drainage upstream to flow towards Dip Creek. Fisheries and Oceans Canada (DFO) requested additional information regarding this diversion (YOR 2014-002-251-1). Specifically, DFO states: “More information is necessary to understand why this diversion is necessary, the value of the existing fish habitat that will be impacted, the species currently using the watercourse, and the potential effect of relocating the watercourse.” To understand the potential effects of this project on fish and aquatic habitat of this unnamed tributary of Dip Creek, the Executive Committee requires more information regarding the airstrip diversion channel. Therefore, please provide the following information:

R288. A discussion of and rationale for the diversion of this drainage around the airstrip. This discussion should consider alternatives, such as allowing the drainage to pass underneath the airstrip.

R289. A discussion of the potential for seasonal stranding of fish in the lower portion of the dewatered channel.

8.4.4 Fisheries Protection Provisions of the Fisheries Act

The federal government enacted changes to the *Fisheries Act* in 2012; the Act came into force in November 2013. The Project's Preliminary Fish Habitat Compensation Plan (FHCP), prepared for the Proponent by Palmer Environmental Consulting Group Inc. (PECG) on November 29, 2013, does not take into account the new provisions. PECG acknowledges this fact, noting the new provisions had yet to be widely implemented at the time. The Department of Fisheries and Oceans notes that the policy has been replaced with the Fisheries Productivity Investment Policy: *A Proponent's Guide to Offsetting* and the FHCP should be updated to align with this new policy (YOR 2014-002-251-1). The new provisions focus on protecting the productivity of commercial, recreational and Aboriginal fisheries. As such, the Executive Committee requires the compensation plan to demonstrate how the overall productivity of the affected fishery will be maintained or improved. Therefore, please provide the following information:

R290. An updated Fish Habitat Compensation Plan to align with the new requirements of the *Fisheries Protection Provisions* of the new *Fisheries Act*.

8.4.5 Physical Habitat Simulation Model and Habitat Evaluation Procedure

The Project's FHCP identifies potential impacts of the Project on in-stream fish habitat, assessed using a physical habitat simulation model (PHABSIM) and a habitat evaluation procedure (HEP). The PHABSIM was used where a partial loss of flow is predicted while the HEP was used where a complete loss of flow is predicted. The models were used to quantify both in-stream and riparian habitat loss alongside fish-bearing watercourses.

EcoMetrix indicates that the information provided in the FHCP used to assess potential impacts of the Project with the PHABSIM and the HEP is not sufficient to evaluate the FHCP (YOR 2014-0002-235-1). Similarly, Selkirk First Nation's consultant, LGL Limited, identifies issues with the PHABSIM analysis and outputs (YOR 2014-002-255-1), noting it excludes potential effects on Arctic grayling, potentially resulting in an undervaluation of the total habitat lost. The Executive Committee requires additional information in order to evaluate the effectiveness of the FHCP and the HEP. Therefore, please provide the following information:

R291. A detailed description of the physical habitat simulation model. Details should include:

a. data used in the model (habitat and hydrological) and methods for field data collection;

b. locations of all transects (of each mesohabitat type - riffle, pool and glide) on each watercourse;

c. habitat suitability indices (HSI) curves for Arctic grayling in all life stages which consider site specific conditions;

d. species and life stage periodicity chart highlighting the seasonal use of the study area by different life stages of the target species, and a discussion of whether migration patterns were considered in the model;

e. discussion of whether seasonal use by life stage requirements of target species was considered in the model;

f. target flow velocities for low, mid and high flows, with a comparison to the baseline and projected flows for construction, operation and closure phases, indicating and providing rationale for the selected minimum in-stream threshold;

g. discussion of impacts to Britannia Creek from reduced flows in Canadian Creek as flow is redirected to the pit; and

h. a comparison of percent reduction in flow for areas affected by reduced stream flows considering natural variability observed in stream.

R292. A detailed description of the habitat evaluation procedure. Details should include:

a. methods and assumptions for the calculation of habitat lost;

b. summary of HSI values for each variable;

c. identification of and rationale for habitat types included; and

d. data and methods used to calculate habitat gains, including from all proposed compensation options.

8.4.6 Habitat Loss Calculations – Airstrip Diversion Channel

Section 3.2 of the Preliminary Fish Habitat Compensation Plan identifies estimated in-stream habitat loss. Table 3-8 shows that 1 509 m² of fish bearing habitat will be lost due to the airstrip, and that 2 342 m² of wetted habitat loss due to stream flow reductions in Dip Creek will occur. In its comment submission to the Executive Committee, Selkirk First Nation's consultant, LGL Limited, asked for clarification regarding the calculation (YOR 2014-002-255-1).

In addition, LGL Limited notes a discrepancy in a second calculation. Table 4-5 presents a habitat balance summary, indicating in-stream habitat gains equal 4 753 m² for the naturalized airstrip diversion channel. LGL Limited points out that habitat area equals 3 772 m² rather than 4 753 m², based on the proposed airstrip diversion channel width of 2.5 m and length of 1 509 m.

Further, LGL Limited comments that the methods of calculation of in-stream habitat gains differs from those for the calculation of in-stream habitat impacts, as habitat evaluation procedures were not applied to in-stream habitat gains accounting for the value of all compensation measures (as was done for the in-stream habitat impacts).

Therefore, please provide the following information:

R293. Clarification of whether the estimated habitat loss in Dip Creek was accounted for in the total habitat loss calculation for the proposed airstrip tributary diversion channel.

R294. Clarification of, and rationale for, the methods used to calculate the figures in Table 4-5: in-stream habitat impacts and in-stream habitat gains. This clarification should include the calculation of 4753 m² as identified in Table 4-5, based on the proposed airstrip diversion channel width of 2.5 m and length of 1 509 m.

8.4.7 Habitat Evaluation Procedure Analysis

Section 2.3.2 of the Freegold Road Fish and Aquatic Resources Baseline Report identifies the assessment framework used to identify fish-bearing statuses of streams crossed by the proposed Casino roads. Class 3 streams have greater than a 20 percent gradient, and were assumed to be non-fish bearing, with the gradient confirmed at and below the crossing. Selkirk First Nation's consultant, LGL Limited, comments on this framework, requesting the proponent: "identify those streams of <20% gradient where fish bearing status was in doubt and which were conservatively assumed to be fish bearing. Were these 'assumed fish bearing' streams also included in the HEP analysis for habitat loss and compensation?" (YOR 2014-0002-255-1)

The Executive Committee requires more information on the assessment framework used to identify fish-bearing statuses of affected streams. Therefore, please provide the following information:

R295. Clarification of whether the assumed fish bearing streams (those of less than 20 percent gradient) were included in the habitat evaluation procedure analysis for habitat loss and compensation.

8.4.8 Ford Rehabilitation

Selkirk First Nation's consultant, LGL Limited, observes that Appendix A, Drawing 4, "Typical Channel Restoration at Abandoned Fords," suggests glide habitat will be created at abandoned fords. LGL Limited notes: "If pool habitat is believed to be limiting for the target fish species in the streams (as stated in the FHCP), wouldn't the creation of more functional pool habitat through the establishment of riffle-pool habitats at restored ford crossings be more preferred?" (YOR 2014-002-255-1). Drawing 4 shows an arrow pointing to the stream bed with the text: "restore to existing natural conditions (cobble bed/riffle/pool)." Table 4-2 indicates the Britannia Creek ford restoration will be restoring natural (pre-existing) channel morphology. It is unclear what type of habitat will be created by ford restoration. The Executive Committee requires additional information for the type(s) of habitat created by ford restoration. Therefore, please provide the following information:

R296. Identification and rationale for the type(s) of habitat created by ford restoration.

8.5 WATERCOURSE CROSSINGS

8.5.1 Embedded Culverts on Fish Bearing Streams

Section 10.4.1.1 of the proposal indicates that the airstrip access road and the Freegold Road extension will require the construction of clear-span bridges for fish-bearing creeks, where culverts will be constructed for non-bearing watercourses. Specifically, the proposal states "clear-span bridges will be installed on all fish-bearing creeks" for these two project components, where the Freegold Road upgrade will require clear-span bridges installed on "the majority of" fish-bearing creeks. The Freegold Road Report indicates that embedded closed-bottom culverts may be used at fish-bearing crossings. DFO requires clarification on the use of embedded culverts while EcoMetrix notes that the

effects assessment and calculation of lost/gained habitat in the Habitat Compensation Plan does not consider the effects of culverts.

The Executive Committee requires additional information in order to address uncertainty with regard to aquatic resources and the Freegold Road extension and upgrade. Therefore, please provide the following information:

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.

8.5.2 Existing Stream Crossings

The upgrade of the existing Freegold Road will require an extensive realignment for much of its length. This may result in abandonment or removal of existing creek crossings. The Executive Committee requires more information on the decommissioning of existing structures. Therefore, please provide the following:

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

8.5.3 Nordenskiold River Bridge

Section 10 notes all bridges will be constructed in the winter, while culverts will be installed in the summer. As the Nordenskiold River Bridge is a two-span bridge with a pier located in the river channel, it is unclear when and how the pier will be constructed (given winter conditions, for example), what potential effects of this construction have been identified, and what mitigative measures will be undertaken to address these potential effects. The Department of Fisheries and Oceans raises questions about the Nordenskiold River in its comment submission, noting that the proposal identifies the river provides Chinook and Chum salmon habitat but does not include a description of the quality of habitat likely to be impacted by the construction of the bridge (YOR 2014-0002-251-1). Further, DFO notes, it is unclear whether the bridge pier could be constructed on an island apparently present in the middle of the river as an alternative to within the wetted stream channel. The Executive Committee requires more information about the Nordenskiold River and the potential effects of the bridge. Therefore, please provide the following information:

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

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.

R301. The fish species (and their life stages) present in the area potentially affected by the Nordenskiold River bridge. Discussion should include identification of potential effects of the bridge and the pier.

8.5.4 Classification of Crossings

Little Salmon Carmacks First Nation consultant, Rob Walker Consulting, indicates that the use of the term clear span bridges may be used inappropriately in the proposal. DFO criteria define a clear span bridge as a structure in which all components are above the ordinary high water mark, including armouring, approaches and stream bed modifications. Also included is a criterion that the bridge is "not located on meander bends, braided streams, alluvial fans, active flood plains, or any other area that is inherently unstable and may result in the alteration of natural stream functions…" (Department of Fisheries and Oceans Canada, 2007). DFO also raises concerns regarding vegetation loss, increased sedimentation, and changes to channel morphology, especially due to multiple crossings over the same watercourse (YOR 2014-0002-252-1). The Executive Committee requires more information on the classification of stream crossings for the Freegold Road. Therefore, please provide the following:

R302. A list of stream crossings for the Freegold Road including stream name, kilometre marker, crossing properties and the type of crossing, considering DFO's definition of clear-span crossing.

8.5.5 Erosion

EcoMetrix notes, "The procedure to assess overall erosion and sedimentation risk that will form the basis for designing and ultimately preparing an Erosion and Sediment Control Plan (ESCP) for construction for the Freegold Road Extension was not used for the Freegold Road Upgrade, the Airstrip Access Road or the Casino Mine site" (YOR 2014-0002-235-1). These road construction components are substantial undertakings and will also cross a number of fish-bearing watercourses. There is little rationale provided that details why this procedure would not also apply for the Freegold Road Upgrade, Airstrip Access Road and Casino Mine site. Section 10 of the project proposal states that sufficient data was not available to conduct the same procedure for these areas and that it could be conducted "if the appropriate data becomes available at later project stages" (YOR 2014-0002-050-1).

Since the Freegold Road Upgrade, Airstrip Access Road and Casino Mine site access roads will cross a number of fish-bearing watercourses, the Executive Committee requires additional information to assess potential adverse effects to fish and fish habitat, aquatic resources and environmental quality. Therefore, please provide the following information:

R303. An assessment of the overall erosion and sedimentation risk that will form the basis for designing and ultimately preparing an erosion and sediment control plan for the Freegold Road Upgrade, Airstrip Access Road and Casino Mine site.

The Erosion and Sedimentation Risk Assessment Report contains three map series, depicting erosion potential, potential ecological consequence, and overall erosion and sedimentation risk. Within Map Series 3 (overall erosion and sedimentation risk), maps on sheets 2,3,5,6,9 and 14 show locations where watercourse crossings have a low overall erosion and sedimentation risk. EcoMetrix noted that the maps do not identify fish bearing and non-fish bearing reaches of relevant water bodies (YOR 2014-0002-235-1). Yet Section 4.2 states: "Streams where fish and/or fish habitat were identified are all buffered by an approximately 30 m wide high ecological sensitivity boundary strip." The map series does not indicate where fish and/or fish habitat were identified.

The section also states, "Within 30 m of any watercourse, no low ecological consequence rankings were determined through the analysis, as should be expected." As fish bearing and non-fish bearing reaches of affected watercourses are not indicated on the maps, the Executive Committee is not able to confirm the classification of risk of downstream sedimentation to fish bearing waters. It is unclear whether all watercourse crossings rated as having a low overall erosion and sedimentation risk are non-fish bearing and are a significant distance upstream from fish bearing waters.

Can-nic-a-nic Environmental Services further expresses concern that ongoing use of the access road may lead to "increased sediment yields into streams and little information is given how this will be addressed during the operational phase in the proposal." (YOR 2014-0002-283-1)

The Executive Committee requires additional information to understand risk of downstream sedimentation to fish bearing waters. Therefore, please provide the following information:

R304. Identification of fish-bearing and non fish-bearing reaches of affected watercourses in the Map Series 3 (overall erosion and sedimentation risk) of the Erosion and Sedimentation Risk Assessment Report.

R305. Discussion on the methods of monitoring for erosion and sedimentation during all phases of the Project.

8.6 AQUATIC MONITORING PLAN

The proposal identifies recommended sampling locations for each stage of the Project. Site W16 in Dip Creek is not recommended for monitoring until Closure Phase 2 and 3 (Years 31-113 and 114+). Site W16 is the most downstream of the hydrometric stations used by CMC for the preparation of stream flow baseline data in the Dip Creek drainage. Baseline data for station W16 indicates reduced flow eight months of the year compared with upstream station W5. The recommended monitoring sampling locations for the operations phase and closure phase (years 1-22 and years 23-30) include W5 but not W16. Given the reduced rates of flow at W16, when compared with W5 in the baseline data, Dip Creek may be affected sufficiently by the project to change the suitability of the creek as fish habitat (even if temporarily). It would seem to be important to be monitoring the water quality, sediment quality, and aquatic biota at W16 throughout the life of the Project.

Little Salmon Carmacks First Nation's consultant, Can-nic-a-nick Environmental Services, express concern on both a lack of downstream baseline data (as discussed in Section 8.3) but also unclear monitoring methods, objectives, and responses.

Monitoring beyond W16 may be beneficial to confirm that effects have dissipated and to achieve a more thorough understanding of project effects in the long term.

The Executive Committee requires additional information regarding monitoring at W16. Therefore, please provide the following information:

R306. Discussion of and rationale for the exclusion of W16 or other downstream locations from monitoring throughout the life of the Project.

8.7 CLARIFICATION

Section 10.4.1.2 of the proposal in its discussion on lethal effects on fish and aquatic organisms cites other sections for more details, particularly on water quality. Specifically, this section of the proposal refers to Section 7.4.5.1 and 7.4.5.2 for more information on potential for blasting residues to leach into nearby watersheds and potential lethal impacts on aquatic biota following reduced air quality, respectively. However, as those subsections do not exist under Section 7.4.5, the Executive Committee requires clarification on the locations of this detailed information. Therefore, please provide the following information:

R307. The information related in Section 7.4.5.1 and 7.4.5.2.

9.0 RARE PLANTS AND VEGETATION HEALTH

9.1 PROJECT INFRASTRUCTURE AND SENSITIVE HABITATS

The Project will involve the construction and operation of a 1 600 m airstrip, a terminal building and an access road from the airstrip to the mine site. Section 4.1.1.2.1 of the proposal states the airstrip will replace a small existing airstrip, and that the airstrip will be located on a "flat area adjacent to Dip Creek." Section 4.3.3.1 describes the airstrip as 30 m wide with an 80 m grade width and a 60 m run out at each end. The proposal notes that the design considers the ice-rich soils of the undisturbed ground to prevent airstrip and permafrost degradation. Figure 3.1 in the Vegetation Baseline Report identifies the vegetation types with which the airstrip and airstrip access road intersect. These include shrubby fen (Wf), coniferous treed bog (Wbc), and riparian shrub (Sr). These areas typically have a high soil moisture regime. The airstrip also overlaps with one large unidentified polygon.

As the construction of the airstrip and airstrip access road will require clearing, infilling and water management, proximate vegetation and wetlands may experience adverse effects. Alteration of the terrain, ground and water flows could potentially impact downslope wetlands. Section 11.5.1 of the proposal does not address this potential affect. Wetlands are an important ecosystem that play a role for many species, contribute to biodiversity, and act as a buffer zone between terrestrial and aquatic habitats.

Similarly, Government of Yukon (YG) draws attention to the overlap between project features and sensitive habitats (YOR 2014-0002-252-1), identifying tors and fens as areas of particular concern (as having high potential for species of conservation concern). Tors often provide habitat for birds and rare plants. Fens are generally abundantly diverse with species which may be of conservation

concern (e.g. dragonflies). YG identifies borrow pits, several areas of roads and the airstrip as overlapping with tors and fens.

The Executive Committee requires more information regarding the potential effects on proximate vegetation and wetlands to the airstrip and access road, as well as other project infrastructure or activities such as borrow pits. Therefore, please provide the following information:

R308. Discussion of the potential effects of the construction, operation, and possible decommissioning of other project infrastructure on habitat (such as fens and tors) with elevated potential for rare species.

R309. Discussion of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands. In particular, this discussion should identify impacts to downslope wetlands.

R310. An update to Figure 3.1 with the ecosystem types identified in the large vegetation polygon overlapping with the centre of the airstrip.

9.2 SELECTION OF INDICATORS FOR THE VEGETATION HEALTH VALUED COMPONENT

Section 11 of the proposal identifies rare plants and vegetation health as valued components due to their particular sensitivity to disturbance. Table 11.5-2 identifies key indicators as rare plant abundance, presence of invasive species, vegetation health in areas near dust and emission sources, and vegetation health. Despite their importance and vulnerability to project effects, vegetation quantity and wetlands/riparian vegetation associations have not been identified as key indicators. Both SLR (YOR 2014-0002-238-1) and Selkirk First Nation consultants (MacLean, LGL Limited, and Silas) (YOR 2014-0002-259-1) raise this issue.

During construction and operation, the project area will lose vegetation, yet Section 11.4 of the proposal, in its discussion of baseline conditions for vegetation, provides little vegetation association distribution information. A summary table, such as Table 3.1 in Appendix 11A, could clearly identify the percentage of vegetation, as well as each vegetation association, that will potentially be directly and indirectly affected by the Project.

For example, the potential disturbance area, at 80.6 km², represents 15 percent of the local study area (LSA). The LSA in this case is defined as the area where rare plants and vegetation health potentially immediately interact with project components. As a result, 15 percent of the vegetation in the LSA will be lost during construction and operation. Although this calculation assumes all vegetation is present at baseline (which is not the case, as existing infrastructure exists), anything above a 10 percent change in natural variability in vegetation conditions is considered a high magnitude rating, according to Table 11.3-1. Table 3.1 in Appendix 11A indicates that riparian vegetation associations represent approximately 10 percent of the total vegetation in the LSA.

Riparian areas are an important ecosystem that plays an important role for many species, contributes to biodiversity, and acts as a buffer zone between terrestrial and aquatic habitats. A buffer zone can act as a mitigation of impact on wetlands and riparian vegetation. A management plan for areas where riparian vegetation must be disturbed (such as stream crossings), wherein mitigation measures

and residual impacts are identified, would provide support to the assessment on vegetation. The Executive Committee requires more information on vegetation health. Therefore, please provide the following information:

R311. Discussion of the use of "Loss of Vegetation Associations" and "Wetlands and Riparian Vegetation Associations" as indicators for vegetation health.

R312. A clear mitigation (buffer zone and avoidance) and management plan (where avoidance cannot be achieved) to support the residual effect assessment, for both the construction and operation of the project components.

9.3 SOIL EROSION, RE-VEGETATION AND INVASIVE SPECIES

Section 22.3.5 outlines the Erosion and Sediment Control Management Plan. The Executive Committee recognizes the management plan has yet to be developed. However, SLR has identified gaps in the plan that prevent the Executive Committee from beginning an assessment of the project (YOR 2014-0002-238-1). Selkirk First Nation has submitted comments supporting these concerns (YOR 2014-0002-259-1).

Soil erosion control mitigation measures listed are vague. Integrated management plans for riparian zones during construction and operation would address erosion and permafrost management in those areas. A consistent buffer (and rationale for the selected buffer) around wetlands and valuable vegetation associations or sites would help address concerns about potential effects such as soil erosion. Note as well that Section 4.1.2 of the Wildlife Mitigation and Monitoring Plan states that "no-clearing buffer zones will be established around riparian areas (e.g. rivers and creeks) to minimize disturbance to movement corridors" for wildlife.

Re-vegetation can also reduce soil erosion, besides being an important component of reclamation. Plans for re-vegetation and reclamation of project areas immediately following construction could expedite the recovery of the species in affected area. Documents regarding best species for re-vegetation and reclamation in a Yukon context are available. Adequate planning for this mitigation should help reduce residual impacts to vegetation, water quality, dust and run-off management, and species and their habitats.

The introduction of non-native species, particularly weeds and invasive species, can have significant impacts on re-vegetation, including crowding out existing less competitive species. The control of weeds and invasive species during project phases is important in reducing residual impacts on vegetation health, biodiversity, and habitat. More information on the plans for this strategy is required. In addition, this information can be linked to impacts on other valued components; for example, species propagation can affect wildlife behaviour. Selkirk First Nation notes specific concerns regarding the potential effect of invasive plant species in the project area, noting that: "The traffic volumes estimated for this project are high, with many of them travelling from areas with known invasive species" (YOR 2014-002-259-1).

The Conceptual Closure and Reclamation Plan provides information about topsoil salvage and use in reclamation. This plan also notes that non-invasive species will be used while the "use of native species will be promoted." Tailings reclamation is only addressed in general terms. Further, the plan

indicates that the re-vegetation plan will be developed and updated throughout the life of the mine. However, the plan does not address the evaluation of effective plant recovery. Selkirk First Nation notes a lack of clarity regarding methods of re-vegetation (YOR 2014-0002-259-1).

The Executive Committee requires additional information regarding re-vegetation and reclamation. Therefore, please provide the following information:

R313. Details on a conceptual integrated management plan for project activities affecting vegetation. Details should include:

a. proposed buffer zones around wetlands, valuable vegetation associations or sites, and riparian areas which also consider the needs of wildlife for movement corridors;

b. species to be used for re-vegetation;

c. timeframe for re-vegetation and reclamation activities;

d. measures to monitor success and take corrective actions as necessary; and

e. control of invasive species.

10.0 WILDLIFE

10.1 REFERENCES

References are missing throughout Section 12 and appear as “Error! Reference source not found.” This is also present in the footers of the table of contents and Sections 1 and 25. The Executive Committee requires the in-text citations in order to follow up with the references. Therefore, please provide the following information:

R314. The correct references for each place in Section 12 that this error text appears.

10.2 FREEGOLD ROAD AND OTHER ACCESS ROADS

10.2.1 Population Dynamics

For caribou, moose, Dall sheep and wood bison, a new road can increase predation and other risks, causing increased mortality. Section 12 acknowledges the Freegold Road upgrade and extension will potentially affect wildlife through land clearing and vehicle traffic (collisions and noise), with effects to habitat, movement, and mortality risk. Another important potential effect is the changes in wildlife populations due to changes in the predator-prey balance. For example, the road has the potential to increase predator access to wildlife, to increase hunting access, and to increase predator movement close to vulnerable habitat such as late winter caribou concentration areas or adjacent to mineral licks. In addition, the road will create attractants, including road salt, re-vegetation forage species (such as willow), and road kill, which can draw wildlife to the road.

Many comments received during the adequacy review speak to these issues. Government of Yukon (YOR 2014-0002-252-1) and SLR (YOR 2014-0002-238-1) identify concern with the potential for

increased predation by wolves. Government of Yukon notes that the proposal states “snow tracking surveys detected wolves along the entire length of the surveyed section of the Freegold Road and Casino Road extension.”

SFN notes “further information is needed to determine a more robust effects assessment or validation of assumptions on habitat effectiveness, habitat displacement, and barriers to movements.” (YOR 2014-0002-259-1) SFN also notes that “further work on the effects of aerial and road traffic is recommended,” for caribou, moose, and grizzly bears. Little Salmon Carmacks First Nation consultant, ElknWillow Environmental Consulting, notes that the road may act as an attractant for both predators and prey and that increased sightlines, use of salts, and herbaceous species on shoulders compound species’ interactions and that the proposal does not consider these effects.

These issues are of particular importance due to the length of the road, both extension and upgrade. As well, the road approaches important areas where wildlife concentrate, such as wintering areas and mineral licks. As these areas are of particular importance to the survival of a species, negative impacts in these areas pose a greater risk of population-level impacts. The Executive Committee requires further information regarding potential effects to wildlife as a result of the Freegold Road. Therefore, please provide the following information:

R315. Discussion on the effects to wildlife for caribou, wood bison, and Dall sheep, related to predator-prey systems affected by the Freegold Road, airstrip and airstrip access road, through all project phases. This discussion should:

a. use the most current data and information available;

b. include changes to population dynamics; and

c. include areas of wildlife concentration, such as mineral licks.

10.2.2 Wildlife Crossing Areas

Section 12 indicates that along access roads, “crossing areas will be placed in areas of greater wildlife movement based on observational data and caribou collar data.” The Wildlife Baseline Report indicates caribou tracks were observed intermittently between km 107 and 129 during 2012 snow track surveys, and that none were observed in 2013 (p 20). It is not clear whether this snow tracking survey will be utilized for the placement of crossing areas, or whether other data for such a purpose has already been collected. Further, it is not clear whether these crossing areas will be fixed or fluid to represent changing patterns of use. The Executive Committee is concerned that enough data will be (or has been) collected to determine with confidence the areas of high use, before design and construction of the access road. Therefore, please provide the following information:

R316. Describe how wildlife crossing areas will be implemented. Details should include:

a. the schedule and methods for data collection and analysis regarding the determination of high use wildlife crossing areas along the access roads; and

b. how crossing areas may change seasonally and annually.

10.2.3 Road Management

In Section 12.3.3.6, the proposal states: “The effect of the Project on caribou mortality is not significant at the scale of the Klaza caribou herd. Although consideration of the mechanisms that could lead to increased caribou mortality and the commitment of mitigation measure enactment suggest high confidence in this prediction, some uncertainty exists regarding the legality of CMC operating and managing a private industrial road.” The operation and management of the Freegold Road extension is an important factor in the Proponent’s ability to implement many of its proposed mitigations. For example, the Proponent has committed to activities on the road such as snow management, speed limits, a continually manned access gate, and roadside clearing.

Selkirk First Nation also includes comments in its submission to the Executive Committee that “further discussion on the regulation of access, wildlife-vehicle mortalities, and the potential indirect effects from wildlife harvesting is required” (YOR 2014-002-259-1). SLR recommends the Proponent provide “detail on how the road will be managed and the gate controlled to prevent increased hunting access” (YOR 2014-0002-238-1).

The increase in access to wildlife by hunters resulting from the Freegold Road extension is also a critical issue. While the proposal indicates the road will be gated, there have been varying degrees of success using gated roads to control hunter access in other jurisdictions. The Executive Committee requires information on the effectiveness of wildlife crossings as a potential mitigation, as proposed by the proponent. Additional information required on the access road details and management is found above in Section 2.5.

Many of the mitigations proposed to reduce or eliminate negative effects on many species of wildlife are dependent on the Proponent having full legal authority to operate and manage the road. The Executive Committee requires more information regarding road management and mitigation measures for wildlife in the event that the Proponent is not able to operate and manage the road as planned. Therefore, please provide the following information:

R317. Detail on road maintenance activities (e.g. road salt, road margin vegetation management for wildlife, etc.), and other mitigations (such as reducing the frequency of traffic, having periods of time with no traffic, etc.), with a particular emphasis on key wildlife areas. This discussion should include rationale for the effectiveness of mitigations.

R318. Wildlife monitoring and adaptive response strategies.

R319. Alternative mitigation measures to reduce or eliminate negative effects on wildlife in the event that the Proponent does not have full legal authority to operate and manage the road.

R320. Further discussion on the potential indirect effects to wildlife from harvesting.

10.3 EFFECTS ASSESSMENT FOR MAMMALS

10.3.1 Caribou

10.3.1.1 Klaza Caribou Herd

Regarding the caribou habitat suitability model, SLR recommends the Proponent consider providing objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds to support actions that may mitigate adverse effects (YOR 2014-0002-238-1).

The caribou habitat suitability model does not demonstrate consideration of noise from vehicles, aircraft, or mine operations associated with the Project. It is possible that noise will displace caribou from important habitats, particularly in the vicinity of the Freegold Road extension. Selkirk First Nation (SFN) raises the issue of effects to wildlife from project noise, particularly from road and air traffic and blasting. SFN notes that "Blasting is not part of the background noise of an operating mine but is intermittent with a magnitude potentially greater than an averaged noise background. It requires to be separated and the blasting effects to wildlife be reported" (YOR 2014-0002-259-1).

Further, references used to illustrate caribou responses to disturbance do not represent the most recent research; current references are available and should be used in the effects assessment, including the Government of Canada Woodland Caribou Recovery Plan(s). Information from these sources may provide updated information regarding the extent and implications of risks that exist.

The Executive Committee requires more information on the caribou wildlife effects assessment. Therefore, please provide the following information:

R321. 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.

R322. A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds to support actions which may mitigate adverse effects.

10.3.1.2 Fortymile Caribou Herd

The proposal does not consider effects to the Fortymile caribou herd. Section 12.3.3.2 briefly discusses historic aspects of the Fortymile caribou herd. However, Government of Yukon notes

> the winter of 2013/2014 saw a high proportion of the Fortymile caribou herd wintering in the Yukon, reoccupying historical ranges not used for decades. Fortymile caribou were documented as occurring adjacent to and west of the Casino Mine Site, within the wildlife study area shown in figure 12.1-01 of the project proposal. (YOR 2014-0002-252-1)

Little Salmon Carmacks First Nation (YOR 2014-0002-282-1), Tr'ondëk Hwëch'in (TH) (YOR 2014-0002-260-1) and Government of Yukon (YOR 2014-0002-252-1) raise concerns regarding the lack of baseline data regarding the Fortymile caribou herd but also the lack of an effects assessment in

relation to the herd. Habitat potential is not known in the area, nor is much data available on herd size, distribution, or movements. This is especially important as recent data show large proportions of the herd recently wintering in historical ranges in Yukon. The Executive Committee requires more information on potential Project effects to the Fortymile caribou herd. Therefore, please provide the following information:

R323. A discussion of potential Project effects to the Fortymile caribou herd supported by available data.

10.3.1.3 Klaza Caribou Herd Winter Habitat Suitability Model

Section 3.2 of the Wildlife Baseline Report describes the caribou winter habitat suitability model. The Government of Yukon (YG) raised a number of issues with the resource selection function (RSF) model presented to evaluate potential loss of winter habitat for the Klaza caribou herd (YOR 2014-0002-252-1).

For example, YG notes the RSF model is built using only February-April 2013 GPS collar locations and that it compares them with random points within the larger winter range, but that one winter is inadequate for developing a model from which long-term impacts on caribou are assessed. YG indicated the proposal does not contain an adequate evaluation of relative habitat quality in the Klaza herd's range, and the effects assessment does not adequately consider project impacts in years where a significant percentage of the herd may winter in the Creek-Selwyn River area and interact with the Freegold Road Extension. The Executive Committee requires a discussion about the differences in habitat suitability among years based on environmental conditions to support development of effective monitoring and mitigation measures.

Other concerns raised by YG include:

- use of a paired approach (specific GPS point + random location);
- absence of an estimate of a true condition model estimated (can be done with the "mclogit" package);
- lack of clarity whether a random intercept was used, and/or whether random slopes were tested;
- including elevation and landcover in the same model;
- estimation of the interaction of elevation and landcover provides results difficult to interpret;
- clarification or additional classification scheme is needed on the landcover classes developed for the RSF (burned, unburned, sub-alpine/alpine);
- clarification needed on the use of variables ("dummy integers");
- a need for improvement on the reporting of parameter estimates. The Elevation2 parameter is listed as - 0.000 on Tables 3.9 and 3.11 of the Wildlife Baseline report, yet the confidence intervals for these estimates do not include 0. Furthermore, there is no reporting of the estimated Standard Deviation of the random effect of animal;

- lack of clarity regarding how the model fit was considered relatively good; and
- clarity on the model intercept as reported in Tables 3.9 and 3.11: was this intercept included or omitted from the calculation of raw RSF values?

The Government of Yukon acknowledges many of the items listed in its comments may have been incorporated in the development of the RSF; however, documentation is lacking. Further, if the issues raised by YG were not incorporated, the RSF model used to quantify reduction in habitat effectiveness may be inadequate. The Executive Committee requires more information on the RSF model. Therefore, please provide the following information:

R324. Discussion of the development of the RSF model, including all inputs. Consideration should be given to concerns raised by the Government of Yukon.

R325. Discuss how the RSF model:

a. reflects the distribution of high quality habitat across the Klaza caribou herd's range; and

b. accounts for the variability in caribou distribution based on environmental facts and among years.

10.3.1.4 Klaza Caribou Herd Late-Winter Range Distribution

The Government of Yukon (YG) raises concerns to the Executive Committee regarding the late-winter distribution data for the Klaza caribou herd. Specifically, YG notes that "kernel density estimates for Klaza caribou herd late-winter range distribution is biased towards one year of data and not representative of the entire data set" (YOR 2014-0002-252-1). With the potential bias in the estimated winter range, the current assessment and interpretation related to reduction of winter habitat effectiveness for the Klaza herd may not be adequate. Key issues include the use of a fixed kernel estimator, pooling of data and inappropriate use of collar data (resulting in misrepresentation of numbers). The Executive Committee requires more information on the Klaza caribou herd late-winter range distribution. Therefore, please provide the following information:

R326. Discussion of the potential bias in the estimated winter range.

R327. Winter range map or maps that are representative of caribou use since the late 1980s.

10.3.1.5 Klaza Caribou Herd Summer Range Data

The Government of Yukon (YG) notes in its comments to the Executive Committee that it provided new data to the proponent in January 2014 showing Klaza caribou herd summer use in the local study area. The Executive Committee acknowledges that this data was provided after the proposal was prepared. However, this new data should be incorporated into the effects assessment. Therefore, please provide the following information:

R328. An evaluation of the Klaza caribou herd use of the local study area during summer, using the most recent GPS radio-collar data provided by the Government of Yukon.

10.3.1.6 Fire and Impacts on Caribou

Government of Yukon and Little Salmon Carmacks First Nation consultant, ElknWillow Environmental Consulting note that the caribou habitat is "strongly correlated with fire history" (YOR 2014-0002-282-1) and that "fire history is also an important factor when considering potential effects on caribou habitat" (YOR 2014-0002-252-1). The proposal does not discuss how changes to the fire regime due to the Project may affect caribou habitat and herds. The active fire regime of the region "will likely change and with that, the habitats used and available for caribou" (YOR 2014-0002-282-1). The Executive Committee requires more information on how fire and project activities may cumulatively affect caribou. Therefore, please provide the following:

R329. A discussion of how the Project may affect (e.g. fire suppression) the Dawson Range's fire regime and its corresponding implications to caribou and caribou habitat.

10.3.2 Moose

10.3.2.1 Baseline Moose Demographics

The moose effects assessment, Section 12.3.4, does not include baseline moose demographics such as calf to cow and bull to cow ratios. This absence prohibits analysis of the baseline predation levels, as well as the population's resilience. For an adequate assessment of effects to moose late winter habitat, the Executive Committee requires an analysis of population surveys and models; such work would enable assessment of the resilience of the existing local population as well as potential effects from increased access by hunters and predators.

The moose effects assessment lacks a quantitative measure for estimating changes in harvest due to increased access for hunters. In addition, First Nation harvest estimates will inform changes in moose harvest, providing an important component to the overall estimate. The harvest and death rates provided in Table 12.3-19 are in total numbers, rather than broken into age and sex of harvest or different scenarios of female moose harvest. The proposal states that in the most accessible zones the Project will not facilitate harvest, yet this claim is unsupported.

Other jurisdictions use moose harvest and survey data to model the risk of population change based on female or calf mortality. Without a demonstration of the existing population's sensitivity to additional mortality (particularly to cows), an accurate risk analysis is difficult to assess.

The increased access provided by the road, for predators and hunters, is the greatest risk presented to this species. Many of the mitigations rely on road access control and gating. SLR notes: "the reviewer has not experienced successful management of harvest related to road access through gating of roads on public lands, due to poor management practices around the gating of roads" (YOR 2014-0002-238-1). The Executive Committee requires additional information on moose demographics and harvest data is required to assess the potential effectiveness of the identified mitigations. Therefore, please provide the following information:

R330. Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.

R331. Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.

R332. Mitigation measures for displacement/mortality of moose near roads.

10.3.2.2 Water Pipeline

Section 12.3.4.2 notes that the water pipeline from the Yukon River to the mine site could create a barrier to moose movement. Potential mitigation measures identified include designing the pipeline so that it has a clearance of "a minimum of 180 cm every 400 to 700 m." The proposal suggests "portions of the pipeline could be completely buried (not visible aboveground) to prevent a barrier to movement," and that "pipeline crossing structures (made of vegetated fill or soil) may be constructed in high density crossing/movement areas or areas where the pipeline cannot be raised to sufficient height or buried completely." These statements raise a number of questions, including whether the proponent has considered effects of snow in reducing clearance, whether the height is sufficient for an adult moose, etc. The proponent also has not given rationale for burying sections of the pipeline, which sections will be buried, whether the entire pipeline could be buried, and the effects of such an activity.

Section 12.3.4.4 cites Dunne and Quinn (2009) suggesting evidence that a clearance (height) of at least 185 cm will allow the passage of moose, while some moose surveyed also passed under heights of 140 cm. Aside from this one study, the assessment of the correlation between pipeline elevation and moose passage does not seem to be well researched or documented. As adult Alaskan moose stand greater than 2 m at the shoulder, the proposed Casino mine pipeline height of "a minimum of 180 m every 400 to 700 m (depending on terrain)" seems low. There is a risk that the pipeline may trap moose to the advantage of predators. Furthermore, this concern is greater in the winter when snow depth can significantly decrease clearance. The Dunne and Quinn study notes that snow depth and distance from water were other significant variables affecting moose passage; it is not apparent these factors are considered in the Proponent's effects assessment. In addition, the Dunne and Quinn study focuses on a smaller subspecies of moose than those in the project area; thus, the results may not indicate an absolute measure of effectiveness for the Alaskan subspecies (Dunne & Quinn, 2009).

The proposal indicates that the design of the pipeline is in the preliminary stages and adjustments to facilitate movement will be incorporated, and that "monitoring efforts will help to identify high habitat quality and movement corridors." However, no schedule(s) or methods for monitoring efforts of the design of the pipeline are provided.

The Government of Yukon also raises this issue in its comment submission (YOR 2014-0002-252-1). To adequately assess potential negative effects to moose, the Executive Committee requires more detailed information about the pipeline design. Therefore, please provide the following information:

R333. Detailed design of the pipeline with rationale. If a final design cannot be selected at this stage, please provide detailed design alternatives, and include the potential effects associated with each. In the event that design has not been finalized, please provide the schedule and methods for moose monitoring efforts to inform development of the pipeline.

10.3.2.3 Moose Winter Habitat Suitability Model

The Government of Yukon (YG) outlines concerns with the moose winter habitat suitability model used in the proposal (YOR 2014-0002-252-1). Specifically, YG disagreed with the ratings assigned to the bioclimatic zones:

- subalpine (rated as high value, despite YG's observations that moose largely avoid these areas in late winters with deeper snow); and
- low boreal (rated as having little or no value due to avoidance, despite YG's observations that "riparian forests along creeks and rivers often have good willows and are selected in late winter").

Further, YG disagrees with the model's identification of north-facing slopes as selected, as in this area "north-facing slopes often have fewer willows and more snow." YG indicates that the habitat suitability model, and map, is not an accurate reflection of moose habitat values in the area. Further, YG states: "The bar graph on page 51 of the Wildlife Baseline Report showing general agreement of HSI ratings with observed data presents no statistical support and appears to largely show selection of the different HSI classes identified proportional to their availability." As a result of these concerns, the Executive Committee requires more information on the proponent's habitat suitability model. Therefore, please provide the following information:

R334. A discussion of and rationale for the selected model. This discussion should include:

a. rationale for the ratings assigned to the subalpine and low boreal zones, as well as the selection of north-facing slopes, which considers the comments made by the Government of Yukon; and

b. an explanation of Figure 4.3 in the Wildlife Baseline Report showing habitat quality class, which includes statistical support for each of the bars.

10.3.2.4 Zone of Influence

Government of Yukon (YG) raises concerns regarding the 300 m zone of influence of the project on moose. YG notes that this distance is consistent with that found in the literature the Proponent referenced. However, YG also asserts that in 2010 it had recommended to the Proponent to use a 5 km zone. YG suggests now that at minimum a 500 m zone of influence is appropriate for moose, consistent with research by Shanley and Pyare (2011). The Executive Committee requires more information on the selected zone of influence for moose. Therefore, please provide the following information:

R335. A discussion of and rationale for a 300 m zone of influence. This discussion should consider increasing the zone to at least 500 m.

10.3.3 Grizzly Bear

10.3.3.1 Grizzly Bear Den Surveys

Government of Yukon (YG) raises concerns regarding grizzly bears, noting that the proposal confirms that "there are gaps in the understanding of bear den distribution in the project area," despite a YG request in 2010 for the collection of baseline data for two years. YG recommends that additional data is required to adequately identify effects and mitigations. YG notes that the survey area coverage and protocol is appropriate to establish a den baseline provided surveys are completed over a reasonable temporal sampling effort. YG requests additional data, for a minimum of one year, on bear den presence and distribution in the project area. Section 8.3 of the Wildlife Baseline Report presents the grizzly bear den habitat suitability analyses and map (Figure 8.5). YG notes that den survey work was not used to validate the den habitat suitability map. More data from den surveys could be used to validate each strata.

SLR also comments that the effects assessment in Section 12.3.5 of the proposal is limited in terms of details on the survey effort for dens (YOR 2014-0002-238-1). The Executive Committee requires more information on the grizzly bear den surveys. Therefore, please provide the following information:

R336. Detail on baselines survey efforts, including den surveys, and including routes taken.

R337. Additional data (one year minimum) on bear den presence and distribution within the project area.

YG suggests a correction to Section 12.3.5 which states that "In the Yukon, [grizzly bear] denning occurs between October and April-May." YG comments that denning occurs from mid-September to mid-June, subject to snow conditions, and that family groups may linger around the area (or will be denning) on either side of that window of time. The Executive Committee requires confirmation of the grizzly bear denning season from the proponent, and more information on how the season might affect project activities. Therefore, please provide the following information:

R338. Discussion regarding the dates provided by the Government of Yukon for grizzly bear denning and how these dates may affect or be affected by project activities.

10.3.3.2 Grizzly Bear Habitat Models

Government of Yukon (YG) questions the proposal's grizzly bear habitat models (Section 8.3 of the Wildlife Baseline Report), specifically the habitat suitability and habitat effectiveness models, and the security areas model (YOR 2014-0002-252-1). YG notes that, in Table 8.3: "The bioclimatic classification used to create a habitat suitability map for the habitat effectiveness model is very coarse, and will likely result in an underestimation of the habitat effect of the project." Good ecological land classification mapping for the study area would have facilitated the utility of the models.

YG also requests clarification regarding disturbance events considered in the development of the Habitat Effectiveness and Security Areas models.

Further, YG identifies Section 12.3.5.2 of the proposal regarding traffic projections as unclear. The proposal states that: "Traffic projections predict that during the construction phase, the average number of vehicles per day will be between four and 28. During operation, traffic projections estimate

approximately 125 vehicles per day." YG requests clarification regarding whether the numbers represent actual vehicles or traffic events (i.e. each time a vehicle drives the length of the road). If the number represents actual vehicles, the number of traffic events would be useful in the estimation of disturbance.

YG notes that detail in the grizzly bear section of the Wildlife Baseline Report is lacking to be able to evaluate the efficacy of the modeling used. YG requests specific information relative to the modeling and maps. Therefore, please provide the following information:

R339. Details on the Habitat Suitability and Habitat Effectiveness models, including:

a. additional clarification on why habitat types were rated as presented; for example, alpine habitat is rated as 'low' (0) value in the spring. For bears, alpine has high habitat value in spring;

b. clarification on traffic projections;

c. clarification on the dates used to define the different seasons in the HE model;

d. clarification on the coefficients used to develop the HE model; and

e. clarification on disturbance events considered in the development of the models.

R340. Details on the Security Areas model, including:

a. rationale (including reference if possible) for the selection of the 2300 m asl as the threshold for available security areas, as opposed to 1900 m asl;

b. clarification on traffic projections; and

c. clarification on disturbance events considered in the development of the model.

10.3.3.3 Grizzly Bear Mortality Estimates

Section 12.3.5 of the proposal describes the grizzly bear effects assessment. SLR notes that this assessment is limited in terms of detail on the assumptions used for mortality risk assessment related to the road and camp. In addition, references are either missing (with an error message) or are relatively old. Current research is available relating to grizzly bear movement, response to disturbance, and mortality risk (YOR 2014-0002-238-1). Section 12.3.5.3 of the proposal indicates that a qualitative assessment was used to assess increased mortality, despite the fact that quantitative data are available.

The proposal states six percent as Yukon Environment's annual allowable human-caused mortality quota. Government of Yukon (YG) notes the actual prescribed rate is four percent (YOR 2014-0002-252-1). YG notes that the density estimate for the area is not just 15 bears/1 000 km² (as stated in the proposal) but that it depends on ecozone. For example, the Klondike Plateau estimate is 11 bears/1 000 km², whereas the Yukon Plateau Central is 15 bears/1 000 km².

Finally, YG raises a number of additional questions regarding the description, analyses and risk assessment of grizzly bear mortality rates. The Executive Committee requires more information on the proponent's grizzly bear mortality estimates. Therefore, please provide the following information:

R341. A discussion of and rationale for the use of a qualitative assessment, as opposed to quantitative, for grizzly bear mortality.

R342. Clarification of and rationale for the grizzly bear density estimate for the area.

R343. More 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 relate to the population estimate; and

c. a discussion of the population-level effects of direct mortality.

R344. A discussion on the mortality estimate from the mine site, Freegold Road, and airstrip and airstrip access road. Discussion should include:

a. conflict kills and road kills;

b. consideration of high traffic roads vs. low traffic trails and different traffic types;

c. assumptions used for mortality risk assessment related to the Freegold Road and mine site; and

d. clarification of and rationale for the quota identified for annual allowable human-caused mortality.

10.3.4 Collared Pika

Section 12.3.6.3 of the proposal states the effects assessment for collared pika is limited to areas identified by predictive modeling as suitable habitat within the local study area. However, SLR has notes that focusing on habitat without assessing colony occupancy is not fully effective; population data verifying colony locations can more accurately predict effects on population numbers. The provision of colony occupancy based assessment methods will enable effective monitoring and mitigation, avoiding disruption of active and sensitive denning areas. Adverse effects on these specific areas will have a greater detrimental effect on the collared pika population than effects to areas of suitable habitat where no colonies are active (YOR 2014-0002-238-1).

The collared pika is listed as Special Concern by COSEWIC (though not listed under SARA). The populations in Yukon are listed as Sensitive under the national General Status program.

Actual colony data is required for an accurate understanding of the potential effects of the Project on this species. Government of Yukon determines colony persistence through the use of standardized occupancy modeling protocol; methods can be provided to the Proponent. Suitable habitat can be compared to actual use, and this information can be used to direct disturbance locations and monitor known areas of occupancy for population health throughout the life of the Project. In addition to SLR raising this issue, Selkirk First Nation notes it in its submission to the Executive Committee, encouraging the Proponent to use the monitoring protocol used by Environment Yukon (YOR 2014-0002-259-1). The Executive Committee requires more information regarding the collared pika in the project area. Therefore, please provide the following information:

R345. Collared pika colony occupancy data to accurately predict species' current abundance and distribution. If occupancy data is unavailable, proposed methods for collecting such data prior to habitat alteration.

10.3.5 Wolverine

Section 12.1.3.1 describes the selection of key indicator (KI) species, used to focus the wildlife effects assessment. The key criteria for the selection of these KIs include species at risk as a consideration. This section of the proposal states the assessment must consider effects on species listed under SARA, and that the COSEWIC designation is regarded in the proposal as a SARA designation.

The western population of the wolverine (including those in Yukon) is assessed as Special Concern by COSEWIC, in part because of the increasing fragmentation of its habitat by industrial activity. (The eastern population is listed under SARA as Endangered.) The COSEWIC Assessment and Update Status Report for the wolverine indicates that "the species has a low reproductive rate and requires vast secure areas to maintain viable populations" and "increased motorized access will increase harvest pressure and other disturbances" (COSEWIC, 2003).

Table 12.1-2 identifies the species known or likely to occur in the project area but that are not included as KIs. This table lists wolverine, with the following rational for its exclusion from the assessment:

> Low density and wide home range movements. Effects may be inferable from effects assessment on grizzly bears (e.g., security habitat). Application of general mitigation measures for wildlife year-round (e.g., waste management) will mitigate most potential project effects on wolverine (e.g., avoid attraction to mine site). Distribution is likely prey-based rather than habitat-based. (p 12-6)

SLR (YOR 2014-0002-238-1), Environment Canada (YOR 2014-0002-249-1) and the Government of Yukon (YOR 2014-0002-252-1) emphasize the grizzly bear is not an appropriate umbrella species for the wolverine, a species limited by ecological factors not relevant or limiting to grizzly bears. Reasons for this include: wolverine are active in winter whereas bears hibernate; wolverines have species-specific denning requirements; and wolverines are strict carnivores, whereas most grizzly bears are primarily herbivorous.

In its comment submission to the Executive Committee, the Government of Yukon (YG) notes that it recommended to the Proponent that baseline data be collected "based on track counts, mapping of denning habitat based on local knowledge and, if the track counts indicated that wolverines used the area around the proposed mine and mine site, a census of wolverines using bait posts" (YOR 2014-0002-252-1).

Without a detailed assessment of effects for wolverine, the Proponent is at risk of inadequately mitigating and monitoring project effects. Selkirk First Nation also raises the issue (YOR 2014-0002-259-1). The identification of existing dens within the project area can minimize the disturbance of females with kits at den sites; this activity is particularly important during especially sensitive periods (mid-February to the end of April). Minimizing disturbance at that time reduces the potential for loss of

young. Preferred denning areas within the project area can be identified through satellite imagery; occupancy can be confirmed through fieldwork and/or incidental observation.

Recently, (COSEWIC, 2014) has identified wolverine-human conflicts at mining camps as a potential threat to wolverine populations in NWT and Nunavut. While a similar conflict exists with grizzly bears, wolverines, which occur throughout the project area, are active year-round. The Executive Committee requires more information regarding the exclusion of the wolverine as a key indicator species. Therefore, please provide the following information:

R346. A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.

R347. 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.

10.3.6 Little Brown Myotis

Section 12.1.3.1 describes the selection of key indicator (KI) species used to focus the wildlife effects assessment. The key criteria for the selection of these KIs include species at risk as a consideration. This section of the proposal states the assessment must consider effects on species listed under SARA, and that the COSEWIC designation is regarded in the proposal as a SARA designation.

Little brown myotis is one of Yukon's two bat species, and approximately half of the global range occurs in Canada. Populations in eastern Canada have been devastated due to an introduced pathogen. In November 2013, following an emergency assessment, COSEWIC designated the little brown myotis as Endangered. Despite this fact, this species has not been considered as a KI. In addition to SLR raising this issue (YOR 2014-0002-238-1), Environment Canada (YOR 2014-0002-249-1) and Selkirk First Nation (2014-0002-259-1) also note this omission in their comment submissions to the Executive Committee.

Maternity colonies can take up residence in buildings. An understanding of what types of structures will be constructed and their suitability to bats as roosting sites will help determine potential effects. The Executive Committee requires more information regarding the effects assessment for the little brown myotis. Therefore, please provide the following information:

R348. Areas of use by the little brown myotis within the LSA and RSA, particularly for roosting and foraging.

R349. If baseline data is unavailable, proposed mitigation and monitoring efforts for the species.

10.3.7 Dall Sheep

Section 5 of the proposal identifies valued components (VC) relevant to the Project and effects assessment. Reasons for identifying the VCs include to "focus the analysis on potential key project-environment interactions." In addition, the proposal states that:

All VCs selected for the Proposal shared common attributes:

- The VC was considered to have importance;
- The VC is relevant to YESAA requirements;
- A potential Project-VC interaction exists because the VC is potentially affected by Project components and/or activities and is the receptor component; and
- Assessing the Project-VC interaction is feasible because the resulting effect pathways can be clearly understood. (p.5-2)

Dall sheep, a regionally important species, occurs in the project area near the Freegold Road extension. They are potentially affected by changes in predator access, and are vulnerable to access-related (hunting, predators, vehicles) mortality. Baseline information is lacking for Dall sheep; in its absence, a Wildlife Mitigation and Monitoring Plan with a detailed monitoring program is required. Such a program will validate assumptions made in the effects assessment.

The Executive Committee requires further information to complete the assessment of the Project effects on these wildlife species and their habitats. Therefore, please provide the following information:

R350. Baseline information for Dall sheep or, if unavailable, proposed mitigation and monitoring measures, particularly in relation to the Freegold Road.

10.4 EFFECTS ASSESSMENT FOR BIRDS

10.4.1 Alpine Bird Species at Risk

Section 12 of the proposal identifies cliff-nesting raptors, bird species at risk, passerine birds, and waterfowl as key indicator (KI) species, and includes effects assessments for each of these groups. However, alpine bird species are not included in the list. Alpine bird species are a high priority for conservation. Section 12B of the proposal notes that 53 species of birds with the potential to occur within the LSA “have been identified as priority species for conservation under the recent bird conservation strategy for Bird Conservation Region 4” (p 9). The Project is located within Bird Conservation Region (BCR) 4. This section also states that BCR 4 is home to seven alpine species threatened by reduction in alpine tundra due to climate change. Despite the supporting evidence provided in the proposal, alpine bird species have not been included as KIs and therefore are not specifically addressed in the avian effects assessment.

The Bird Baseline Report notes seven alpine species documented or expected to occur in the local study area are threatened by reduction in alpine tundra due to climate change. Alpine birds specialize in limited habitat; further reduction in habitat could have significant effects on these species. The Project will have potential effects on priority alpine bird species, yet the assessment of these effects is difficult without habitat data. The Executive Committee requires further information regarding the exclusion of alpine bird species as KIs. Therefore, please provide the following information:

R351. Discussion of alpine breeders as key indicator species, which considers their associated priority for conservation and the project's potential effects on this group.

R352. The location of alpine meadows in the local study area and regional study area.

10.4.2 Baseline Data for Species at Risk

Wildlife is selected as a valued component (VC), with particular species or species groups selected as key indicators to represent potential project effects on wildlife. Section 12 identifies the particular key indicator species for the wildlife effects assessment, and explains the rationale or criteria used for the species selection. Included in the criteria is whether the species is at risk: "Species at risk are included as key indicators (KIs) in the VC because they must be assessed where potential Project effects can occur (SARA, subsection 79)" (p 12-4). The effects assessment does not include all species listed as Endangered, Threatened, or Special Concern through the federal *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or the *Yukon Wildlife Act*.

In Section 12, the Proponent acknowledges that listed wildlife must be taken into account in an effects assessment, and that adverse effects on listed species and their critical habitats must be identified and mitigated. Excluding such wildlife from the list of KIs risks omitting potential adverse effects and mitigations in the assessment.

Baseline information for short-eared owl (Special Concern), horned grebe (Special Concern), and common nighthawk (Threatened) is required to assess potential effects on these at risk species. SLR, Environment Canada and Selkirk First Nation note this omission (YOR 2014-0002-238-1; 2014-0002-249-1; 2014-0002-259-1 respectively). In the absence of baseline information, the Executive Committee requires a detailed management plan that includes site-specific pre-construction and pre-clearing surveys for breeding birds and bat roosts and colonies.

Section 12.3.7.5 of the proposal notes that common nighthawk is considered unlikely to interact with the Project as it has not been observed in the project area and that the local study area is at the northern extent of its breeding range. Section 12B notes that surveys have not been conducted specifically for this species. Common nighthawk is listed as Threatened under SARA.

The short-eared owl is listed as Special Concern under SARA, with habitat loss and degradation of wintering grounds as the major threat to this species. The proposal states that the short-eared owl could potentially interact with the Project, as it has been documented foraging near the proposed mine during the breeding season. The proposal notes that nesting for this species has not been confirmed, and that the habitat is more suitable for hunting than nesting. The proposal points to a standwatch survey in 2013; this survey consisted of one evening in June. Selkirk First Nation emphasizes the need to better understand the number and behaviours of mating pairs of at risk species such as the short-eared owl (YOR 2014-0002-259-1).

Baseline information on these species at risk is required to fully assess the potential effects on these species and to provide effective mitigation measures from potential effects. An incomplete environmental assessment on SARA-listed species is a potential contravention of SARA s.79(2):

> The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans.

The Executive Committee requires further information on these at-risk bird species in the project area. Therefore, please provide the following information:

R353. The results of baseline surveys for short-eared owl, horned grebe, and common nighthawk pre-construction surveys (i.e. dusk call playback surveys) and a description of plans for mitigation and monitoring of potential adverse effects cause by the Project.

10.4.3 Bird Mortality Risk

Section 12.3.7.2 identifies bird mortality due to collisions with project vehicles or infrastructure as a possible risk, but notes the risk is expected to be limited to particular sites in the potential disturbance area and to not occur in large enough numbers to significantly affect local populations. The Executive Committee requires more information on the actual numbers behind this statement, as well as mitigations regarding traffic. Therefore, please provide the following information:

R354. Additional detail on the mortality risk to birds including identifying areas of highest risk.

10.4.4 Habitat Loss

Section 8 of the Bird Baseline Report (Appendix 12B) describes the methods used for habitat suitability models for select bird species in the local study area. The report states models were developed using various combinations of data sets. One of these data sets is the 1:50,000 scale CanVec water body layer (lakes and streams) provided by Natural Resources of Canada. The report notes that for the rusty blackbird model still water bodies were obtained from this water body layer, and additional water bodies were delineated by the consultant (EDI) using available imagery.

As rusty blackbirds, a species at risk, may use these small open water ponds, it is possible the Proponent's model underestimates habitat for this species in the event that the model used was not able to detect small open water ponds (<30 m^2). The Executive Committee recognizes the baseline report states: "The model for rusty blackbird reflects their strong association with shrubby habitats at the edge of ponds or lakes and shrubby wetlands" (p.40). However, the Executive Committee requires details on the rusty blackbird model for assurance the model adequately considers rusty blackbird habitat. Therefore, please provide the following information:

R355. Details on the rusty blackbird model. Details should include model inputs and assumptions and indicate whether and how it accounts for small wetlands.

Section 8 of the Bird Baseline Report also describes the habitat model for olive-sided flycatcher, noting that the species is "typically found in coniferous or mixed forest habitats where they show a preference for forest openings and/or edges, particularly along wetland or bog edges" (p 40). Table 8.1 identifies habitat ratings (high, medium, low, nil) for ecosystem types. Mixed forest habitats

provide an abundance of snags in riparian zones, which are favourable habitat for the species. Thus, mixed forests often provide good habitat when intersecting rivers. Rivers and large tributaries are a dominant feature in the local study area. SLR suggests that mixed forest habitats within 100 m of water should be included in high quality habitat for olive-sided flycatcher (YOR 2014-0002-238-1). Further, SLR suggests that as short-eared owl is "a species at risk with special habitat requirements and is intolerant of human activity" that habitat identified as moderate quality should be considered to be high quality habitat, for a more cautious assessment (YOR 2014-0002-238-1).

Therefore, the Executive Committee requires more information on the short-eared owl and olive-sided flycatcher assessment. Please provide the following information:

R356. Discussion regarding the models for olive-sided flycatcher and short-eared owl, including categorization of high quality habitat types. Consideration should be given to an expanded model for the short-eared owl and olive-sided flycatcher.

SLR notes the Project "may cause substantial habitat loss for horned grebes (direct and indirect loss combined)" and requested the proponent map observation sites and potential breeding wetlands within the project footprint for this species. The Executive Committee requires further information on the potential breeding sites for the horned grebe. Therefore, please provide the following information:

R357. A map showing observation sites and potential breeding locations for horned grebes within the project footprint.

10.4.5 Noise Effects

Section 12 of the proposal discusses sensory disturbance (through noise, visual or physical disturbances, etc.) as a potential project interaction with birds. Sensory disturbance can result in species avoiding areas close to the project site; the proposal identifies the area within which these habitat effects can occur as the zone of influence (ZOI). The proposal indicates such disturbance can result in a decrease in overall bird densities within the ZOI, and/or a shift in the species composition. Appendix 12B identifies habitat ratings (high, medium, low, nil) for ecosystem types determined through habitat suitability modeling. The proposal indicates a 300 m ZOI was applied to all project components, and that within the ZOI habitat ratings were decreased by one class, to a minimum of low. That is, a high rating becomes a medium rating, medium and low become low, and nil remains as nil.

Chronic noise can significantly reduce the quality of bird habitat; reducing high-quality habitat by one instead of two orders of magnitude may underestimate the amount of habitat loss for birds. This issue is of particular concern for species at risk.

A more representative prediction, tied to the level or intensity of noise, of the degradation of the quality of bird habitat in project areas would more accurately consider project effects and effective mitigation (such as suitable buffer widths). For example, in areas where loud, chronic noise is anticipated, habitat ratings could be reduced by two orders of magnitude (from high to low). The proposal does not indicate why all predicted effects will reduce the orders by one, and not two in intense cases, orders of magnitude.

In addition, the Wildlife Mitigation and Monitoring Plan does not propose to address noise effects through buffer widths. Establishing suitable buffers between high quality habitats and project activities likely leading to loud, chronic noise would potentially reduce the effects on species. This mitigation would require an appropriate buffer size; for example, 100 m buffers around active nests may prevent a breeding bird from avoiding or abandoning its nest near a noisy project activity. SLR observed that 10 m buffers from disturbance around active bird nests, as suggested in the proposal, are not likely to be effective. SLR notes “A buffer of 30 m has been employed in previously undisturbed areas for some large projects in BC” (YOR 2014-0002-238-1).

In its comment submission to the Executive Committee, Selkirk First Nation expresses concerns about potential effects of chronic noise and noise from blasting on raptors, and, in particular, effects on the breeding and foraging behaviours and habitat of peregrine falcon (YOR 2014-002-259-1).

The Executive Committee requires more information regarding the Proponent’s effects assessment for birds. Therefore, please provide the following information:

R358. Rationale behind decreasing habitat quality ratings one class, as opposed to two in some cases.

R359. Proposed mitigations for effects of chronic noise on bird species.

R360. Discussion of and rationale for buffer sizes around active bird nests.

10.4.6 Cliff-Nesting Raptor Survey

Section 12.3.8.1 of the proposal outlines the Proponent’s cliff-nesting raptors effects assessment. Section 4 of the Bird Baseline Report (Appendix 12B) describes the cliff nesting raptor field surveys conducted in 2010 and 2013. The Baseline Report says that prior to the 2013 survey the biologists compiled a list of all known sites, and that the 2013 survey visited all sites within 3 km of the project. However, many aspects of the survey methods are not included in this section.

In addition Selkirk First Nation comments that further information on the status of raptors in the area, particularly golden eagles who are sensitive to disturbance, is needed (YOR 2014-0002-259-1).

The Executive Committee requires more information about the study methodology to assess the validity and reliability of the assessment and proposed mitigations. Therefore, please provide the following information:

R361. Confirmation on whether the cliff-nesting raptor survey involved re-visiting previously documented nests.

R362. A figure showing the aerial route followed during cliff-nesting raptor surveys within the local study area and regional study area.

10.4.7 Cliff-Nesting Raptor Nest Sites

Section 12.3.8.2 of the proposal indicates that a 500 m buffer will be provided around cliff-nesting raptor nest sites. However, it also notes the literature recommends an 800 m buffer. The Executive

Committee requires more information about the buffer size selected for cliff-nesting raptor nest sites. Therefore, please provide the following information:

R363. Rationale for the size of the proposed buffers around cliff-nesting raptor nests.

10.4.8 Waterfowl – Presence of Wetlands

Section 12.3.9.1 of the proposal outlines the waterfowl effects assessment. The baseline summary states: “The LSA contains no lakes. Open-water wetlands and pond habitats are generally infrequent and small” (p12-78). The section does not identify where these wetlands are relative to the project. It also does not identify how wetland information was derived, for example, at what scale of map, and whether or not the information was verified (by survey). These methods and results are important to understanding project effects.

Open-water wetlands as small as 1 000 m² are important to semi-aquatic wildlife. Knowledge of the location of all wetlands in the project area is necessary to assess effects on waterfowl species, including horned grebe, which is particularly reliant on open-water wetlands, and to establish appropriate mitigation strategies. Environment Canada echoes these concerns (YOR 2014-0002-249-1). The Executive Committee requires more information on the waterfowl effects assessment. Therefore, please provide the following information:

R364. Methods used to identify wetlands, including open-water wetlands and small ponds.

R365. Information displaying the locations of these wetlands and ponds, and their distribution across the LSA.

R366. Discussion of potential effects to these wetlands and ponds, and any associated mitigations.

10.4.9 Waterfowl – Mine Water Bodies

In Section 12.3.9.5, the proposal indicates the two wetlands developed on the north and south of the tailings management facility (TMF) may be attractants for waterfowl. Section 12.3.9.2 of the proposal discusses potential project interactions with waterfowl and identifies negative health effects from water within the TMF and other mine water bodies (e.g. the events pond) as the key issue. Waterfowl are highly reliant on wetlands for habitat; identifying adjacent wetlands would help with the assessment. For example, during spring migration staging areas are limited, as many water bodies are frozen. If the TMF thaws earlier than surrounding wetlands, it could attract and increased number of waterfowl. Adjacent watersheds, including Walhalla Creek; Yukon River to Fort Selkirk; Wolverine Creek to the northeast; Klotassin River and Klaza River to the southwest, are not included in the proposal’s assessment of effects of the TMF on waterfowl.

The proposal also indicates that modeling for the TMF post-closure predicts elevated levels of sulphate, cadmium, copper, molybdenum, selenium, and uranium. The proposal acknowledges that exposure to trace metals at elevated levels can cause detrimental effects to waterfowl, and indicates

selenium as of particular concern due to toxicological effects at low concentrations and its tendency to bio-accumulate within the environment.

The proposal notes that exposure to elevated levels of trace metals has the potential to affect reproduction in waterfowl. The proposal suggests that water quality mitigation measures will address concerns, and that if water quality monitoring indicates unacceptable levels of trace metals or other constituents, the residual effect will be limited.

The TMF is a risk to waterfowl, which are particularly vulnerable as they are wetland habitat obligates. Of particular concern is the horned grebe, a species at risk in the area. Many studies have been done regarding bird mortality, particularly waterfowl, caused by tailings ponds; in particular, the effects of selenium have been well researched. The assessment references very little of this research. The proposal's conclusion that no effects to waterfowl will occur based on these select articles appears unjustified. Both SLR and Environment Canada stress these concerns, "The effects of the TMF in particular are poorly explored and the potential for waterfowl mortality related to toxicity of the TMF is inadequately addressed. The Wildlife Management Plan expresses the proponent's intention not to mitigate potential adverse effects on migratory birds and wildlife in advance" (YOR 2014-0002-249-1; 2014-0002-238-1). Environment Canada also notes that efforts to prevent waterfowl from using all mine water bodies are vague and lack supporting evidence, and recommends further consideration and detail be provided.

The Executive Committee requires more information regarding the potential effects of the TMF on waterfowl. Therefore, please provide the following information:

R367. An effects assessment of the TMF wetlands, as they relate to waterfowl.

R368. Monitoring and mitigations to prevent waterfowl from utilizing the TMF wetlands and other mine water bodies (events pond, pit lake, etc.). Details should include effectiveness of proposed mitigations.

R369. Clarification on the meanings of "unacceptable levels of trace metals" and "limited effects" in relation to waterfowl, and rationale for the statement that despite unacceptable levels of trace metals shown by water quality monitoring, resulting effects to waterfowl will be limited.

R370. Rationale for how water quality mitigation measures alone will address concerns around waterfowl exposure to elevated levels of trace metals.

10.4.10 Bird Baseline Clarification

In the Bird Baseline Report (Section 12B), Figure 8.1 is labeled "Baseline habitat quality for passerine bird species in the Casino Project LSA," while the figure's legend refers to "upland birds." As passerines are upland birds but not all upland birds are passerines, the Executive Committee requires clarification as to which group the habitat quality rating applies. Therefore, please provide the following information:

R371. Clarification as to whether Figure 8.2 in Section 12B refers to only passerine bird species or to upland birds in general.

10.5 CONSIDERATION OF CLIMATE CHANGE IN RELATION TO WILDLIFE

Based on current research, it is likely climate change will affect wildlife and vegetation. Appendix 20A, the proposal's Climate Change Report, primarily discusses climate change projections in the context of the project area. Section 2.5 of this report offers limited information on engineering design considerations, and no discussion of effects to wildlife and wildlife habitat as a result of climate change.

The information provided in the Climate Change Report on recent trends in temperature and precipitation is useful. However, the discussion lacks consideration of potential consequences of climate change; such consequences would potentially influence the assessment of impacts and identification of mitigations. For example, projected increases in the frequency and magnitude of extreme weather events, as well as changes to snow pack (reduced spring snow depth and increased icing), have not been considered, although these events and changes can directly affect species. In addition, the report does not include information specific to the ecosystems in the project area.

Throughout, the proposal does not integrate climate change for wildlife effects assessments or management. Climate variables are important drivers in determining the suitable habitat for and effects on wildlife. Consideration of how climate change is affecting, and will affect, vegetation and wildlife would improve the assessment of potential project effects on these species; it would also aid in designing adaptive management measures over the life of the Project.

SLR provided the following examples of potential impacts of climate change on key indicators, identified through research (YOR 2014-0002-238-1):

- **Caribou:** Climate change has a range of potential effects on habitat, body condition and reproductive success. For example, increased fire frequency and intensity result in overall habitat loss; increased snow depth makes cratering for terrestrial lichens more energy-intensive; winter thaws or icing events create snow crusts or ice layers which reduces access to food and increases predator mobility (and decreases caribou mobility); changes in biting insect timing (due to changes in timing of the seasons) can increase caribou calf mortality and reduce adult fitness.
- **Collared pika:** The main threat to the collared pika is considered to be climate change (through increased weather variability and changes to habitat).
- **Wolverine:** Denning occurs in areas with spring snow cover and spring snowpack is greatly affected by climate change. Female wolverine distribution is highly connected to distribution of spring snowfall.
- **Alpine habitat in relation to birds:** Loss of alpine habitat due to climate change is implicated in declines of, or considered a threat to, several bird species of relevance to the Project.

Without due consideration of climate change in the affects assessment, impacts may be underestimated. For example, certain types of habitat (or certain species) might be more vulnerable to climate change, may disappear more quickly, and be disproportionately affected by the Project.

Thus, these habitats or species may be considered to be more valuable in an effects assessment. The Executive Committee requires more information on how the Proponent will address concerns related to climate change. Therefore, please provide the following information:

R372. The potential effects of climate change on key indicator species over the life of the Project.

R373. Discussion of monitoring and adaptive management measures to be implemented to detect and mitigate potential effects of the Project in the context of climate change.

10.6 WILDLIFE MITIGATION AND MONITORING PLAN

Section 5 of the Wildlife Mitigation and Monitoring Plan (WMMP) provides a framework for monitoring effects on wildlife. Section 5.4 describes the focal species monitoring that will be conducted. However, the plan does not outline clear protocol regarding methods for monitoring surveys for caribou, ungulates, carnivore dens, collared pika colonies, and species at risk. Without protocols for monitoring, it is difficult to assess the activities. The Executive Committee requires further information about monitoring protocols; therefore, please provide the following information:

R374. Details on the timing, spatial boundaries, frequency, and general methods of monitoring surveys for caribou, moose, carnivore dens, pika colonies, obligate alpine breeders, waterfowl, and bird species at risk.

11.0 ECONOMY

11.1 BOOM AND BUST CYCLES

The Project's contribution to Yukon GDP during construction is estimated at $363 million in total, and $274 million annually during operations. This compares against $314 million for the Yukon's entire mining sector in 2011, including quarrying and oil and gas extraction.[2] The proposal claims that "Yukon businesses are familiar with the cyclical nature of the mining industry (section 15.4.4.1)". The proposal builds on this by stating that the effects of a bust cycle are "manageable within the region's socio-economic context (section 15.4.4.1)". Given the size of the Project in relation to both Yukon's economy and the resource sector, commodity price fluctuations may be experienced as magnified boom and bust cycles.

The proposal accepts that boom and bust cycles exist, but does not provide further analysis. The proposal does not describe what would occur to employees, businesses, or the Yukon economy in a temporary closure or reduced workforce scenario. The Executive Committee requires more

[2] Yukon Bureau of Statistics, Gross Domestic Product by Industry, 2012. Jan 2014. Numbers from 2012 not used as these have not been revised; previous years show pre-revision numbers can be out by a considerable amount. Number is in chained 2007 dollars.

information to understand the potential effects of boom and bust cycles. Therefore, please provide the following:

R375. Discussion and rationale on the Proponent's position that the boom and bust cycle to be either minimal or acceptable within the context of Yukon. Consideration should be given to the contribution of annual taxes, royalties and GDP to the Yukon economic base and the scale of the Project.

R376. A description of what measures will be put in place to reduce the effects of boom and bust cycles.

R377. Identify specific conditions and scenarios where the Project might operate on a reduced scale.

11.2 BUSINESS OPPORTUNITY

Section 15.4.1.1 of the proposal outlines the potential for business opportunities within Yukon. The proposal estimates that nearly $600 million of goods and supplies will be supplied by Yukon vendors during construction alone. The ability of local business to sufficiently scale their capacities, including businesses located within the communities of Pelly Crossing and Carmacks, is critical to their ability to benefit from Project activities. Section 15.4.2 outlines how the Proponent intends to involve or prioritize local suppliers, while encouraging joint ventures between First Nations' businesses and other regional businesses in the procurement process; however, it is not clear how the Proponent intends to achieve this. The Executive Committee requires more information on how the Project will affect local business opportunities. Therefore, please provide the following information:

R378. Details regarding any specific methods that the Proponent intends to use to enable local and Yukon businesses to supply or service the Project.

R379. Details regarding any specific methods that the Proponent intends to use to enable First Nation businesses to supply or service the Project.

11.3 ECONOMIC EFFECTS MONITORING

The proposal indicates that a mitigation measure for negative economic effects is "monitoring Project socio-economic effects and adapting management measures where required" (Section 15.4.2). It is unclear how the Proponent anticipates monitoring socio-economic effects over the lifetime of the Project and what measures will be used to judge Project effects. The Executive Committee requires additional information in order to ensure the effectiveness of socio-economic monitoring and adaptive management strategies. Therefore, please provide the following information:

R380. A detailed plan on how the proponent intends to monitor and manage socio-economic effects. This plan should include:

a. objectives, indicators, and monitoring methods;

b. thresholds and triggers for action; and

c. adaptive management strategies.

11.4 SUPPORTING DOCUMENTATION

Sections 13 and 15 of the proposal rely on Meyer Norris Penney's (MNP) "Economic Impacts of the Casino Mine Project" to inform the proposal regarding changes in income and employment, but it is not included within the proposal documents. The report is required to understand the parameters and assumptions that are built into the effects assessment within these sections. The Executive Committee requires this report to further evaluate economic effects. Therefore, please provide the following information:

R381. The following referenced report: MNP LLP. 2013. Economic Impacts of the Casino Mine Project. March 2013. Casino Mine Corporation.

12.0 EMPLOYABILITY AND EMPLOYMENT

12.1 TRAINING AND EDUCATION

The employability section of the proposal summarizes that all employability effects will be beneficial and most likely long term in nature (Table 14.4-2, Table 14.4-7). The Proponent also predicts, in Section 14.4.1.1, that by 2017, a large gap will begin to develop between the market supply of skilled labour and market demand in Yukon. Moreover, the provided predictions are that this gap will continue for 10 years, to 2027. The proposal claims this shortage in available labour is already apparent in existing Yukon mines. The addition of a major mine (and potentially Copper North, Eagle Gold, Mactung, Brewery Creek, and/or Selwyn) could create a severe challenge to the goal of a 78 percent local workforce, which is the Proponent's target. If this level of Yukon resident employment is achieved, 5.6 percent of Yukon's workforce will be directly involved with the Project.

The proposal estimates that 31 percent of the necessary workforce for the Project will need to be trained or recruited from another workforce by 2023. The Proponent has indicated that the company will work with Yukon College, government departments, and local communities to address the gap in available labour.

Furthermore, according the proposal's Socio-economic Baseline Report, 70 percent of Yukon businesses expressed difficulties in hiring locally. The mining industry has only succeeded in hiring about 50 percent locally within Yukon. It is unclear how CMC will overcome these hiring challenges and meet the target of a 78 percent Yukon resident workforce. The anticipated high proportion of Yukon resident employees and acknowledged labour shortages appear to be contradictory.

The Executive Committee requires more information on how this quota will be reached. Therefore, please provide the following:

R382. A plan on how the Proponent intends to meet their commitment to hire within Yukon including:

a. anticipated training programs;

b. a monitoring mechanism including indicators;

c. how the plan has or will involve communities and First Nations considering Chapter 22 of the Umbrella Final Agreement;

d. implementation timelines; and

e. apprenticeship and co-op opportunities.

12.2 AFFECTED COMMUNITIES' ACCESS

During construction, the proposal indicates, in Section 4.3.1.2, travel to the workplace from communities other than Whitehorse may be possible by "independent carriers on a chartered basis". It is unclear on whether such measures would be continued into the operational phase of the mine or if alternate transportation indicates employee/contractor or Proponent initiative. The Executive Committee anticipates that effective and quick transportation to the mine is critical in hiring and retaining employees within Carmacks and Pelly Crossing. Therefore, please provide the following information:

R383. Transportation alternatives for potential employees in Yukon communities outside of Whitehorse during each Project phase.

R384. Details of the "hiring policy that encourages the employment of workers from Yukon and in particular the rural communities of the LSA" and workforce opportunities for residents in Carmacks and Pelly Crossing and citizens of affected FNs.

12.3 EMPLOYMENT AND MIGRATION

While the overall effect of proposed migration to Yukon in relation to the Project is modest compared against natural growth and current migration trends, the Project will result in substantial numbers of new residents. The Project will also result in some migration within Yukon as people move to take advantage of new opportunities.

The proposal states, in Section 14.4.1.1, that 134 workers will migrate to Yukon by 2023. This statement requires more elaboration or the provision of supporting documentation that is based on a 2013 survey of long distance commuters in Yukon's mining industry. Furthermore, details regarding migration over the Project's lifetime are unclear.

Whitehorse, as the primary link for employees to the Project site, may be a more natural location for employees to reside in when compared against Pelly Crossing or Carmacks. Secondly, also due to being the primary link for employees to the Project site, many of the economic benefits may be concentrated in Whitehorse. This may lead to downward population pressures in Pelly Crossing and Carmacks. It is unclear if the Proponent's modeling has taking this into account.

The Executive Committee requires additional information for each community and forecasts of population changes. Therefore, please provide the following information:

R385. Assumptions supporting migration estimates, including between communities in Yukon and how downward population pressures were considered.

R386. A breakdown of direct Project employment projected for each affected community. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.

12.4 FLY IN-FLY OUT AND SHIFT STRUCTURE

In Section 10.4.2 of the proposal, CMC states:

> The magnitude of effects on family relationships are uncertain since they depend on how families adjust to work schedules. There is little information on family characteristics, values, and expectations that would allow us to quantify these effects. However, with mitigation strategies in place, the effects of work schedules are not expected to be significant. (p 16-25)

No clear mitigation strategies for effects to family relationships have been presented in the proposal. There is reference to flexible rotations, counseling services, and a form of adaptive management. Further, the nature of the proposed shift structure may preclude portions of communities' populations unable to participate in community and cultural events. The Executive Committee requires more detailed information and clarity on how fly-in fly-out shift structure effects will be mitigated. Therefore, please provide the following information:

R387. Clarify if the flexible rotations, counselling services, and adaptive management are the mitigation strategies for the proposed shift structure as suggested in the proposal. Please elaborate in detail for each mitigation strategy.

R388. Details on how CMC will accommodate cultural and community events, including funerals and potlatches, in its proposed shift structure.

13.0 COMMUNITY VITALITY AND WELLBEING

13.1 METHODOLOGY

Section 16 of the proposal, the community vitality section, is unclear in why the effects assessment categorizes all effects as taking place within a context of high resilience. In order to evaluate the significance of an effect, the context must be clearly established. Selkirk First Nation's consultant, North/West Resources, goes so far as to state "There is insufficient evidence presented in the proposal to support this assertion [of resiliency] – indeed there is considerable information presented that contests it." (YOR 2014-0002-258-1) A determination of high resilience in regards to potential effects reduces the significance of potential effects. The Executive Committee requires more information on how the Proponent determined a high degree of resilience for effects to community vitality. Therefore, please provide the following:

R389. Rationale for the determination of high resilience as the context for possible effects to community vitality. In addition, provide a discussion on the implications of using a more conservative estimate of resiliency.

13.2 SOCIAL AND CULTURAL EFFECTS MONITORING

Section 16 of the proposal, the community vitality section, does not provide definitions of community wellbeing or community vitality. Clear definitions help clarify mitigation objectives which then can shape data collection, monitoring and indicators, and evaluation of effects. Morrison Herschfield in its technical review noted that without clear connections between indicators and valued components, baseline data or monitoring data is not connected to the Project but merely a backdrop (YOR 2014-0002-237-1). Furthermore, measures of success, once the Project is operational, are dependent upon clear criteria and methods both of which depend on definitions of valued components. The importance of monitoring, and its methods, is also clearly outlined by Selkirk First Nation's consultant, North/West Resources, as follows:

> Socio-economic monitoring of multi-year resource projects, especially those that have a project-life of five years or longer, are important in that they evaluate predicted socioeconomic effects against those that are actually occurring with an active project. This is particularly important with respect to
>
> (a) evaluating the accuracy of predicted effects and identifying those that have not been predicted;
>
> (b) evaluating the effectiveness of a project's mitigation and enhancement measures in addressing those effects, and
>
> (c) making adjustments to mitigation and enhancement measures and project management.
>
> (YOR 2014-0002-258-1)

Further, as project effects may not be felt evenly throughout each community, consideration of Project effects on marginalized members of communities is also important in the construction of a monitoring plan. Monitoring is crucial to ongoing mitigation design and adaptation, especially for a project of this temporal length. In order to evaluate the effects of the Project, the Executive Committee requires more information on community wellbeing and vitality including clearer definitions. Therefore, please provide the following:

R390. A plan for of how community well-being will be monitored, including:

a. a clear definition of community wellbeing and community vitality, and how the community has been involved in the process of definition;

b. indicators to monitor and evaluate the level of community well-being and vitality in each affected community;

c. methods of monitoring each indicator;

d. how the Proponent will communicate monitoring results; and

e. any monitoring efforts outside of Pelly Crossing and Carmacks.

13.3 EFFECTS ASSESSMENT VALUED COMPONENTS

Selkirk First Nation's consultant, North/West Resources, outlines concerns around the selection of valued components used in the proposal (YOR 2014-0002-258-1). They suggest using valued components already used for monitoring and assessment of socio-economic effects with the Minto Mine. The benefits of using similar criteria and categories for socio-economic assessment could provide additional baseline data while providing an improved framework for assessing effects, especially as these valued components are more resonant with the community of Pelly Crossing and the Selkirk First Nation. The Executive Committee requires some discussion regarding incorporation of these valued components into a management and monitoring program for socioeconomic effects resulting from the Project. Therefore, please provide the following:

R391. A description of how these suggested valued components can be incorporated into the Project's management, effects monitoring, and community involvement.

14.0 HERITAGE RESOURCES – ARCHEOLOGICAL AND HISTORICAL SITES

Section 18 of the proposal discusses cultural continuity as a valued component. This section comprises "Places of Historical, Cultural, and Archaeological Value" and a number of cultural and land use components that are discussed in Section 15, Land Use, of this Adequacy Review Report.

14.1 HERITAGE MANAGEMENT PLAN

Section 2 of the proposal, First Nations and Community Consultation, and Appendix 2A, consultation log, mentions the development of a heritage management plan (HMP). However, no HMP is provided in the proposal. This omission is highlighted by Tr'ondëk Hwëch'in (TH) in its adequacy period comment submission. The comment submission by TH emphasizes that the definition of heritage resources in the management plan should consider how heritage resources are defined, but should also reflect First Nation values and methods for heritage management. This may be difficult as the proposal indicates that there are no Project specific Traditional Knowledge (TK) or Traditional Land Use (TLU) surveys to draw from in shaping an HMP.

Furthermore, at site KfVi-5 the same mitigation measures and approach proposed were used previously. This resulted in an area that was "extensively disturbed by construction of a borrow source" (YOR 2014-0002-21-1). The mitigations suggested in Section 18 for effects assessment were given a "high" predictive effectiveness (Table 18.4-3); however, this case exemplifies the potential ineffectiveness of this mitigation measure. In the long and short term, a more detailed mitigation strategy is required in order to ensure avoidance of archaeological and historic sites.

A management plan should also acknowledge that awareness of heritage resources may diminish with time and contain a strategy to maintain awareness of heritage resources.

The Executive Committee requires more the HMP to further understand potential effects to heritage resources. Therefore, please provide the following:

R392. A Heritage Management Plan including:

a. a description of input from First Nations including Traditional Knowledge;

b. a range of mitigation measures;

c. heritage resource management framework;

d. definitions and objectives; and

e. a monitoring and evaluation mechanism.

14.2 Nature and Number of Archaeological and Historic Sites

Section 18.3.2 of the proposal states there are 11 archaeological sites within the Project footprint. Appendix 18A identifies 11 archeological sites, while Appendix 18B identifies 15 archeological sites along the realigned Freegold Road between kilometers 33 and 66. Section 18B also lists sites that were revisited outside this study area (Table 2), about 16 archaeological sites are listed in this table. Section 18B also references work done under another permit, 11-04ASR, which was for the Freegold Road extension. The results of the work completed under this permit were not provided. Data for historical sites is also incomplete or unclear.

The Executive Committee requires a more complete, accurate, and thorough overview of all archaeological and historic sites in the area. Government of Yukon (YG) has commented on this concern as well, stating that the proposal does not include an overview of all heritage sites in the Project area. The proposal, YG continues, does not state the scope of impacts to heritage resources in the Project area nor what mitigation strategies will be employed at specific sites where disturbance is predicted.

Clarity, provided in a table that describes archeological sites, predicted impacts, and proposed is required. A description of the characteristics of each site would aid in assessing effects. Additional clarity for historical sites would also be beneficial in clarifying potential impacts to historical resources.

The Executive Committee requires clarity on the number, location, management and status of known heritage sites. Therefore, please provide the following:

R393. A table summarizing the number of historical and archaeological sites, their relative location in relation to the mine site, the Freegold Road Upgrade, the Freegold Road Extension, the airstrip location and associated borrow sites. Within that table include additional details such as:

a. characterization of predicted disturbance;

b. proposed Mitigation;

c. description of the site;

d. if applicable, the Project component footprint that the site overlaps; and

e. site name, date of discovery, general location and traditional territory.

14.3 FREEGOLD ROAD HISTORIC SITES

Section 5.2 of the Historic Resources Impact Assessment for the Freegold Road report indicates six previously unrecorded historical sites were identified during 2013 fieldwork. These six resources appear to be located at the east end of the Freegold Road, near Seymour Creek. Five of these resources appear to be within the planned road realignment. The report recommends avoiding construction impacts to these structures. If this is not possible, the report recommends gathering additional documentation on the sites prior to construction. The Executive Committee requires more information on the mitigations proposed for identified historic sites along the Freegold Road. Therefore, please provide the following:

R394. Clarification regarding whether avoidance is possible for the five historic sites located along the Freegold Road Extension. If not, a description of next steps and proposed mitigations is required.

15.0 LAND USE

15.1 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE

The proposal states Traditional Knowledge (TK) requires “oral communication and practicing Aboriginal traditional land uses” (Section 18.1.2). TK thus requires continued and stable access to traditional land uses. The potential effects of the Project on continued and stable traditional land uses remain unclear. While the Cultural Continuity section of the proposal considers TK and Traditional Land Use (TLU), no TK/TLU studies were undertaken as part of the collection of baseline data. The TK/TLU baseline information provided in the Land Use section of the proposal is inadequate and the Cultural Continuity section also fails to provide sufficient information on TLU in the Project footprint.

Comments received during the adequacy period reinforce this notion. Selkirk First Nation, in its adequacy review comment, states that order to better understand impacts to TK and TLU, a comparison of other similar projects’ impacts to TK and TLU within a northern context would be beneficial (YOR 2014-0002-258-1). White River First Nation notes “the Proposal itself admits to significant gaps in information of significance to First Nation traditional use stemming from a failure to conduct traditional knowledge and/or traditional use studies.” (YOR 2014-0002-279-1) Information on how TK has been incorporated into the proposal and baseline data related to TLU is critical to understand the context of potential effects.

The Executive Committee requires information regarding baseline TK and TLU and how it has been considered in the proposal. Therefore, please provide the following:

R395. Clarification on the specific efforts and processes undertaken by the Proponent to gather TK and TLU in order to inform the proposal. A description of what TK or TLU information the Proponent received for the purposes of drafting the proposal.

R396. A TK and TLU study for the Project.

R397. A review of effects from resource projects and effects on TLU in a northern context.

R398. A framework for monitoring effects to TLU resulting from the Project.

R399. An assessment of impacts of the Project on traditional economy.

15.2 FISHERIES

The proposal lacks details in the consideration of potential impacts to fisheries, aboriginal, commercial, or recreational. DFO in their adequacy period comment submission specifically request discussions on how the Project may affect local fisheries. White River First Nation in their comment period submission note that the consideration of effects to fish and aquatic resources stop in upper Dip Creek which omits potential effects to fisheries downstream from the Project. Little Salmon Carmacks First Nation consultant, Rob Walker Consulting, expresses concern over the "potential increase in harvests of freshwater fish from improved access to streams associated with the construction of the Freegold Road extension" (YOR 2014-0002-281-1)

DFO raises a concern that the predicted flow changes may have an effect on the populations of Arctic grayling in the Dip Creek and Casino Creek watersheds, and on the commercial, recreational and Aboriginal fisheries based on these populations (YOR 2014-0002-251-1).

Concerns regarding the geographic extent of fish and aquatic resources are outlined in Section 8.0, while concerns relating to the geographic extent of water quality and quantity predictions are included in Section 4.0.

Given the potential for effects to water quality and thus to fisheries the Executive Committee requires more information regarding potentially affected fisheries. Therefore, please provide the following:

R400. 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. 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.

15.3 HARVESTING OF PLANTS

Certain plant species are important to First Nations or other users for food and/or medicinal purposes. Such plant species are not identified or discussed in Section 11 (Rare Plants and Vegetation Health), nor are they considered in depth in Section 18 (Cultural Continuity), or Section 19 (Land Use). It is unclear what effects the Project may present to the harvesting of plants of traditional, cultural or economic importance. Section 18.4.1.2 of the proposal states that "it is assumed that the plants used for subsistence and recreational harvesting are widespread and common through the Land Use LSA and RSA;" however, the rationale for this statement is unclear, especially considering the species to which it refers to are unclear.

The Executive Committee requires more information regarding traditional, cultural or economically important plant species within the Project area. Therefore, please provide the following:

R401. Description of any identified 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.

R402. Any ground studies that sought to identify and map plants of concern.

15.4 HARVESTING OF ANIMALS

The proposal is unclear regarding whether and how First Nation consultation informed its assessment of impacts to traditional economy and traditional land use. It is also missing any concerns raised by hunters or First Nations in regard to hunting that may be induced by increased and improved access in addition to direct Project effects. Little Salmon Carmacks First Nation consultants, Rob Walker Consulting (YOR 2014-0002-281-1), and ElknWillow Environmental Consulting (YOR 2014-0002-282-1), express concern about this. Rob Walker Consulting states "[e]xisting First Nation uses support a traditional economy and practices that are integral to maintaining culture. Improved access will bring economic competitors for subsistence and culturally significant resources."

The Executive Committee requires more information regarding the impacts of the Project on hunting. Therefore, please provide the following:

R403. If, during consultation with First Nations, any concerns were raised on impacts to important areas of wildlife harvest.

R404. A monitoring plan for induced hunting effects along the Freegold Road, either independently or in conjunction with First Nations.

15.5 TRAPPING AND OUTFITTING

The consultation overview in Section 2.1.2 of the proposal lists eight Registered Trapping Concessions (RTCs), two big game outfitters, and other trapline tenure holders potentially affected by the Project. The consultation log for the general public, in Table 2A-3, identifies RTCs Nos. 121 and 148 as being invited to attend a community meeting. The log indicates a meeting on October 2, 2012 with an unidentified trapper who provided access, use, and harvest information for his trapline, and an email from RTC No. 121 regarding effects to his tenure. The log also indicates the outfitting businesses were contacted. However, the record of contact with the users is limited. It appears all eight RTCs were not contacted. The discussions and issues identified by resources users are not presented.

There does not appear to be a record of the potential effects of the Project on trapping activity or big game outfitting. As a result, the effects of the Project on trappers and outfitters are difficult to assess, and are potentially not included in the proponent's effects assessment. This information would enable the Executive Committee to incorporate these perspectives and potential effects in the screening. Therefore, please provide the following information:

R405. Description of discussions with and feedback from affected trapline concession holders including how many trapline concession holders were contacted and responded

R406. Description of discussions with and feedback from affected outfitting concession holders including how many outfitting concession holders were contacted and responded

R407. A summary of any geographically specific important areas for outfitting or trapping that overlap or may be affected by the Project and the species involved.

15.6 QUARTZ AND PLACER CLAIM HOLDERS

The realignment and improvement of the existing Freegold Road, in addition to its extension may affect the ability of mineral rights holders to access their claims. This is also important in the context of access management for the extension of the Freegold Road. The Executive Committee requires more information on how mineral rights holders have been informed of the proposal. Therefore, please provide the following:

R408. A description of any contact or discussions between CMC and mineral rights holders in relation to the road.

15.7 OTHER LAND USERS

Within Section 1.3.11 there is discussion of other tenures, including a public utilities right of way, and rural residential tenures. These are mapped in figure 19 and within the south-eastern portion that map there is reference to rural residential tenure No. 334151. It falls within the 500 m buffer of the road yet there is no consideration or description of potential impacts or the significance of effects. The Executive Committee requires more information regarding this tenure. Therefore, please provide the following:

R409. A rationale for why tenure No. 334151 is not considered in the effects assessment.

The heritage resources section of the proposal notes a modern cabin as lying at the southern edge of a proposed borrow pit. The proposal indicates possible impacts, though specifics about a mitigation strategy are lacking. It is also unclear if the cabin owner is aware of potential impacts to the structure. The Executive Committee requires more information regarding this cabin. Therefore, please provide the following:

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.

16.0 NOISE

Section 9 of the proposal assesses the anticipated impacts from noise generated by both the mine site and along the Freegold Road transportation corridor. Baseline conditions were established in the summer of 2011 over a 22-hour period on the Freegold Road near Carmacks. Section 9.4

summarizes project specific effects in relation to sound. Predictions of noise used the German Guideline for Noise Protection on Streets RLS-90 and ISO 9613-2:1996. Modeling was executed using the Cadna/A software package.

ISO 9613-2:1996 takes into account the following physical effects[3]:

- Geometrical divergence
- Atmospheric absorption
- Ground Effect
- Reflection from surfaces
- Screening by obstacles

It does not apply to aircraft in flight or blast waves from mining.

The assessment included predictions for daytime and nighttime sound levels, as well as baseline information for daytime and nighttime. It is not clear to what extent inversions are covered, for example inversions over water are not. RLS-90, the German Guideline for Noise Protection on Streets (Richtlinien für den Lärmschutz an Straßen), is primarily a traffic noise model that is able to take into account wind and inversions.

Inputs to sound modeling conducted by the Proponent include:

- Mobile sound sources such as road traffic and mine vehicles.
- Stationary sources such as crushers, conveyors, power plants, heat recovery steam generators,
- Off-site roads such as the Freegold Road and road to the airstrip.
- Construction activities

Noise was modelled for night and day during both the construction and operational phases.

Two study areas were established for the noise section, one encompassing the mine site and another encompassing the Carmacks area; however, no modeling was conducted for Carmacks: “LSA 2, which consists of Carmacks, was not modelled as there are no mine operations here and mine-related traffic is not expected to pass through this area.” It is not clear why traffic noise was not modelled in Carmacks especially as prior to bypass construction traffic will proceed through Carmacks rather than around it. No further consideration of Carmacks was provided.

It is not clear within the provided materials how modeling accounted for differing weather conditions throughout the year. Inversion conditions, for example, can refract sound down. Nor is it apparent

[3] ISO 9613-2:1996(en) from the online browsing platform from the ISO. https://www.iso.org/obp/ui/#iso:std:iso:9613:-2:ed-1:v1:en Accessed November 2014.

how different wind regimes have been accounted for. Baseline data, which may have helped inform modeling, is limited to one day in summer conditions. Model results were not provided for the Freegold Road despite the potential for effects to wildlife.

Table 9.4-1 outlines noise sources incorporated into modeling and their total sound pressure level (in dBA). However, it is not clear which reference value from the specified sources applies to the identified source. The Department of Environment, Food, and Rural Affairs (UK) source for example has multiple rows for excavators depending on class and power capacity.

Table 9.4-1 appears to exclude some significant noise sources. This includes the concrete batch plant, aircraft movements, blasting, and other sources. Additional clarification is needed to understand the provided models.

The Executive Committee requires more information on noise modeling for the Project to better understand potential effects due to noise. Therefore, please provide the following:

R411. Details regarding how the noise model accounted for seasonal variability.

R412. Details how the collected baseline data informed modeling or if other sources were used.

R413. Rationale on model selection including model limitations.

R414. Rationale on why noise levels in Carmacks and the FGR were not modeled

R415. Identification of reference equipment used to calculate sound pressure levels.

R416. Confirmation that the noise modeling accounts for air traffic, shovels, cycloning, blasting, the concrete batch plant, and HLF crushing operations and revised predictions if these are not included in the original proposal.

17.0 EMERGENCIES AND HUMAN HEALTH

The Project has two major components when considering emergencies, the mine site itself and its transportation routes. Provided emergency plans, the Emergency Response Plan (Appendix 22b), in the Project are lacking in terms of content. The size of the Project and its potential for accident or disaster warrant a much closer look at how the Proponent will handle emergency response. The emergency response plan (Appendix 22B), outlines a basic level of emergency operation hierarchy and a list of contact information for emergency personnel.

17.1 ACCIDENTS AND MALFUNCTIONS METHODOLOGY

The proponent, in Section 21.4, examined the various components of the project and identified the following seven general scenarios that could present hazards to Valued Components:

- embankment failures;
- slope failures;
- spills or leaks;
- transportation accidents;

- water conveyance and storage system failures;
- fires and explosions; and
- failure of erosion and sediment control measures.

The proponent then identified which of the above scenarios had potential to interact with the various VCs, and the level of any such interaction.

The project was broken down into 13 broad components or activities (e.g. mining, heap leach facility, hazardous material storage). In each case, specific types of potential accidents or malfunctions were identified, and the hazards they presented were qualitatively described.

The likelihood of each identified potential accident or malfunction was then given one of four possible qualitative ratings (likely, possible, rare and unlikely) and the potential severity of the consequences of each potential accident or malfunction was in turn given one of four possible qualitative ratings (high, moderate, low, very low).

Risk, which is technically the product of a measure of the likelihood of a given negative event and a measure of its consequences was also rated qualitatively. Four qualitative risk ratings (high, moderate, low and non-actionable) were assigned to each identified potential accident or malfunction. Only risks classified as being high (i.e. a likely or possible event with high consequences; a likely event with moderate consequences) were deemed to warrant a risk rating of 'significant'. No situations of this nature were identified in the proponent's qualitative risk assessment.

Appendix 21B (Accident and Malfunction Register) of the proposal provides the detailed results of the risk assessment. In three instances (fire/explosion resulting from an aviation accident; fire/explosion resulting from accumulation of gas in confined space in the LNG facility; fire/explosion resulting from a transportation accident), the Risk Register includes 'health' as one of several affected VCs, even though the proponent previously rejected 'worker and public health safety' as VC.

The Executive Committee and its advisors view the proponent's failure to discuss and systematically address accidents and malfunctions in the context of either worker health and safety or public health and safety as a deficiency. Therefore, please provide the following:

R417. A revision of the section on accidents and malfunctions to address worker and public health and safety.

17.2 GENERAL EMERGENCY

The Project is located in a remote area with limited access. The distance from emergency services in terms of travel time is considerable. With upwards of 1 000 workers on-site, numerous industrial facilities, and dangerous environments, careful consideration of emergency capacity is required at the Project site. It is clear that there a significant emergency will require support from the surrounding communities, how this support will be coordinated and utilized is unclear. It is also unclear what effects this may have on emergency service providers themselves. These deficiencies are underscored in Morrison Herschfield's review of the proposal (YOR 2014-0002-237-1).

The Executive Committee requires more information on emergency response in regard to the Project. Therefore, please provide the following:

R418. Clarification of the procedures that will be established in the event of a Level II Emergency Event, as defined in the conceptual Emergency Response Plan, and how these procedures rely on existing infrastructure and services.

R419. For accidents on the Freegold Road, a description of how emergency services will be coordinated, and where these services will come from.

R420. A description of any discussions between CMC and protective and emergency services regarding increases in traffic and therefore and increase in accidents on the Freegold Road, Alaska Highway or Klondike Highway?

R421. Details regarding on-site personnel, equipment, and services that are provided based on anticipated requirements.

17.2.1 Evacuation

There is one vehicular access route and up to 1 000 personnel on-site during construction and up to 800 during operation. There exists a potential situation where site evacuation may be necessary; this will provide a logistic challenge that changes with the seasons. The Executive Committee requires more information pertaining evacuation scenarios at the Project site. Therefore, please provide the following:

R422. Describe and outline how would the mine site be evacuated in different seasons. Details should include:

a. length of time an evacuation would require; and

b. logistics for transportation;

17.3 FIRE

17.3.1 Mine Infrastructure and Fire

The proposal's Emergency Response Plan (Appendix 22b) indicates that the minimum water supply that will be available for firefighting is 682 m^3. The proposal states this is enough water for two hours in a severe fire. The rationale for this as the minimum water quantity required is unclear. The proposal lacks information regarding firefighting infrastructure and the sourcing of off-site emergency firefighting capacity. The presence of explosive magazines, LNG facilities, and a myriad of other infrastructure and hazardous materials require a greater level of detail in regards to emergency response in case of fire. Therefore, please provide the following:

R423. The rationale for two hours, or 682 m^3, as the minimum capacity for water storage for on-site firefighting capacity.

R424. Confirmation of where off-site emergency fire services for the Project will come from.

R425. A description of the human element in fire suppression and equipment available including:

a. the level of training will be available to workers in fire suppression;

b. a description of firefighting infrastructure will be on-site; and

c. a description of any equipment available for first responders.

R426. An elaboration on the need or absence of need for non-water jet firefighting methods.

R427. Description of the consideration of fire at the cyanide, LNG, or explosives facilities.

R428. A description of any plans to train and familiarize first responders with the Project and associated hazards, infrastructure, and layout.

17.3.2 Wildfire

The proposal's Emergency Response Plan (Appendix 22B) indicates that the minimum water supply that will be available for firefighting is 682 cubic meters. This is enough water for two hours in a severe fire. The proposal also indicates that wildfires will not cause the Project's critical components and activities to shut down for more than 24 hours (Section 20.3.4.4). It is unclear why the Proponent feels that wildfire is seen as an implausible threat to the near uninterrupted operation of the Project. The Executive Committee requires rationale regarding these positions as they relate to potential reliance on emergency services. Therefore, please provide the following:

R429. Rationale for the statement in Section 20.3.4.4 that wildfire will not cause a shutdown of the mine for more than 24 hours.

R430. Implications to the Project if a wildfire results in a mine shutdown, or access road closure, for more than 24 hours.

17.4 MEDICAL AND HEALTH

The proposal provides little information on medical facilities, infrastructure, and capacity in the event of a medical emergency. With an industrial workforce upwards of 1 000 individuals, the proposal requires more information on how CMC plans to handle inevitable medical emergencies. As indicated in the Proposal and noted above, medical facilities in Carmacks and Pelly Crossing are limited and, according to the proposal, understaffed and under resources for current needs. The socio-economic report notes that the health centre in Carmacks is also the most likely destination for medical emergencies at the Minto Mine site. The Executive Committee requires more information on the provision of medical services. Therefore, please provide the following:

R431. A description of any medical infrastructure that will be in place on-site regarding medical emergencies, and the depth of nursing, pharmaceutical, and first aid services that CMC forecasts as being available on-site.

R432. Details on the capacity to provide medical treatment planned in event of a potential delay to emergency response. Please describe this in terms of both the ability to provide emergency medical care for multiple casualties concurrently as well as in terms of overall duration and level of care.

R433. Considering the remote nature of the Freegold Road, a description of medical and communication capacity along the Freegold Road and its extension including the need or absence of need for any helipads.

R434. A description of how a destination medical facility will be chosen and the threshold for medevac.

R435. Details of a Human Health Monitoring Plan.

17.5 DANGEROUS GOODS, SPILLS AND LEAKS

Section 22 of the proposal outlines conceptual environmental plans. The spill management plan is outlined in 22.3.4. The spill management plan, like the waste management plan, is only outlined however. The section outlines that the "Spill Contingency Management Plan will provide specific guidance for the prevention, response, reporting, and remediation of spills for the Casino Project." The section acknowledges the potential for spills involving the TMF, diesel, LNG, heap leach constituents, and other liquids. The Executive Committee requires more information regarding spills and their potential effects. Therefore, please provide the following:

R436. Any description of spill infrastructure along public highways or the Freegold Road upgrade and extension.

17.5.1 Flotation and Heap Leach Constituents

The proposal lists which chemicals are anticipated for use in the flotation and heap leach circuits in table 4.3-4, but not what the rates of use or storage capacity will be for these chemicals. Given the volume of ore processing anticipated, these volumes may be considerably large. The Executive Committee requires more information on the expected or anticipated use of materials and chemicals within the heap leach and flotation processes. Therefore, please provide the following:

R437. A complete list of floatation circuit and heap leach chemicals with their anticipated on-site storage capacities and rates of use.

17.5.2 Materials Management Plans

Section 22 of the proposal outlines, at a very broad and conceptual level, the nature of management plans that the proponent will develop. LNG is mentioned only once in passing is the entire section (in the subsection entitled 'Spill Contingency Management Plan' where it is included in a list of hazardous materials). Spills of LNG are not explicitly addressed, nor are the unique safety hazards associated with LNG acknowledged in any way.

Cyanide, in appendix 22b, is the subject of a conceptual management plan; however, the plan lacks details especially in regards to transportation and spills. The conceptual management plan states "sodium cyanide containers will be offloaded to concrete pads with concrete curbing that provide a minimum of 110% containment of the largest sized container." However, this section provides no detail on the amount of cyanide that will be used, transported, and stored on site. More details are required in order to properly assess potential impacts.

Explosives, and their safety concerns, are mentioned briefly in the objectives of the Hazardous Materials Management Plan. For LNG, no details are specified. This low level of detail tends to underplay the potential challenges that the operation will have in managing hazardous materials such as explosives, cyanide on site.

The Executive Committee requires detailed management plans for a range of hazardous materials to be used on-site. Management plans for hazardous goods should include:

- applicable regulations and standards;
- coordination with federal, First Nation, territorial, and municipal governments; police; and emergency services;
- volumes to be stored on-site and rates of use;
- evaluation of transportation route, including community involvement;
- storage and security during shipment;
- interim loading, storage, and unloading during shipment;
- safety and maintenance of the means of transportation throughout transport;
- transport to the Project;
- task and safety training for transporters and handlers throughout transport; and
- security and emergency response throughout transport both along transportation routes and at the Project site.

The Executive Committee requires more information on management of hazardous goods. Therefore, please provide the following:

R438. A detailed Cyanide Transportation Management Plan. Details should be Yukon-focused, and in particular the Freegold Road to the Project site.

R439. Clarification regarding handling, storage, and use of cyanide at the Project site. Details should include:

a. description of unloading process and area for solid sodium cyanide (NaCN);

b. details on storage of solid NaCN in bulk bags;

c. the process for moving: the solid NaCN from the unloading area to the storage area in the adsorption, desorption and recovery building; the solid NaCN from the storage area to the NaCN mix tank; and the NaCN from the mix tank to the liquid NaCN storage tank;

d. use of level indicators and high-level alarms for the liquid NaCN mix and storage tanks;

e. ventilation requirements for the solid NaCN in the cyanide storage area within the adsorption, desorption and recovery building; and

f. ambient air monitoring requirements within the solid NaCN storage area, liquid NaCN mixing area and liquid NaCN storage area to protect workers.

R440. A detailed management plan for LNG.

R441. A detailed management plan for explosives and its constituents.

R442. An assessment of risk for the transportation of LNG, cyanide, ammonium nitrate, and other hazardous materials with focus on sensitive areas such as major bridge and culvert crossings.

R443. A more detailed description of what will be included in the Emergency Response Plan for emergencies related to cyanide. Details should include:

a. potential cyanide failure scenarios appropriate for the site-specific environmental and operating circumstances;

b. specific response actions such as clearing site personnel and advising potentially-affected communities;

c. use of cyanide antidotes and first aid measures for cyanide exposure; and

d. control of releases at their source and containment, assessment, mitigation and future prevention of releases.

17.6 HUMAN HEALTH RISK ASSESSMENT

For a Project of this scale, it is expected that the Proponent complete a Human Health Risk Assessment (HHRA). A HHRA identifies hazardous materials present on-site, evaluates toxicity, finds and assesses pathways, and characterizes risk to human health. An HHRA in relation to this project should include an analysis of effects resulting from the consumption of wildlife, fish, and traditional food.

A qualitative approach to addressing the significance of risks to human health and safety is not appropriate in cases that require societal value judgments on what constitutes an acceptable risk to human life. The Executive Committee therefore expects the evaluation of such risks to be based to the greatest extent possible on quantitative assessment of risk, which is amenable to examination by the Executive Committee, government agencies, outside experts and the general public.

The Executive Committee requires the following information to assess Project effects to human health; therefore, please provide the following:

R444. A comprehensive Human Health Risk Assessment for each stage of the Project.

R445. Add a valued component and assessment for worker health and safety to the Project proposal.

17.7 EMERGENCY SERVICES AND OTHER USERS

The Socio-economic Baseline Report states that the medical infrastructure in Carmacks is under-staffed and incapable of handling increases in demand. It also states that Minto Mine is most likely to utilize this community's medical facilities before others. Given that emergencies on the Freegold Road will likely be referred to Carmacks and non-life threatening injuries on-site requiring immediate medical attention may rely on Carmacks as well, consideration must be given to the community's ability to handle such emergencies. The Executive Committee requires additional information to ensure there is enough capacity in the community of Carmacks to handle emergencies arising from the Project. Therefore, please provide the following information:

R446. Describe how emergency and non-emergency services in Carmacks were factored into Project plans and design. Consideration should be given to health, law enforcement, conservation, and other government services.

18.0 ACCIDENTS AND MALFUNCTIONS

There are several activities associated with the Project that may result in accidents or malfunctions and subsequent adverse effects to various values at the mine site and along the access routes. Section 21 of the proposal, Accidents and Malfunctions, states:

> The effects of accidents and malfunctions on employee health and safety or on the economics of the Project will be addressed as part of the Project health and safety program and in the operations management manual, respectively, and are not addressed in this section of the Proposal (p 21-2).

However, Section 22, Environmental Management Plans, and Appendix B of Section 22, Emergency Response Plan, do not adequately address potential adverse effects to health and safety from accidents and malfunctions related to mine infrastructure failures. These sections only provide general overviews of safety plans that will be required for the Project and there is little detail in terms of characterization of mine infrastructure failures. The Executive Committee requires additional information to better understand the nature and magnitude of accidents and malfunctions associated with mine infrastructure failures and the proponent's planned responses for such failures. Therefore, please provide the following information:

R447. A detailed characterization of potential major mine infrastructure failures and proposed response measures to these events.

Section 21, Accidents and Malfunctions, provides general analyses for embankment failures associated with various mine components. For example, there is a general discussion regarding the

likelihood and consequence of a TMF embankment failure. However, there is uncertainty in the confidence for the Proponent's predictions. A likelihood of failure rating of 'unlikely' is based on the embankment's design considering the "site specific geotechnical, hydrogeological, hydrometeorological, and seismic information" (YOR 2014-0002-014-1) but, as noted in other sections of this Adequacy Review Report, more information is required to increase confidence in the characterization of site conditions. Similarly, there is uncertainty in the Proponent's rating of consequence of a TMF embankment failure as 'high.' Without a dam-break and inundation analysis, it is impractical to accurately assess potential consequences of an embankment failure. The Executive Committee requires additional information to better understand the potential for TMF embankment failure, considering the TMF will remain on-site in perpetuity. Therefore, please provide the following information:

R448. An updated discussion regarding the likelihood and consequence of a TMF embankment failure considering the entire lifetime of the facility (i.e. in perpetuity) in light of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.

Section 21 - Accidents and Malfunctions also states:

> The Project Emergency Response Plan (Appendix 22B) will outline the containment and cleanup measures to be implemented in the unlikely event of any TMF embankment failure, methods for the disposal of contaminants and debris, and post-incident evaluations (p 21-20).

However, Appendix 22B does not include any details in relation to the containment and cleanup measures beyond noting, "[t]he Mine Infrastructure Failure Response Plan will provide details on the designs, operations, and response procedures should an incident involving any Project infrastructure (e.g. TSF embankments, stockpiles) occur" (YOR 2014-0002-009-1). The TMF will be sized to store approximately 956 million tonnes of tailings and up to 658 million tonnes of potentially reactive waste rock. In addition to this waste material, the TMF will retain a massive amount of water with an approximate ponded area of 11 km^2. An embankment failure would result in a catastrophic release of both contaminated water and liquefied tailings; however, it is difficult to assess the effectiveness of failure response measures without understanding the potential magnitude and effects of a TMF embankment failure. The Executive Committee requires additional details pertaining to the response measures after a mine infrastructure failure to understand potential effects to downstream VESECs. Therefore, please provide the following information:

R449. A Mine Infrastructure Failure Response Plan that includes consideration of updated site condition characterization and dam break/inundation analysis as outlined in other sections of the Adequacy Review Report.

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