

Adequacy Review Report Information Request No. 2

Project Assessment 2014-0002

Casino Mining Corporation Casino Mine



May 15, 2015

Prepared by

Executive Committee

Yukon Environmental and Socio-economic Assessment Board

THIS PAGE IS INTENTIONALLY LEFT BLANK AS THE BACK PAGE TO THE COVER PAGE.

Table of Contents

1.0 INTRODUCTION	1
1.1 Acknowledgements	1
1.2 Scope of Adequacy Review	4
1.3 Summary of Adequacy Review	4
1.3.1 Access Road	5
1.3.2 Traditional Land Use	5
1.3.3 Closure and Reclamation	6
1.3.4 Tailings Management Facility	7
2.0 PROJECT DESCRIPTION	9
2.1 Oversight of Design, Construction, Operation, and Closure	9
2.1.1 Independent Geotechnical Review Panel	9
2.1.2 Change Management and Technical Review Procedures	11
2.2 Alternatives	12
2.2.1 Tailings Management Facility	12
2.2.2 Risk Assessment	15
2.3 Feasibility of the Sulphides Removal Process	18
2.4 Roads, Supply Routes and Transportation	18
2.4.1 Freegold Road Extension and Upgrade	18
2.4.2 Existing Highways	20
2.5 Water Management Plan	22
2.5.1 Conveyance of Water	22
2.5.2 Probability of Failure Analysis of Infrastructure Components	24
2.6 Heap Leach Facility	25
2.6.1 Liners	25
2.6.2 Leak Detection and Recovery	25
2.6.3 Leachate Solution and Water Flows	26
2.6.4 Ore Stacking Rate	27
2.7 Tailings Management Facility	27
2.7.1 Design Methodology and Feasibility	27
2.7.2 TMF Dam Failure	35
2.7.3 Quantity and Quality of Borrow Source Materials	37
2.7.4 Earthquakes	38
2.7.5 Flood Modeling	40
2.7.6 Spillways	41

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

2.7.7 HLF Failure	43
2.7.8 TMF Dam Core and Downstream Filter	43
2.7.9 Use of Cyclone Sand in Embankments	45
2.7.10 Faults and Shear Zones	47
2.7.11 Hydraulic Conductivity of Bedrock and Overburden	48
2.7.12 Presence of Frost-Susceptible or Frozen Materials During Construction.....	49
2.7.13 Cold Weather Construction of the TMF Dam.....	51
2.7.14 Surface Preparation	53
2.7.15 TMF Dam Core Construction	55
2.7.16 Starter Dam and Tailings Interface	56
2.8 Liquefied Natural Gas and Diesel	56
2.8.1 Description of LNG Facilities.....	56
2.8.2 Description of Diesel Facilities	57
2.9 Conceptual Closure and Reclamation Plan	57
2.9.1 Long-Term Closure and Ongoing Monitoring and Maintenance.....	57
2.9.2 Design and Operation of Wetland Water Treatment System	59
2.9.3 Open Pit Stability.....	63
2.9.4 HLF Closure and Cyanide.....	63
2.9.5 HLF and Cover Material	64
2.9.6 TMF Winter Seepage Mitigation Pond.....	64
2.9.7 Temporary or Early Closure	65
2.9.8 Mine Reclamation and Security	66
2.10 Waste Management.....	68
3.0 TERRAIN FEATURES	68
3.1 Permafrost	68
3.2 Thermal Erosion Modeling	69
3.3 Ground thermal condition and permafrost temperature monitoring.....	70
3.4 Surficial geology and terrain mapping method and maps	71
3.5 Terrain Hazards Assessment	72
4.0 WATER QUALITY AND QUANTITY	74
4.1 Water and Sediment Quality Baseline	74
4.1.1 Water Quality	74
4.2 Hydrology Baseline	74
4.3 Geochemistry and Source Term Predictions	75
4.3.1 Geochemical Characterization of Ore, Waste Rock and Tailings.....	75
4.3.2 Geochemical Characterization of Borrow Sources and Access Road.....	77

4.4 Numerical Groundwater Model.....	79
4.5 Transparency of Water Quality Predictions.....	81
4.6 Metal Mining Effluent Regulations.....	81
4.7 Submersion of PAG materials.....	82
5.0 CLIMATE CHANGE REPORT	82
6.0 AIR QUALITY	83
6.1 Air Quality Modeling	83
6.1.1 Model Inputs	83
6.1.2 Mitigations.....	84
6.2 Dust and Dustfall	84
7.0 FISH AND AQUATIC RESOURCES	85
7.1 Fisheries Act – Fisheries Protection Provisions	85
7.2 Charge Weights.....	85
7.3 Baseline Data	86
7.3.1 Missing Appendices Documenting Baseline Data.....	87
7.4 Physical Habitat Simulation Model and Habitat Evaluation Procedure.....	88
7.5 Watercourse Crossings	89
7.5.1 Embedded Culverts on Fish Bearing Streams	89
7.5.2 Existing Stream Crossings	89
7.5.3 Nordenskiold River Bridge.....	89
7.5.4 Classification of Crossings	90
8.0 RARE PLANTS AND VEGETATION HEALTH	91
9.0 WILDLIFE	92
9.1 Freegold Road and other Access Roads	92
9.1.1 Population Dynamics.....	92
9.1.2 Wildlife Crossing Areas	93
9.1.3 Road Management.....	94
9.2 Effects Assessment for Mammals	95
9.2.1 Caribou	95
9.2.2 Moose	97
9.2.3 Grizzly Bear	98
9.2.4 Collared Pika	100
9.2.5 Wolverine.....	100
9.2.6 Little Brown Myotis	101
9.2.7 Dall Sheep	101
9.3 Effects Assessment for Birds	102
9.3.1 Species of Concern and Baseline data	102

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

9.3.2 Disturbance, Mitigations and Monitoring.....	103
9.3.3 Waterfowl – Presence of Wetlands.....	103
9.3.4 Mine Infrastructure and Birds.....	104
9.4 Wildlife Mitigation and Monitoring Plan.....	105
10.0 ECONOMY.....	106
10.1 Boom and Bust Cycles.....	106
11.0 EMPLOYABILITY AND EMPLOYMENT.....	106
11.1 Affected Communities' Access	106
11.2 Employment and Migration	106
11.3 Fly In-Fly Out and Shift Structure	107
12.0 COMMUNITY VITALITY AND WELLBEING	107
13.0 HERITAGE MANAGEMENT PLAN	109
14.0 LAND USE.....	109
14.1 Traditional Knowledge and Traditional Land Use.....	109
14.2 Fisheries	110
14.3 Harvesting of Plants.....	111
14.4 Harvesting of Animals.....	111
14.5 Trapping and Outfitting	112
14.6 Quartz and Placer Claim Holders	112
14.7 Other Land Users.....	112
15.0 NOISE.....	113
16.0 EMERGENCIES AND HUMAN HEALTH	114
16.1 Evacuation	114
16.2 Fire.....	114
16.3 Dangerous Goods, Spills and Leaks	115
16.4 Human Health Risks	115
16.5 Emergency Services.....	116
17.0 ACCIDENTS AND MALFUNCTIONS	117
APPENDIX A BIBLIOGRAPHY	119

List of Figures

Figure 1: Figure 1: 24 hour PMP contour lines for Alaska (taken from Figure 2-12 of TP-47, Weather Bureau, 1963)	23
---	----

List of Tables

Table 1: Input received from external parties	2
Table 2: Consultants retained by the Executive Committee.....	3

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
CSP2	Center for Science in Public Participation
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

km ²	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
m ²	square metres
m ³	cubic metres
MDE	maximum design earthquake
MEND	Mine Environment Neutral Drainage Program
mg	milligram
ML	metal leaching
mm	millimetre
Mm ³	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	<i>Species at Risk Act</i>
SART	sulphidization, acidification, recycling and thickening
SFN	Selkirk First Nation
SSE	safe shutdown earthquake
SSWQO	site specific water quality objectives
SUP	supergene

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

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	<i>Yukon Environmental and Socio-economic Assessment Act</i>
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 Supplementary Information Report (SIR) submitted by Casino Mining Corporation (CMC) on March 16, 2015. The information provided in the SIR, submitted in response to the YESAB Adequacy Review Report of January 27, 2015, forms part of the proposal for the “Casino Mine”. The Executive Committee has determined that the information contained in the proposal and SIR is insufficient to deem the proposal adequate. This Adequacy Information Report specifies the 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 for this project, by telephone at 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 in relation to the supplementary information submitted by CMC from various First Nations, Decision Bodies, and regulators including:

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

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Table 1 lists input the Executive Committee received from parties in relation to the supplementary information submitted by CMC. 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 #
Tr'ondëk Hwëch'in	TH Adequacy Comment Submission - 2015-03-24	2014-0002-386-1
Fisheries and Oceans Canada	DFO Comments on Supplementary Information Request - 2015-04-17	2014-0002-389-1
Little Salmon/Carmacks First Nation	Little Salmon Carmacks First Nation (LSCFN) Comment Submission - 2015-04-22	2014-0002-390-1
Environment Canada	Environment Canada (EC) Comment Submission - 2015-04-24	2014-0002-391-1
Natural Resources Canada	NRCan Comment Submission - with revisions - 2015-04-24	2014-0002-392-2
Selkirk First Nation	Selkirk First Nation (SFN) Comment Submission - 2015-04-24	2014-0002-393-1
Carcross/Tagish First Nation	Carcross/Tagish First Nation (CTFN) Letter to YESAB - 2015-04-24	2014-0002-394-1
Government of Yukon	Government of Yukon Comment Submission - 2015-04-24	2014-0002-395-1
Tr'ondëk Hwëch'in	Tr'ondëk Hwëch'in (TH) Comment Submission #2 - 2015-04-24	2014-0002-397-1
White River First Nation	White River First Nation (WRFN) Comment Submission - 2015-04-24	2014-0002-398-1

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

Consultants were requested to review relevant sections and appendices of the SIR and 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	2014-0002-399-1
Wildlife and Wildlife Habitat	SLR Consulting (Canada) Ltd.	2014-0002-400-1
Socio-economic Considerations	Morrison Hershfield Limited	2014-0002-401-1
Use of Liquefied Natural Gas and Air Quality	ARCADIS Canada Inc.*	2014-0002-402-1
Mine Site and Access Road Geohazards	SNC-Lavalin Inc.	2014-0002-403-1

Notes:

*SENEC Canada changed their name to ARCADIS Canada Inc. The consultant team retained by the Executive Committee to review the use of liquefied natural gas remains the same.

The Executive Committee retained two experts to aid in drafting of this Adequacy Review Report.

Dr. Norbert Morgenstern provided expert opinion to the Executive Committee and assessment team in areas related to tailings and waste rock storage and management. His expert opinion was considered by the Executive Committee in the review of the proposal and supplementary information

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

report as well as in preparing this information Adequacy Review Report. His advice has been provided in YOR 2014-0002-404-1.

Robert McLean, Artifex Engineering Hydrology Inc., provided support in drafting and review of comments in relation to water quality and quantity. His work was provided as draft sections of this report which was considered and edited by the Executive Committee in preparing this Adequacy Review Report.

1.2 SCOPE OF ADEQUACY REVIEW

During the review of the SIR, many concerns were raised from a wide range of sources as listed above in Tables 1 and 2. The concerns and issues raised by consultants and experts retained by the Executive Committee, external parties invited to comment, and others who submitted comments, were considered in preparing this Adequacy Review Report. However, not all concerns and issues resulted in requests for additional information.

This Adequacy Review Report 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 review of the SIR that do not meet the above objectives are generally not put forward to the Proponent in this information request. This does not mean that those concerns will not be addressed in the screening process, if appropriate.

In numerous sections of the SIR, CMC states that certain project activities and components do not require more detailed descriptions or supporting information until the regulatory phase of the Project. The Executive Committee disagrees with this assertion in many instances. In the Executive Committee's opinion, these matters must be considered at the assessment stage in order to fulfill our mandate as well as the proponent's obligations under the Act. The Executive Committee will continue to request the information necessary for us to prepare a statement of scope as well as to conduct a comprehensive assessment. The determination of adequacy of a proposal is made by the Executive Committee once it has received sufficient information to meet the requirements in the Act and in the rules. Until a determination is made, the Executive Committee may request any information necessary to meet its requirements.

The following sections of this Adequacy Review Report specify the supplementary information that is required.

1.3 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 Nordenskiöld River will be constructed.

The Executive Committee issued an Adequacy Review Report and first information request to CMC on January 27, 2015. This report contained 449 specific requests related to various aspects of the Project. CMC provided supplementary information in a SIR on March 16, 2015. We have determined that the information contained in the proposal and SIR is insufficient to deem the proposal adequate. 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 130 pages in length and contains 224 specific requests.

The main concerns remain the same and are related to the lack of information on: the access road to the Project; traditional land use; closure and reclamation; and the tailings management facility and associated dam. In addition, there is a lack of socio-economic baseline information to inform the Project as a whole. These information gaps are summarized further in the following sections.

1.3.1 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, particularly late-winter, habitat for the Klaza caribou herd.

The Executive Committee previously requested a wide range of information regarding the road, its design, construction, management, and effects. The Proponent did not provide the requested information on activities related to the upgrade of the existing Freegold Road.

1.3.2 Traditional Land Use

The Executive Committee requires additional information on traditional land use including traditional knowledge. Comments from First Nations and consultants retained by the Executive Committee highlighted the need for further study of this topic to assess effects of the Project. An effects assessment and the subsequent monitoring and mitigation of effects, as proposed by the Proponent, is not possible without adequate baseline data; this has not been provided by CMC in the SIR.

The Executive Committee has re-iterated the request for a traditional land use study that is informed by traditional knowledge, and asked for a description of effects to those traditional uses as a result of project activities, including downstream effects in the event of accidents or failures of project infrastructure.

1.3.3 Closure and Reclamation

The Executive Committee does not yet have the information necessary to begin its assessment of the closure and reclamation activities. The design of the wetland treatment system provided by CMC is conceptual in nature. We understand that the development of a wetland treatment system for mine closure requires a phased approach, which includes aspects such as pilot scale tests on-site during operations. However, a certain level of information and detail is required in order to understand the implications of its effectiveness. This is critical to understanding potential effects to a wide range of values. If the wetland treatment system does not function as anticipated, it has the potential to result in significant adverse effects. The Executive Committee requires information in relation to: long-term closure and ongoing monitoring and maintenance; design and operation of wetland water treatment system; temporary or early closure; and mine reclamation and security.

We are not confident that the proposed wetland treatment system will achieve water treatment objectives. There are no examples of successful, full-scale wetland treatment systems used to treat similar high flows under cold climate conditions. We have requested that CMC conduct further analysis on closure options.

While CMC outlines a phased approach to design, it has not provided performance levels or clear objectives to measure performance. In addition, CMC has only conducted preliminary testing to inform the design. Given the importance of the wetland treatment system for closure, the Executive Committee expects to see more detailed and project specific testing at this time. There is also significant concern regarding the lack of details and consideration of alternative or contingency measures that may be required in the event of temporary or early closure or if the wetland treatment system does not function as designed. We have requested that CMC provide details on performance levels and clear objectives to measure performance as well as contingency, alternative, or additional treatment options available to treat water.

There is considerable concern with security cost estimates provided by CMC in relation to closure requirements. Estimates provided to date are general in nature and do not seem to account for all phases of the Project. Comments received suggest that cost estimates may not be reflective of actual costs for aspects such as long-term monitoring and maintenance. For example, Government of Yukon, Energy Mines and Resources suggests:

CMC should provide detail on the care and maintenance costs in perpetuity – this estimate should be supported by a conceptual operations, maintenance, and surveillance manual for the TMF which documents the ongoing care and maintenance requirements during the closure and post-closure period. Costing should be presented as a net present value calculation using current bank interest rates for at least a 200 year period into the future, and should include periodic

maintenance and repair costs as well as monitoring costs.
(YOR 2014-0002-395-1, p 27)

We have requested CMC provide additional justification and discussion on security estimates as well as updated estimates based on Government of Yukon updated guidance.

1.3.4 Tailings Management Facility

The Executive Committee does not yet have the information necessary to begin its assessment of the Tailings Management Facility (TMF). In developing this report, the Executive Committee obtained the expert advisory services of Dr. Morgenstern. In his review of matters related to the TMF, Dr. Morgenstern stated the following:

I have reviewed the material sent to me and I am favourably impressed by the breadth of your consultation in formulating the next round of SIR's [supplementary information requests]. While I do not necessarily agree with all of the comments that have been summarized, the differences are not material with respect to your objectives of framing a comprehensive assessment process. (YOR 2014-0002-404-1)

A number of technical experts have informed the Executive Committee that the design of the TMF dam is beyond the state of practice due to its scale, the potential for permafrost degradation, the QA/QC challenges of constructing in a northern environment, and the lack of any comparable mine sites of similar scale and context. As such, the Executive Committee is of the opinion that a dam of this scale and type, built in a northern context and intended to exist in perpetuity, has the potential to result in significant adverse effects.

The Executive Committee requires information in relation to: CMC's alternatives analysis; a risk assessment and related dam breach and inundation study; the dam hazard classification; the ability of the TMF dam to transition from active to passive care; and, details for the establishment of an independent geotechnical review panel (IGRP).

Section 50 of YESAA requires CMC to consider alternatives to, and alternative ways of undertaking, a project that would avoid or minimize any significant adverse effects. A comprehensive alternatives analysis has not been completed; the analysis provided does not consider the full life-cycle of this infrastructure (i.e. in perpetuity). The Executive Committee, therefore, requires a more comprehensive and robust alternatives analysis than the one completed to date.

In addition, CMC did not complete a risk assessment to understand probable modes of failure and their associated likelihood and consequence; nor did CMC complete a dam breach and inundation study as requested in the previous Adequacy Review Report. The Proponent has expressed uncertainty in how to proceed with a dam breach and inundation study; determining credible modes of failure is a complex and difficult task.

The risk assessment and dam breach and inundation study are critical for determining possible adverse effects and their significance, which in turn informs whether mitigations and/or alternatives to the proposed TMF are required. A risk assessment and dam breach and inundation study should also inform the dam hazard classification. At present, the Proponent has classified the dam hazard as "high". The validity of this classification is debateable given that the underlying risk assessment, and

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

related dam breach and inundation study that should inform this classification, have not been completed. A properly informed hazard classification is critical as it in turn, informs the design of the TMF. The Executive Committee, therefore, requires a risk assessment and a dam breach and inundation study in order to be able to assess any potential adverse effects of the TMF dam.

CMC states the TMF dam, which utilizes a wet cover for the management of tailings and waste rock, can successfully transition into passive care throughout the post-closure phase of the Project (i.e. in perpetuity). The CDA guidelines call this assertion into question. The Executive Committee believes that CMC has not given adequate consideration to the potential significant adverse effects throughout post-closure. The Executive Committee requires information to demonstrate how the TMF dam will be able to achieve a steady state condition for passive care during the post-closure of the Project.

CMC has committed to establishing an IGRP to “provide independent, expert oversight, opinion and advice to CMC on the design, construction, operational management and ultimate closure of the TMF and HLF.” The Executive Committee acknowledges this important commitment and is of the opinion that the IGRP must be established during the adequacy phase to provide oversight on:

- alternatives assessment for tailings and waste rock management;
- risk assessment for the chosen method for tailings and waste rock management;
- design of tailings and waste rock management infrastructure;
- change management framework;
- technical review framework;
- hazard classification and rationale for the proposed TMF dam; and
- dam breach/inundation study.

There is broad support for the early establishment of the IGRP as noted in comments by: Selkirk First Nation (Northland Earth and Water Consulting Inc.), Little Salmon/Carmacks First Nation (BGC Inc.), Tr’ondëk Hwëch’in First Nation (CSP2). Further, Dr. Morgenstern states the following:

The CMC response is as expected. However you are requiring the IGRP to be in place now and providing input to the process. This is a significant change in precautionary procedures and will likely result in a major delay in the assessment process. In my view, the presence of an IGRP and a risk assessment at this stage are appropriate for defending the selection of the TMF embankment, given the issues involved and limited precedence. (YOR 2014-0002-404-1)

In order for the Executive Committee to commence the screening of the Project, the Executive Committee requires information in relation to: CMC’s alternatives analysis, a risk assessment and related dam breach and inundation study, the dam hazard classification, the ability of the TMF dam to transition from active to passive care, and details for the establishment of an IGRP that would provide oversight on these matters prior to screening.

2.0 PROJECT DESCRIPTION

The Executive Committee emphasizes that CMC's response to questions in s.2.1 and 2.2 may have implications on, and inform responses to, questions in sub-sections throughout this Adequacy Review Report. It is critical for CMC to address the questions in s.2.1 and 2.2 prior to responding to the remaining questions, where applicable.

2.1 OVERSIGHT OF DESIGN, CONSTRUCTION, OPERATION, AND CLOSURE

2.1.1 Independent Geotechnical Review Panel

The Executive Committee does not yet have the information necessary to begin its assessment of the TMF. A number of technical experts have informed the Executive Committee that the design of the TMF dam is beyond the state of practice due to its scale, the potential for permafrost degradation, the QA/QC challenges of constructing in a northern environment, and the lack of any comparable mine sites of similar scale and context.

BGC stated that the proposed TMF dam is “beyond the state of practice” (YOR 2014-0002-274-1). Similarly, Dr. Morgenstern states that “What makes this beyond the current state of practice in my view is the degrading permafrost environment, the wet closure (ARD issues), and the likelihood of a complex construction process” (YOR 2014-0002-404-1).

CMC has not been able to demonstrate that there are comparable mine sites existing today that are at this scale in a northern environment. There are currently five mine sites that propose larger TMF dams with similar design (i.e. cyclone sand); however, the Executive Committee emphasises that these sites are ‘yet to be constructed or are under construction’ and are ‘not located in a northern environment.’ As a result, there is no historical basis to demonstrate that dams of this scale have been built in a northern environment – the design exists in a vacuum of practice and experience.

R4 from the ARR of January 27, 2015 sought additional details regarding the proposed oversight of the design, construction, operation, and closure of mine components. The Executive Committee requested that CMC “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.”

CMC's response to R4 of the ARR includes a commitment to:

voluntarily establish an Independent Geotechnical Review Panel (IGRP) for the Casino Project to review and consider the Project's TMF and Heap Leach Facility (HLF) with a focus on their structural stability and integrity. The IGRP will provide independent, expert oversight, opinion and advice to CMC on the design, construction, operational management and ultimate closure of the TMF and HLF. The IGRP will have unimpeded access to all technical data necessary to enable them to assess CMC's TMF and HLF on an ongoing basis to ensure that these structures meet internationally accepted standards and practices which effectively minimize risks to employees, lands and communities. (YOR 2014-0002-297-1)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The establishment of an IGRP is in line with best applicable practices (BAP) as identified in the *Report on Mount Polley Tailings Storage Facility Breach* (Mining Association of British Columbia, 2015) and the Executive Committee is encouraged by CMC's commitment.

The establishment of an IGRP also aligns with the recommendations of a number of participants. Little Salmon/Carmacks First Nation's (LSCFN) technical consultant, BGC Engineering Inc., notes that "Most dam projects of this size and status engage a review board of experienced tailings dam engineers at the feasibility stage to examine the design for critical components that may affect the technical and financial feasibility of the dam" (YOR 2014-0002-274-1). Comments from Northland Earth and Water indicate support for CMC's commitment to establish an IGRP; however, it also notes the value of having IGRP oversight at an early stage and suggests that:

this panel be required to provide a review of the current mine waste management proposals prior to the project moving into assessment. Not receiving the advice of this group prior to moving forward with assessment of the project is an inefficient and ineffective use of this type of oversight (YOR 2014-0002-393-1).

As stated by CSP2, on behalf of Tr'ondëk Hwëch'in First Nation:

In light of the Mt Polley dam failure, which happened before these comments were written, the statement above does not present a rational appreciation of the failure at Mt Polley, and the warning it sends for other tailings dams, present and future, in British Columbia. It is also of note that wording very similar to this statement was given by Knight-Piésold prior to the Mt Polley dam failure. In the interest of public safety, and contrary to the engineering hubris displayed by this statement, the recommendation of the Expert Panel at Mt Polley that: "The Panel firmly rejects any notion that business as usual can continue" should be more carefully considered. (YOR 2014-0002-397-1)

Dr. Morgenstern further emphasizes the value of an IGRP at this stage of the assessment in the following statement:

The CMC response is as expected. However you are requiring the IGRP to be in place now and providing input to the process. This is a significant change in precautionary procedures and will likely result in a major delay in the assessment process. In my view, the presence of an IGRP and a risk assessment at this stage are appropriate for defending the selection of the TMF embankment, given the issues involved and limited precedence. The RXXX [regarding risk assessment] should not imply that the risk assessment is highly quantified. Limitations to quantification should be recognized. (YOR 2014-0002-404-1)

The Executive Committee requests additional information in other sections of this report, which would benefit from the "independent, expert oversight, opinion and advice" of an IGRP, including the completion of a risk assessment for the proposed tailings dam at the feasibility design level to provide a better appreciation of risks. As EcoMetrix points out, "Leaving such a risk analysis to the detail design stage for this project as described, is not in the best interests of the proponent or other stakeholders" (YOR 2014-0002-399-1).

Given the commitment by the Proponent, the fact that the design of the TMF dam exists in a vacuum of practice and experience and the uncertainty expressed by the Proponent in how to proceed in relation to gathering certain information, the Executive Committee is of the opinion that the

establishment of the IGRP will allow the Proponent to provide the information necessary for the Executive Committee to commence the screening.

The Executive Committee requires information in relation to the proposed establishment of an independent geotechnical review panel. Therefore, please provide the following information:

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

The Proponent will provide outcomes from the IGRP's work prior to entering the screening process.

2.1.2 Change Management and Technical Review Procedures

The Executive Committee understands that the adequacy of the information for the Project, as proposed, is based on currently available data. However, CMC qualifies a number of responses by indicating that changes may be made during the permitting and detailed design phases, and during and after construction. For example, EcoMetrix notes that,

Additional drilling and characterization of the embankment foundation area will continue and the practical feasibility of the proposed TMF and construction planning will likely be revised based on the new information. We recognize that engineering details for the TMF will continue to be refined during the permitting and detail engineering phases, for this reason a Technical Review Procedure and a Change Management Procedure for the TMF and embankment areas (also applies to R88 and R89), as described in R4 and R6 should be considered. (YOR 2014-0002-399-1)

EcoMetrix highlights the need for strong external independent expert engineering review for managing potential changes made to mine infrastructure throughout design, constructions and operations and suggests the following:

The Project would benefit from a Change Management Procedure that would set a framework for managing changes, in particular, changes in currently proposed designs and plans leading up to the detailed design phase or later. A change

management procedure recognizes that aspects of the project may be modified or optimized during the detailed design phase or by the implementation of CMC's best practices. A change management procedure would define a process for making and approving changes to designs or operating plans, such as may occur when conditions encountered in the field during construction or operations differ from design assumptions. The purpose of this additional information will be to provide confidence that the conclusions of the Project screening will remain valid through the project detailed design, construction and operation stages. (YOR 2014-0002-399-1)

The Executive Committee requires additional information in relation to the change management and technical review procedures for the construction, operation and closure of the mine infrastructure.

Without this information, the Executive Committee is unable to enter the screening process.

Therefore, please provide the following information:

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

2.2 ALTERNATIVES

2.2.1 Tailings Management Facility

The Executive Committee requires a more robust and comprehensive alternatives analysis for the TMF. Section 42 of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) directs the Executive Committee to consider:

- (e) 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.

Section 50(2) of YESAA requires the Proponent to consider these same matters. However, the tailings/waste rock management alternatives assessment presented to-date does not provide the Executive Committee with sufficient information to consider Section 42 requirements in a meaningful way or evidence that the Proponent has given adequate consideration to these matters.

CMC's response to R1 refers to original information presented in Section 4.8.4.4 of the proposal as well as to information in the Tailings Management Facility Construction Material Alternatives report (Appendix A4.A). CMC provides a summary of its alternatives assessment and notes that the preferred option, slurry tailings deposition with a cyclone sand embankment, was chosen due to several considerations. These considerations include production rates that are beyond dry stack capacity, the geochemistry of pyrite tailings precludes encapsulation within a dry stack, and operational challenges associated with dry stack construction in a cold climate. Slurry tailings deposition is identified within the alternatives report as the most efficient and cost-effective option.

CMC's Tailings Management Facility Construction Material Alternatives report (Appendix A.4A) concludes "The findings of the comparative assessment indicate that the use of cyclone sand for embankment construction is the preferred option and provides the most efficient and cost effective design concept for the project's TMF."

In the Executive Committee's opinion, the alternatives analysis is not only too narrowly focussed, but is also not thoroughly completed – even in relation to the considerations that were addressed. CMC's alternatives analysis focusses primarily on economic considerations and does not consider the full lifecycle costs of the TMF dam (i.e. in perpetuity). CMC indicates that their alternatives assessment includes environmental considerations and includes a list of factors (Section 5.3). However, these considerations are minimal within the report; the information supporting environmental considerations amounts to less than half of a page of text for the three TMF options presented.

The alternatives analysis does not adequately consider economic considerations for the full life cycle of mine infrastructure (i.e. in perpetuity). There were a number of comments that were critical of the lack of economic analysis that went into the Proponent's consideration of alternatives. For example, YG states that:

CMC should provide additional detail on the cost analysis conducted to determine that slurry tailings, compared to other options, would be the most cost effective method. In particular, the analysis for the proposed management method should not only consider the cost to build and operate the facility over the operating life, but to also maintain and monitor the facility in perpetuity. CMC should demonstrate that the chosen facility is the most appropriate design from a risk management perspective for the operational and closure periods. (YOR 2014-0002-395-1)

YG further states, "the factors that were used to determine cost effectiveness [of alternatives] have not been provided" (YOR 2014-0002-395-1). Notably, the *Tailings Management Facility Construction Material Alternatives* report does not include consideration of the long-term monitoring and maintenance requirements for the presented alternatives. In fact, the report states that operating costs analyzed are limited to "tailings, reclaim and freshwater pipeworks and pumping/infrastructure systems over a 28 year period." Further, the comparative cost estimate "excludes various infrastructure components, indirects [sic], operating costs, etc." The proposed TMF will require monitoring and maintenance in perpetuity. There could also be significant costs associated with repairs required in response to major events, including earthquakes and floods, or emergencies such as potential dam failure. The information presented to date does not allow for a complete assessment of potential risks or realistic appreciation of full lifecycle costs associated with the proposed TMF and alternatives.

EcoMetrix also notes that the rejection of the filtered tailings alternative (i.e. dry stack) "appears to be based on economics." It is common to base a rejection of filtered tailings alternatives on economic grounds because full life cycle costs, let alone environmental and social considerations, are often not fully accounted for in the selection of a preferred option. The Mount Polley report highlights this approach where "comparisons of capital and operating costs alone invariably favour conventional methods". However, the Mount Polley report also cautions against this narrow approach:

Full consideration of life cycle costs including closure, environmental liabilities, and other externalities will provide a more complete economic picture. While economic

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

factors cannot be neglected, neither can they continue to pre-empt best technology.
(Mining Association of British Columbia, 2015)

The alternatives analysis also does not examine social and environmental considerations in enough detail. A number of comments support this assertion. Selkirk First Nation's (SFN) consultant, Northland Earth and Water Consulting Inc. (Northland), notes that:

the alternatives analysis completed do not [sic] meet the standard that should be expected for a project of this magnitude particularly given that the majority of created mine waste is considered reactive and requires perpetual management in some form to ensure its effects might be acceptable. (YOR 2014-0002-393-1)

Northland's comments also included references to new requirements related to tailings dam alternative assessments recently released by British Columbia's Environmental Assessment Office (BCEAO). In light of the recent Mount Polley tailings dam failure, the BCEAO has specified more robust alternative assessment requirements for proposed projects with tailings dams.

Government of Yukon (YG) comments align with the intent of these requirements. The Executive Committee recognizes that BCEAO's new requirements are at the forefront of the industry and that they are, in large part, in response to the dam failure at Mount Polley. Dr. Morgenstern states that, "The imposition of the recent BC requirements seem to be the appropriate vehicle to test the Proponent's commitment to evaluate the safety case. The Polley report outlines the controlling principles that would guide the proponents [sic] analyses" (YOR 2014-0002-404-1). The Executive Committee believes heightened scrutiny of the TMF dam is warranted because of the scale of waste management requirements, the challenges associated with managing reactive tailings and waste rock in perpetuity and the unprecedented nature of the proposed TMF (e.g. permafrost environment).

Northland's review of CMC's response also includes a reference to Environment Canada's (EC) *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* and suggests that this guidance "provides a template for a far more robust alternatives evaluation than has been conducted by CMC" (YOR 2014-0002-393-1). EC's guidance states that

The alternatives assessment should objectively and rigorously consider all available options for mine waste disposal. It should assess all aspects of each mine waste disposal alternative throughout the project life cycle (i.e. from construction through operation, closure and ultimately long-term monitoring and maintenance).

and that

The assessment should address environmental, technical and socio-economic aspects of all of the elements ... for each alternative throughout the project life cycle. A comprehensive economic assessment of the alternatives is also required and should consider the full costs of each alternative throughout the project life cycle.
(Environment Canada)

The Executive Committee acknowledges that the BCEAO requirements and Environment Canada guidance would help CMC to create a more robust alternatives assessment. We also recognize that there may be other guidance to achieve the same outcome. Either way, we require a more robust alternatives assessment in order for CMC to fulfill their requirements under s.50 of YESAA. Due to the potential for significant adverse effects related to the proposed option (e.g. TMF dam failure),

more detailed information is required to understand alternatives to or alternative ways of undertaking the Project that would avoid or minimize significant adverse effects. Therefore, please provide the following information:

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

2.2.2 Risk Assessment

CMC has not completed a risk assessment of the TMF dam. The Executive Committee requires a risk assessment to assess potential significant adverse effects. CMC states:

Should the IGRP recommend it, CMC may undertake failure modes and effects analysis for select components of the Project. The inundation study to be completed by CMC (see the response to R81) will include an evaluation of credible modes of failure of the TMF embankment. (YOR 2014-0002-0297-1)

The Executive Committee is supportive of this commitment; however, the Executive Committee is of the opinion that a risk assessment is required to support CMC's proposed TMF dam design prior to moving into the screening regardless of whether or not an IGRP recommends it.

Several comments received in response to CMC's SIR highlight the requirement for a risk assessment of the proposed TMF dam. Government of Yukon (YG), in relation to risk management and how it informs design of the TMF, notes:

CMC should demonstrate that the chosen facility is the most appropriate design from a risk management perspective for the operational and closure periods (YOR 2014-0002-395-1).

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Northland states:

“that such a risk assessment process be undertaken by CMC with the inclusion of its IRP and additional stakeholders as a necessary requirement prior to moving into the assessment of the project effects... the understanding of the project risks is an essential component of knowledge all stakeholders require in order to provide meaningful input into the assessment of the project. The requirement to conduct such a task as a requirement to support the assessment of the project is easily justified given the vast magnitude of the project and recent awareness of issues with the use of wet tailings storage schemes as most clearly seen in the recent Mount Polley disaster. (YOR 2014-0002-393-1)

Tr’ondëk Hwëch’in consultant Center for Science in Public Participation (CSP2), in relation to assessment of risks, urges:

the Executive Committee of the Board to ensure that the proposal that advances to screening provides enough information to permit a thorough assessment of risks, contingency plans and design alternatives. (YOR 2014-0002-397-1)

EcoMetrix also asserts the need for a risk assessment:

The proposed designs for the Casino tailings dam pose a level of risk. Because of the lack of a precedent, it cannot be known at this time if risks can be mitigated and/or managed in practical terms and reviewers suggest that results of a probability-based risk analysis (such as described in the response to R81) during Project screening could provide for a better appreciation of those risks.

There are a number of relatively high risks associated with the proposed designs, construction and performance of the proposed cycloned tailings dam shell which have not been sufficiently assessed in the information available for review. The most pronounced risks include potentially inadequate compaction of tailings, the possibility of building-in frost and snow into the dam shell, inadequate drainage characteristic of the tailings, potential liquefaction of saturated tailings zones (including tailings zones subject to high stresses that would result in a contractive response to shearing), potential for slumping of parts of frozen or unfrozen dam slope during construction and the potential for failure surface to extend along the dam foundations under seismic load if the bottom part of the dam shell is saturated and thus liquefiable. Managing these risks in respect to the proposed Casino tailings dam would be unprecedented for this size of dam, its remote location (considering longterm maintenance and surveillance requirements) and the climatic conditions. Also, proper QA/QC could be difficult to achieve given the climatic conditions and the construction schedule constraints for the cyclone tailings option.

The reviewer notes that carrying out a meticulous risk analysis (a probability-based risk assessment) at the feasibility design level could provide for a better appreciation of construction and performance risks associated with the tailings dam. In this case, the risk assessment would concentrate on identifying the probabilities of design, construction or operating oversights (errors) that could lead to a failure of the dam, the probability of insufficient knowledge of subsurface conditions, the probability of not understanding dam conditions and/or inadequate engineering analyses resulting from the unprecedented size of the dam, and the probability of an adverse impact of climate change on the conditions of the dam. For each of those probabilities, the potential failure mode of the dam would be defined and the extent of the resulting

damages (the magnitude of the consequences of dam failure) determined. Where applicable, those probabilities would be estimated with reference to the long term closure phase. From the probabilities and the potential consequences of dam failure, the risks and the cost of carrying the risks could then be estimated... In the reviewer's opinion, the results should be made available for review during the environmental assessment. (YOR 2014-0002-399-1)

The CDA 2014 technical bulletin "Application of Dam Safety Guidelines to Mining Dams" states that, "a risk-informed approach is encouraged because it includes traditional deterministic standards-based analysis among many considerations. Also, as noted above, the consequence classification does not address all of the potential risks presented by a dam" (Canadian Dam Association, 2014).

Finally, Dr. Morgenstern also emphasizes the value of a risk assessment at this stage of the assessment in the following statement:

The CMC response is as expected. However you are requiring the IGRP to be in place now and providing input to the process. This is a significant change in precautionary procedures and will likely result in a major delay in the assessment process. In my view, the presence of an IGRP and a risk assessment at this stage are appropriate for defending the selection of the TMF embankment, given the issues involved and limited precedence. The RXXX [regarding risk assessment] should not imply that the risk assessment is highly quantified. Limitations to quantification should be recognized. (YOR 2014-0002-404-1)

The Executive Committee agrees with the statements above and requires a risk assessment for the TMF dam. Therefore, please provide the following information:

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

R5 in the ARR of January 27, 2015, asked CMC to identify if and how independent regulatory audits will be conducted. CMC's response includes a summary of how inspections are conducted in relation to conditions within quartz mining licenses, as well as standard measures for managing non-compliance. CMC commits to establish an independent geotechnical review panel (IGRP) to "provide independent, expert oversight, opinion and advice to CMC on the design, construction, operational management and ultimate closure of the TMF and HLF." However, recognizing that the roles and responsibilities of the IGRP are not fully defined, it is unclear whether it, or another independent body, will be employed to provide oversight or review for regulatory audits required under license conditions. Selkirk First Nation's (SFN) consultant Northland Earth and Water Consulting Inc. (Northland) provides a similar observation and requests confirmation regarding whether CMC is "supportive of independent regulatory audits that would be conducted on behalf of CMC and submitted to regulators as part of conditions of any authorization associated with the project."

CMC's response to R6 includes details regarding Quality Assurance/Quality Control (QA/QC) procedures for the Project "prior to commencement and during execution of the all works." These QA/QC procedures will guide sampling, testing, inspecting and monitoring, as well as records management and reporting. CMC indicates that, "a Professional Engineer representing CMC will carry out periodic independent inspection and testing throughout the construction of the works." Further, "For environmental and socio-economic considerations, a qualified representative for CMC will conduct regular monitoring" in several areas of concern; "During the construction phase the

qualified representative is generally a third party monitor, who is replaced by a company employee during the operations phase.” Government regulatory inspections are primarily done to assess a project’s compliance with regulatory requirements. While such inspections are very useful, regulatory inspectors are not the facility designers.

The Executive Committee requires additional information in relation to independent review. Therefore, please provide the following information:

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

2.3 FEASIBILITY OF THE SULPHIDES REMOVAL PROCESS

CMC provides a significant amount of information in responses to R10 through R12 supporting the proposed sulphide removal process. Selkirk First Nation’s consultant, Northland Earth and Water, requests additional clarification on the following two points (YOR 2014-0002-393-1):

- information on the feasibility and limitations of using “on-stream analyzers” on a continuous basis to monitor sulphur removal from the NAG tailings stream; and
- discussion on the implications related to CMC’s estimate that 25 percent of the processed supergene ore would produce non-PAG rougher tailings.

The Executive Committee agrees with the need for this information and requires clarification on the sulphide removal process and its implications for embankment construction. Therefore, please provide the following information:

- R2-6. Information on the feasibility and limitations of using “on-stream analyzers” on a continuous basis to monitor sulphur removal from the NAG tailings stream.
- R2-7. Discussion on the implications related to the estimate that 25 percent of the processed supergene ore would produce non-PAG rougher tailings.

2.4 ROADS, SUPPLY ROUTES AND TRANSPORTATION

2.4.1 Freegold Road Extension and Upgrade

As per Rule 34 of the *Rules for Screenings Conducted by the Executive Committee*, at the outset of a screening, the Executive Committee must prepare a statement describing the scope of the Project based on the information contained in the proposal. In order for the Executive Committee to prepare this scope, it must have sufficient information as well as a clear understanding of the Project’s activities.

The project proposal includes upgrades to the Freegold Road and the construction of the Carmacks by-pass. The Executive Committee requested more information regarding these components of the Project in its Adequacy Review Report of January 27, 2015. CMC has not provided all of the

information requested because CMC states that it is not responsible for undertaking these activities. CMC states:

the Freegold Road upgrade, and the Carmacks bypass including construction of the Nordenskiöld Bridge, will be the responsibility of the Yukon Government (YG), pending an agreement with CMC and the First Nations on whose settlement land the Freegold Road crosses. CMC cannot comment on the work to be done by YG, however, Section A.4 outlines the incorporation of the Freegold Road upgrade in the Proposal. (YOR 2014-0002-350-1)

Given this response, the Executive Committee does not have a clear understanding of how upgrades to the Freegold Road and the construction of the Carmacks by-pass are incorporated into the proposal. The information provided in relation to these activities lacks specific details: it is uncertain if schedules, management, alignments, or other plans will remain unchanged. Changes to scheduling, for example, may have considerable effects to the community of Carmacks if the by-pass is not built as scheduled. It is also not clear that authorization is possible for the crossing of LSCFN settlement land. These project components may affect multiple values, including land-use, wildlife, fish, traffic, and settlement land. More detailed information is required to describe how these activities are incorporated into the proposal. Alternatively, if these activities are no longer to be incorporated into the proposal, the Executive Committee will require a modified project proposal that does not rely on nor require upgrades to Freegold Road and the construction of the Carmacks by-pass. The Executive Committee is unable to prepare a scope of the Project without all of the information previously requested and / or clarification of specific project activity details. Therefore, please provide the following information:

R2-8. One of the following:

- a. Responses to previous Adequacy Review Report requests as they relate to the Freegold Road upgrade and Carmacks by-pass:
 - R13 and R14 (in relation to the camp for the upgrade),
 - R18 (including safety, wildlife, and maintenance),
 - R27 (in relation to traffic in Carmacks and the by-pass)
 - R297 (in relation to clear span bridges for the upgrade)
 - R298 (in relation to decommissioning of abandoned structures along the alignment)
 - R299 (in relation to the Nordenskiöld River bridge and pier)
 - R300 (in relation to available habitat at the Nordenskiöld River bridge)
 - R410 (in relation to a cabin near the project footprint),

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

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The Project will involve a road construction camp that is described in some detail within the Supplementary Information Report. The provided information describes preparation activities, layout, and details of the camp. However, provided maps show watercourses within the camp footprint. Details on these watercourses, including flow, diversion, and fish presence are not provided. The Proponent also proposes either a septic system or a packaged sewage system; it is unclear if a septic system is appropriate in this location which may have a high water table. Further, while the area already contains some disturbance, it is unclear how much vegetation will be cleared and how the site will be remediated afterwards.

The Executive Committee requires more information regarding the construction camp for the Freegold Extension. Therefore, please provide the following information:

R2-9. Camp details including:

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

Closure of the road at project completion was proposed in the original proposal, and is described within the current road use plan; however, the Supplementary Information Report indicates that closure may not occur. The Proponent indicates the final decision will be the product of consultation with relevant parties. The potential permanence of the road, as suggested in the SIR, means more information is required in order to assess effects to wildlife and fisheries values and in order to assess management plans and objectives. Alternatively, the potential for closure of the access road requires more detail on reclamation objectives, methods, and timelines. Selkirk First Nation's consultants, Northland Earth and Water, raise some of these concerns as well as including concerns over legacy issues and closure after mine operations cease. Closure issues are also considered in section 2.9 of this report. The Executive Committee requires more information on both possible scenarios for the Freegold Road extension. Therefore, please provide the following information:

R2-10. A description and assessment of the two possible scenarios for the Freegold Road extension:

- a. Road closure and reclamation including methods, objectives, and timelines,
- b. Continued road use including management, access, and effects.

2.4.2 Existing Highways

The Supplementary Information Report provides additional information on anticipated project related traffic. As with the original proposal, figures are generally provided in each direction and do not appear to include empty vehicles such as ore trucks not backhauling materials. It is unclear if the Proponent's assessment of effects along affected roadways includes empty vehicles.

South Klondike Highway

The SIR attempts to estimate traffic volumes along the South Klondike Highway based off traffic counts along the Alaska Highway. For the South Klondike Highway this approach estimates 184 trailer trucks per day on the South Klondike Highway at the Carcross cut-off. However, this number is unlikely to remain constant along the length of the South Klondike Highway. Maps provided in the SIR indicate an average of 600 to 1 200 vehicles per day along the South Klondike Highway north of Carcross and 150 to 300 vehicles per day south of Carcross.

Assuming 21 trips per day of ore concentrate to Skagway, and 21 return trips, the Project represents 42 trucks per day. Based on the Alaska Highway counts of 184 trucks per day on the South Klondike Highway, the Project would represent a 23 percent increase from baseline levels, for trucks. Based on the mapped data provided north of Carcross, project trucks would represent between three and seven percent of all traffic. South of Carcross, project trucks could represent between 14 and 28 percent of all traffic.

These are significant increases in truck traffic when compared against baseline conditions. Carcross/Tagish First Nation (YOR 2014-0002-394-1) expresses concern that such a volume of project related traffic will potentially disrupt tourism based economic development, wildlife habitats, and limited infrastructure. More information is required to understand the potential effects along the South Klondike Highway and within Carcross.

North Klondike Highway

As with the South Klondike Highway, the SIR estimates traffic on the North Klondike Highway using vehicle counts on the Alaska Highway east and west of the its intersection with the North Klondike Highway. However, traffic counts east of the intersection were collected just north-west of Porter Creek meaning any traffic destined for areas such as Crestview is inferred to be travelling the North Klondike Highway. Similarly, this approach means that any traffic for the Takhini valley is incorporated into baseline conditions for the North Klondike Highway, even though these vehicles may use only a short portion of the highway. The Proponent infers 267 trailer trucks traveling along the North Klondike Highway per day based on these results. That is to say, 267 more trucks per day were observed north of Porter Creek just west of the intersection of the Alaska and North Klondike Highways. Provided maps on highway use, however, show only 300 to 600 vehicles traveling on the North Klondike Highway, north of the Takhini Hot Springs Road. This would indicate that nearly half to nearly all vehicles traveling the North Klondike Highway were trailer trucks if truck counts are accurate.

Project related traffic will include 21 ore trucks per day, 11 LNG trucks per day, and 4 diesel or lubricant trucks alone (all FHWA classes 8-13), in one direction. This amounts to 72 trips in both directions.

Based on inferred truck volumes, the Project will result roughly 27 percent increase in truck traffic. Based on the provided maps, project related truck traffic will result in a 24 to 48 percent increase in all traffic from baseline conditions.

Consideration in the Supplementary Information Request and proposal focuses primarily on Whitehorse; however, the scale of effects will likely be higher in areas with lower traffic levels and transportation infrastructure that reflects a lower intensity of use. The Executive Committee requested information on how traffic issues would be managed within the Village of Carmacks; however, the Proponent provides only an overview of traffic management which does not address the identified concerns such as noise, congestion, and safety. The Executive Committee re-iterates its need to evaluate effects due to the use of local road networks pending the completion of the Carmacks by-pass.

The Executive Committee requires more information regarding the impacts of traffic on communities, road users, wildlife, and transportation infrastructure. Therefore, please provide the following information:

- R2-11. Clarification if project traffic predictions and the project effects assessment include empty vehicles, and if not, updated predictions and corresponding effects assessments.
- R2-12. An analysis of potential effects along the Klondike Highway, for all affected sections.
- R2-13. An assessment of and mitigations for potential effects due to traffic in Carmacks and Carcross.

2.5 WATER MANAGEMENT PLAN

2.5.1 Conveyance of Water

In response to R33, CMC provides additional details on the methodology used to estimate Probable Maximum Precipitation (PMP). EcoMetrix (YOR 2014-0002-399-1) indicates the methodology used by the Proponent to estimate PMP is sensitive to the value used for standard deviation of the annual extremes of rainfall and that the Proponent should use all years of available rainfall data and not just the dataset used to develop the frequency maps in the 1985 *Rainfall Frequency Atlas for Canada*. EcoMetrix indicates the appropriate value of PMP may be greater than estimated.

The Executive Committee utilized other sources of information to estimate PMP for the Casino Project. Contours presented in Figure 2-12 of Technical Paper No. 47 (TP-47) (Weather Bureau, 1963) indicate that a 24-hour PMP of 10 inches (250 mm) is expected for Eastern Alaska at the same latitude as the project site. The 1963 Alaska PMP analysis completed for TP-47 utilized 184 Alaska and 33 Canadian meteorological station records. Figure 1 presents the 24-hour PMP contours from TP-47. CMC's proposal indicated a 24-hour PMP value for mine facility design of 159 mm as presented in Table A.4.9-2 of CMC (March, 2015).

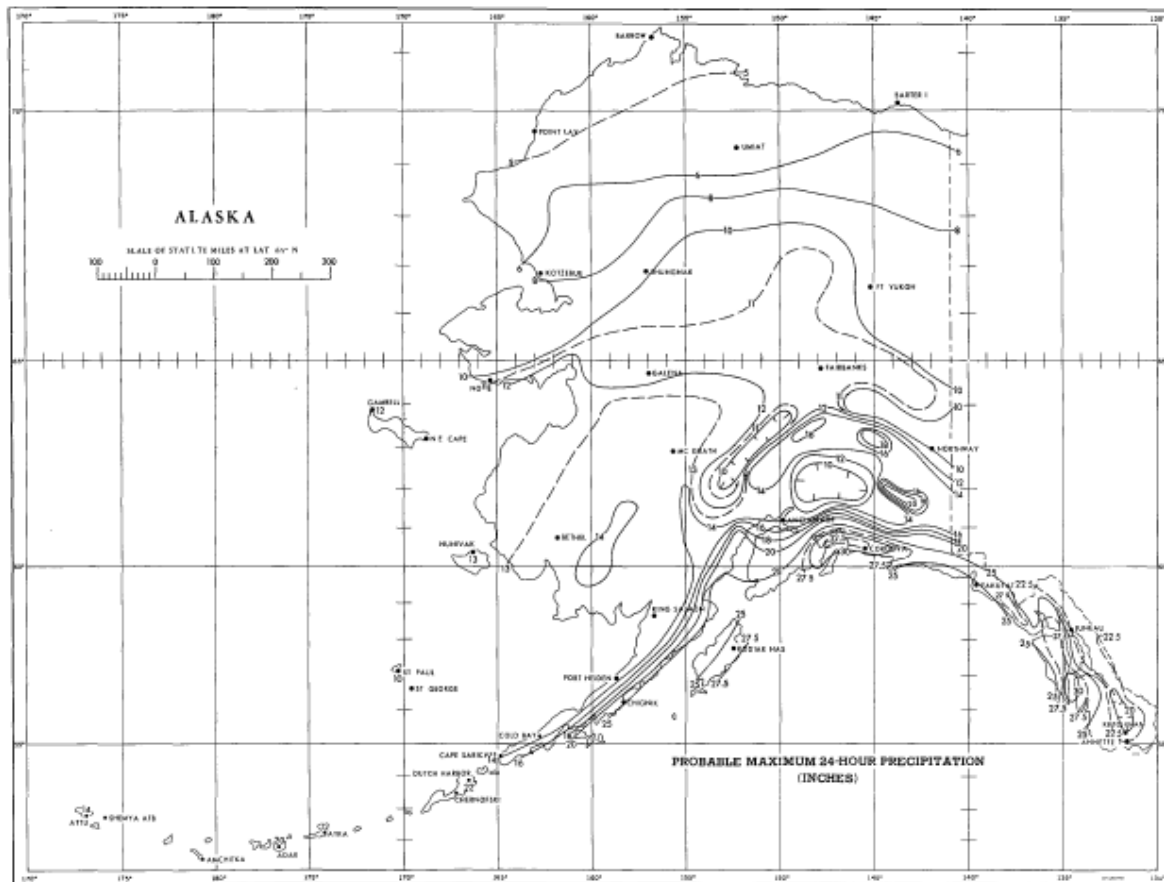


FIGURE 2-12.—Probable maximum 24-hr. point precipitation, in inches.

Figure 1: Figure 1: 24 hour PMP contour lines for Alaska (taken from Figure 2-12 of TP-47, Weather Bureau, 1963)

The Executive Committee requires more information on PMP. Therefore, please provide the following information:

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

In response to R34, CMC refers to Figure 5.8 in Appendix A.4C (Feasibility Design of the Heap Leach Facility). This figure is general in nature and does not provide sufficient detail on cross sections and design drawings for diversion ditches in the HLF area. The potential consequences of a ditch failure in the area of the HLF confining embankment and access road, appear to be very high. In addition, the construction of a HLF on a steep slope in a permafrost region is technically challenging and all components of the design must be well thought out. EcoMetrix states:

The currently available information does not allow reviewers to assess the adequacy of the proposed HLF area ditches in preventing or mitigating potential environmental impacts. The requested typical cross-sections would be expected to indicate the

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

proposed slope, side slope, bank lining material(s) and the bank lining key or toe method, as well as scour protection and energy dissipation methods. (YOR 2014-0002-399-1, p 14)

The Executive Committee requires additional information on diversion ditching across the project site in order to predict potential environmental effects. Therefore, please provide the following information:

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

2.5.2 Probability of Failure Analysis of Infrastructure Components

In response to R42, CMC provides a table that summarizes the water management plan components, return period design criteria, design phase, design life, probability of exceedance, and rationale in Table A.4.7-1 of CMC (2015).

Given the relatively high probability of design exceedance, EcoMetrix notes several areas where additional information should be provided including:

- For instance, in Table A.4.7-1, the probability of design exceedance for the Water Management Pond (WMP) for the respective sediment control function is 97% over a 33 year design life. Given that the design event will likely be exceeded one or more times over the facility design life, what are the respective consequences and are they acceptable?
- Similarly, the WMP overflow spillway, which is expected to operate in perpetuity, has a stated probability of design exceedance of 15% for the operations phase and 39% for the closure phase. Given that the design event will likely be exceeded one or more times over the facility design life in both phases, what are the respective consequences and are they acceptable?
- The same questions could be posed for the HLF components which have a relatively high probability of design exceedance. The reviewer notes that there are stated mid- to low- consequence of exceedance for the HLF components, however, no discussion is provided.

(YOR 2014-0002-399-1, p 17)

The Executive Committee requires more information with respect to the potential consequences of failure and a discussion of the suitability of the stated design criteria for each structure. Therefore, please provide the following information:

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

2.6 HEAP LEACH FACILITY

2.6.1 Liners

The Adequacy Review Report requested information regarding the sufficiency of a 30 cm thick soil liner. CMC's rationale in response relies on the "precedent" example of the soil liner used for Brewery Creek Mine's HLF. However, CMC notes that, "Further analysis of and details regarding the design of the soil liner will be completed as part of detailed design required for future Quartz Mining License and Water Use License applications." Selkirk First Nation's (SFN) consultant, Northland Earth and Water Consulting Inc. (Northland), raises a question regarding the validity of Brewery Creek Mine's HLF as an appropriate precedent and requests "evidence of the acceptability based on the actual conditions that will be present at the Casino operation which may be significantly different than was experienced by the much smaller Brewery Creek operation." Similarly, Environment Canada (EC) challenges the appropriateness of using Brewery Creek HLF as an analogy for CMC's proposed HLF; specifically, EC notes that CMC's response

does not provide details on the similarities such as shear strength, slope stability, stack height, bedrock conditions or comparable liner construction. It should be noted that Brewery Creek was a much smaller facility with less overall mass and no appreciable in-heap pregnant solution storage. (YOR 2014-0002-391-1)

EC also notes that,

In respect to leaching performance during operation of the HLF, it was questioned that if low permeability of the lower lifts of the heap were encountered, whether the company would consider the use of an intermediate liner. The Supplementary Information Report does not seem to address this concern. (YOR 2014-0002-391-1)

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

- R2-17. Additional supporting evidence to demonstrate the sufficiency of a 30 cm thick soil liner based on the actual conditions at the mine site (e.g. shear strength, slope stability, stack height, bedrock conditions).
- R2-18. An outline of plausible mitigation strategies (e.g. intermediate liners; additional and/or higher standard liners) to ensure performance objectives of the HLF are achieved.

2.6.2 Leak Detection and Recovery

In R48 of the Adequacy Review Report, the Executive Committee requested details on the mitigation and management of leaks from the HLF for all stages of operations.

In relation to the leak detection and recovery information presented in relation to the HLF, Environment Canada states that, "The present conceptual design diagram does not provide adequate detail, including that needed to understand the various transitions in liner and leak detection systems intended by the proponent" (YOR 2014-0002-391-1).

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The Executive Committee requires more information on the leak detection and recovery system (LDRS). Therefore, please provide the following information:

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

In R49 of the Adequacy Review Report, the Executive Committee requested details regarding the maintenance of LDRS pumps. Northland notes that sump maintenance and repair is not addressed in the Proponent's response (YOR 2014-0002-393-1). Considering the importance of sumps for leakage detection and recovery and concerns raised regarding the integrity of sumps under the strains imposed by the heap, additional information is required.

The Executive Committee requires more information on the LDRS.

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

2.6.3 Leachate Solution and Water Flows

In response to R50 and the request for details on the pipelines, pumps, and related infrastructure, CMC references the report titled Feasibility Design of the Heap Leach Facility (Appendix A.4C). This report was provided as an appendix to the SIR as well as earlier in the adequacy review process (YOR 2014-0002-160-1 and 161-1). While this report, and Section 5.3 in particular, provide some general details on the leachate collection system, there are no new details.

The Executive Committee requires information on all pipelines and pumps that are required to transfer barren and pregnant leachate solution between facilities such as the gold recovery building, HLF, events ponds as this type of infrastructure can be a source of contamination to the environment.

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 information:

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

Further in their response to R50, CMC indicates that it intends to use and manage cyanide in a manner consistent with the principles and standards of practice of the International Cyanide Management Code (Cyanide Code). CMC identifies, in broad terms, the principles and standards from the Cyanide Code that would apply to their design, use and management of with respect to pipelines, pumps, and related infrastructure. The Executive Committee requires clarification on certification and principles of the Cyanide Code related to independent third-party auditing. Therefore, please provide the following information:

- R2-22. Clarify whether CMC intends to seek certification under the International Cyanide Management Code and conduct independent third-party auditing of its conformance with

the cyanide management standards of practice. If so, clarify whether results of independent audits would be made available for review by interested stakeholders.

2.6.4 Ore Stacking Rate

The Executive Committee requested additional information regarding metallurgical test work completed, or proposed prior to construction, to improve leach cycle time estimates (R58). The Proponent's response to R58 notes that "CMC has various metallurgical test work programs in progress, including column leach testing of representative composite samples, hydrological testing [...] and material characterization work [...] and] CMC may initiate further follow up testing to further develop and optimize the design and operating parameters for the proposed heap leach operation." EC and Northland both provided comments recognizing that additional metallurgical testing is ongoing. However, they both also indicated that this information is important to the assessment and, as such, recommended that CMC provide details about currently on-going testing as well as proposed or planned testing.

The Executive Committee requires additional information to assess the potential impacts of longer-than-projected leach times or reduced HLF stacking rates.

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

2.7 TAILINGS MANAGEMENT FACILITY

The Executive Committee emphasizes that CMC's response to questions in s.2.8.1, 2.8.2 and 2.8.3 may inform responses to questions in the remaining sub-sections of 2.8 – Tailings Management Facility. There may also be implications for questions in other sub-sections of this report. Therefore, it is critical for CMC to address the questions in s.2.8.1, 2.8.2 and 2.8.3 prior to responding to the remaining questions, where applicable.

2.7.1 Design Methodology and Feasibility

The Executive Committee requested justification and rationale for the "high" hazard classification of the tailings management facility (TMF) and implications of using an "extreme" hazard classification in R65 of the Adequacy Review Report. The Proponent's response indicates that the TMF dam hazard classification meets the Canadian Dam Association's (CDA) dam safety guidelines.

CMC's response to R65 indicates that the TMF dam hazard classification was conducted in accordance with Canadian Dam Association's (CDA) *Dam Safety Guidelines*. CMC states that:

Classification of a tailings dam is carried out by considering the potential incremental consequences of a failure. The incremental consequences of failure are defined by the CDA as "the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed." The consequences of failure considered include loss of life, environmental and cultural impacts and losses, and economic loss. (YOR 2014-0002-297-1)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

However, it seems the hazard classification was undertaken in advance of a risk assessment or a dam break/inundation study. CDA guidelines stress:

A significant step in assessing the consequence is a dam break analysis. While dam breach parameters and dam break modeling for conventional water dams is fairly well understood, this is far from being the case for tailings dams. Given the uncertainty in the dam break assumptions and modeling results, care should be taken in assessing the accuracy of dam break analysis results and related inundation maps. (Canadian Dam Association, 2014)

Similarly, the Mining Association of British Columbia states that:

Dam break analysis and inundation studies are primarily used to inform the emergency preparedness and response planning and the dam classification. The dam classification is then used to inform the design specifications. (Mining Association of British Columbia, 2015).

The CDA guidelines also suggest, "A risk assessment may be necessary to justify the selection of criteria" (Canadian Dam Association, 2014). The Proponent has committed to conducting a dam breach/inundation study and indicates, "Should the IGRP recommend it, CMC may undertake failure modes and effects analysis for select components of the Project." However, as this information is yet to be completed and presented, the hazard classification for the TMF dam is premature.

Many comments received in relation to CMC's SIR express a lack of confidence in, or are critical of, the Proponent's TMF dam hazard classification and, in turn, request additional information to facilitate a thorough assessment of the dam. The following comments highlight some notable concerns regarding the dam classification.

Selkirk First Nation's consultant, Northland Earth and Water states:

The rationale for the selection of the consequence classification for the TMF is incomplete as the supporting inundation study that will inform the level of environmental damage resulting from a failure of the facility is still outstanding. Moreover given the perpetual nature of the TMF the economic consequences of a failure during post closure needs to be considered in light of the potential costs associated with management and mitigation of a failure that would have to be borne by the public in the reasonable expectation that the company is no longer present and any remaining security funding would not be sufficient to cover the case of a failure. (YOR 2014-0002-393-1).

EcoMetrix seeks:

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.

The information provided by the proponent is considered to be not adequate. CMC has not provided any additional information that would justify classifying the Casino tailings dam as a "high" (rather than as an "extreme") hazard structure.

The reviewer notes that a major impact to fish populations (threatened or other species) and habitat is not of relatively small concern. Noting also that the proposed tailings dam is unprecedented in height, were it to breach, both NAG and PAG tailings as well as potentially contaminated water would be released and initially wipe

out the fish and fish habitat and the benthic communities for an unknown distance in the downstream streams and rivers. As well, some PAG tailings would likely settle high on the banks of the downstream streams with the potential to generate net acidity for hundreds of years. A recovery period associated with such an event has not been evaluated by CMC. The proponent does not explain how the 'restoration or compensation in kind' required by the CDA guideline would be 'highly possible' (according to the proposed classification of the dam).

There seems to be no doubt that a breach failure of the Casino tailings dam would result in a major impact to the fish populations and the fish habitat, most likely unprecedented in Canada. It is the reviewer's opinion that classifying the Casino tailings dam as an extreme consequence dam, with all the resulting consequences including using the PMF and MCE design criteria as well the effort associated with dam safety evaluations during the operation and closure phases would diminish the risk of such an event (see R6 and R81).

"In the reviewer's opinion, however, the results of an inundation study will not allow for selecting other than the extreme hazard classification category in the Casino dam case. The reviewer's opinion is that wherever a dam failure would lead to the release of PAG tailings with an associated impact on a major fish population and downstream fish habitat, the consequence category should always be extreme since the impact would last for hundreds of years. (YOR 2014-0002-399-1)

Dr. Morgenstern notes:

Given the circumstances around this Project, I find it difficult to avoid CDA's Extreme Case. The dam breach analysis can be of assistance but after Mount Polley any significant loss of reactive tailings would constitute a major environmental and industrial disaster (YOR 2014-0002-404-1)

SNC-Lavalin adds:

The Dam Safety Guidelines (2013) classification scheme followed by CMC is intended to provide guidance with respect to the standard of care expected of dam owners and designers. The guidelines also state, however, that the consequence assessment should follow an analysis of a dam break failure including flood wave routing, inundation mapping and evaluation of impacts. This is further supported by the CDA Technical Bulletin, Application of Dam Safety Guidelines, 2014 that advocates analysis of a 'sunny day' failure.

Further, CDA Technical Bulletin, Application of Dam Safety Guidelines, 2014 acknowledges for dams that may last thousands of years that the 2013 guidelines are insufficient. Following a dam break and consequence analysis, the guideline suggests different criteria to be considered during the design. For example, for a Dam with classification of High would be designed for exceedance probabilities of 2/3 between 1/1000 and PMF (not 1/3 between 1/1000 and PMF which is recommended for dams that are meant to last for decades)" (YOR 2014-0002-403-1)

The Executive Committee requires more information regarding the feasibility and hazard classification of the TMF dam. Therefore, please provide the following information:

- R2-24. An updated TMF dam hazard classification that is informed by the IGRP-overseen risk assessment and related dam breach/inundation study. Where relevant, also include

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

details regarding the impacts to dam design and mitigation strategies as a result of this additional work.

The Adequacy Review Report contains an information request, R66, which seeks “comparisons with other similar sand embankments or compacted sand dams and/or natural analogues within similar environments.” The Proponent’s response to this request points to comparisons with other large cyclone tailings dams within their *Report on the Feasibility Design of the Tailings Management Facility* (Appendix A.4D). Additionally, CMC refers to the response to R94 for additional comparison information with details about dams associated with the Kemess, Gibraltar and Highland Valley mines. EcoMetrix notes none of these identified comparison examples “can be viewed as a precedent closely pertinent to the proposed Casino tailings dam” due to differences in scale, construction material and/or climate/location (YOR 2014-0002-399-1). In addition to requesting details about comparable facilities, R66 also sought information related to natural analogs to the proposed TMF dam, if any. Northland Earth and Water notes that CMC’s response “does not appear to provide more than cursory reference to analogues to the proposed TMF design (YOR 2014-0002-393-1). A more thorough and detailed review of design and operating experience with dams of this size and design should be provided. In addition, natural analogues of the proposed closure state of the TMF should be identified or a statement that none exist should be provided.” It seems apparent that there are no similar facilities to compare to the proposed TMF dam and, as such, natural analogues may provide valuable comparison, particularly for the proposed closure state of the TMF dam.

As noted in Bjelkevik’s state of the art report titled “Water Cover Closure Design for Tailings Dams”:

There is little experience of ageing of dam structures when it comes to thousands of years. A comparison of natural analogies from the latest glacial period can then be useful in choosing the best closure design... The main interest was focused on the mean hydraulic gradients in the formations creating the natural lakes.
(Bjelkevik, 2005)

EcoMetrix notes:

None of the tailings dams referred to in the 2012 Feasibility Design of the TMF report (Kemess, Gibraltar, Highland Valley dams) can be viewed as a precedent closely pertinent to the proposed Casino tailings dam for reasons including size, climate and design. None of the dams presented as examples, is even half as high as the Casino tailings dam. Moreover, the Gibraltar and Highland Valley sites have significantly milder climates and are located far away from the discontinuous permafrost zone. The Kemess site also has a milder climate and, what is particularly important, the Kemess tailings dam is designed differently than the proposed Casino tailings dam. The strength of the downstream shell of Kemess tailings dam is derived primarily from rockfill, with only a relatively thin cycloned tailings cover. CMC has not provided convincing arguments for precedent. The lack of a precedent supports the R65 request for risk analysis for the proposed Casino tailings dam.
(YOR 2014-0002-399-1)

The Executive Committee requires more information regarding the design methodology and feasibility of the TMF dam. Therefore, please provide the following information:

- R2-25. Additional comparison information about natural analogies within similar environments.
Include estimates of the hydraulic gradient(s) for the TMF dam, throughout its lifecycle (i.e.

in perpetuity), and include a discussion that reflects on the findings of the Bjelkevik (2005) report (i.e. compare the estimated hydraulic gradient of the TMF with the hydraulic gradient of natural analogies that have demonstrated long-term stability).

The Adequacy Review Report's R67 requests "detailed rationale for the selection of the factor of safety during dam construction." Several comments speak to CMC's response to this question.

SNC-Lavalin references aspects of CMC's response to R67 where:

Section 5.11 of Reference (i) describes the embankment stability analysis using static and dynamic approaches based on Canadian Dam Safety Guideline (2007). CMC pointed out "A factor of safety of less than 1.0 is acceptable under earthquake loading conditions provided that calculated embankment deformations resulting from seismic loading are not significant ...

Also Section 5.11 of Reference (i) outlined "...the minimum acceptable factor of safety for the tailing embankment under static conditions is 1.3 for short term operating conditions and 1.5 for long-term (post-closure) of the TMF."

Section C.3. of Appendix C describes the slope stability assessment and pointed out the minimum factor of safety calculated is 2.2. (YOR 2014-0002-403-1)

EcoMetrix highlights:

The proponent indicates "The minimum factor of safety requirements adopted for the embankment design are consistent with the recommendations of the CDA Dam Safety Guidelines (2007). Recommendations provided by the CDA Technical Bulletin "Application of Dam Safety Guidelines to Mining Dams" (including minimum factor of safety requirements) have also been considered during the design process." And further: "The CDA Technical Bulletin for Mining Dams (2014) indicates a minimum factor of safety (between 1.3 and 1.5) should be selected based on consideration of the consequence of failure, the loading conditions, and strength parameters." If so, this would show a misunderstanding of the concept of a safety factor for dams. A safety factor is meant to cover for uncertainties in dam material properties, subsurface soil and hydrogeologic conditions, analytical methods, stability calculations, pore pressure dissipation rates, stress distributions in dam and foundations, etc. Those uncertainties will not be any less at the end of construction than in the long term. A dam stability safety factor is not intended to reflect the consequences of dam failure (this is where the problem with the bulletin is). The consequences of failure are reflected in the appropriately chosen design flood and earthquake criteria and the dam surveillance effort.

The CDA guideline clearly specifies the condition under which the 1.3 safety factor can apply: "End of construction before reservoir filling". This condition cannot be made applicable to the end of construction of the Casino tailings dam. The proponent did not provide any convincing arguments in the SIR report in relation to the use of the 1.3 safety factor. It is the reviewer's opinion that a minimum factor of 1.5 should be used for the design of the Casino tailings dam for static load conditions at all times. The reviewer also notes that had a minimum factor of safety of 1.5 rather than 1.3 were used for the design of the Mount Polley tailings dam, that dam would not have failed. (YOR 2014-0002-399-1)

The Executive Committee requires additional information in relation to the design methodology and feasibility of the TMF dam. Therefore, please provide the following information:

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

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

- a. The factor of safety under pseudo-static condition, since the minimum factor of safety for slope stability under seismic loading is 1.0 and not less than 1.0 (refer to Table 6-3 of Canadian Dam Safety Guideline, 2007).
- b. Was the excess pore pressure during the construction period and before the embankment rise considered?
- c. Confirmation that the stability analysis during different stages of construction and impounding meets the minimum factor of safety proposed by CDA such that: the minimum factor of safety of 1.3 “Before the reservoir filling” and FOS of 1.5 at the “normal reservoir level”.

The Adequacy Review Report requests evidence supporting the stability and operation of the dam in perpetuity (R68). The Executive Committee also requested information on monitoring and mitigation activities that may be required during closure, including the extent of remediation required in event of a maximum design earthquake in the Adequacy Review Report (R74). CMC indicates, “Details of monitoring requirements during operations and closure and potential remediation activities required during closure will be developed as part of the Operation, Maintenance and Surveillance (OMS) and Closure Plan documents developed during detailed design.” The Proponent’s response also notes that these documents will include consideration of remediation activities following an MDE. However, as shown in Government of Yukon (YG), Department of Energy, Mines and Resources (EMR), Mineral Resources’ Branch (MRB) comments:

MRB is concerned that the level of detail provided for the Tailings Management Facility (TMF) is not sufficient to understand the long-term implications of such a facility. CMC should provide conceptual Operations, Maintenance and Surveillance (OM&S) plan to demonstrate how the TMF will be managed in both the operational and closure periods. An OM&S plan will provide additional information on how CMC plans to operate the Casino property in a safe manner.

A detailed TMF design and OM&S plan will be required before licenses can be issued. Should this approach be approved, the design and OM&S plan will be required, at a minimum, to meet the Mining Association of Canada’s (MAC) guidance material for tailings management facilities. As a result of the Mt. Polley tailings breach, MAC has begun a review of the current guidance material to identify areas where guidance can be enhanced and strengthened. CMC will be required to submit designs and plans in accordance with these updated guidance materials, which are expected to be released in late 2015.

In addition to the updated guidance material by MAC, Yukon Government is currently reviewing the requirements for designing, constructing, operating and closing tailings facilities in Yukon. Guidance materials are being prepared for proponents to ensure the methodologies and objectives of Yukon are met at all these life of mine stages. CMC will also be required to update plans to meet this guidance document, which is also expected to be released in late 2015

In the case of the Casino Project, as proposed, there will be a requirement in perpetuity to maintain the TMF in a physically stable manner to continue to provide

chemical containment, to ensure water quality from the TMF is suitable for discharge, the open pit water is suitable for discharge to the TMF, and many other elements.

CMC should provide detail on the care and maintenance costs in perpetuity – this estimate should be supported by a conceptual operations, maintenance, and surveillance manual for the TMF which documents the ongoing care and maintenance requirements during the closure and post-closure period.

It appears that the proponent plans to address hydro climactic variability by building in adaptability during the construction phase of the tailings storage facility. Clarification is required on how the proponent proposes to address variability and increases in precipitation for the lifetime of the tailings (perpetuity) after the construction phase and mine operations are completed. How is the proponent planning for change on a long-term scale?” (YOR 2014-0002-395-1)

The following comments received in relation to CMC’s SIR further highlight the inadequacy of the response to R68:

Northland Earth and Water:

This IR question, regarding provision of evidence of long term stability through closure, is of fundamental importance to the assessment of this proposed TMF. The response of CMC does not in fact provide a response to this question. A full and wholesome response to this question should still be required. (YOR 2014-0002-393-1)

EcoMetrix:

The information provided by the proponent is considered to be insufficient on this matter and refers to the recommended information requested in R65. Possible climate change and the remoteness of the site with respect to the long term maintenance and surveillance requirements as well as the stability of the HLF need be accounted for in assessing the long term stability of the Casino tailings dam. The reviewer suggests that the probability of an adverse impact of climate change on the conditions of the dam be considered as part of a probability-based risk assessment for the Casino tailings dam. (YOR 2014-0002-399-1)

Dr. Morgenstern, regarding assurance that the TMF can continue to achieve its design objectives in perpetuity:

This is an important question and is not readily answered without a clearer understanding of the process associated with custodial transfer. My sense is that the question should be put to the Proponent and a potential problem analysis requested, including criteria for custodial transfer (to whom; funding; other obligations). Examples of custodial transfer should be sought. (YOR 2014-0002-404-1)

YG-EMR – Mineral Resources provides additional details about the minimum standards for an OM&S plan. As highlighted by Northland, “the level of activity that may be require [sic] to actively manage this TMF in perpetual [sic] is of importance in terms of assessing the effects of this project” (YOR 2014-0002-393-1).

In their “Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities,” the European Commission states:

The effects of long-term climate change are of intense interest and great uncertainty. Yet for a tailings dam to remain stable in perpetuity requires somehow that the influence of these changes on floods and spillway capacity be accurately predicted, something that even climate experts are not able to do. Climate change may also affect both physical and chemical stability in other ways. Frozen conditions are relied upon to reduce ARD reaction rates at some mines in arctic and sub-arctic regions, where certain tailings dams also depend for stability on the presence of frozen ground. It goes without saying that permanent submergence requires sufficient water, even during sustained drought, periods notwithstanding any future changes in climate.

It is therefore important to evaluate the potential effects of climate change as a part of the Environmental Impact Assessment (see Section 4.2.1.3) if this may be relevant to the long-term behaviour of the chosen management option. (European Commission, 2009)

The Executive Committee requires more information regarding the stability of the TMF through perpetuity. Therefore, please provide the following information:

- R2-27. A conceptual operations, maintenance and surveillance (OM&S) plan to demonstrate how the TMF will be managed in both the operational and closure periods. At a minimum, this plan will meet the current Mining Association of Canada's (MAC) guidance material for tailings management facilities. The OM&S plan must:
- Comprehensively address how custodial transfer will occur for all liability associated with this project. This aspect of the plan will include criteria for custodial transfer (e.g. to whom; timing; security funding; other obligations) and consider scenarios such as abandonment and end-of-mine life transfer. Provide examples of successful custodial transfer of comparable projects.
 - Include supporting information that addresses monitoring and remediation activities that may be required during closure including the extent of remediation required in event of a maximum design earthquake. The plan must also consider response to multiple maximum design earthquakes that may occur considering the TMF is proposed to remain in perpetuity.
 - Evaluate the potential effects of climate change on the Project through all phases, in perpetuity.
- R2-28. Detail on the care and maintenance costs in perpetuity. This estimate will be supported by the OM&S plan, which will document the ongoing care and maintenance requirements during the closure and post-closure period. This estimate must consider costs for all liability associated with the mine site infrastructure including accidents and malfunctions

The CDA's 2014 technical bulletin "Application of dam safety guidelines to mining dams" (Canadian Dam Association, 2014) states:

- The consequences of failure of a wet cover system can be more severe than for a dam containing a dry cover system. Not only will a dam break include the water forming the wet cover, but the tailings that are contained will be more mobile because they are saturated.

- The OMS requirements will be greater for a dam supporting a wet cover than a dry cover.
- A wet cover is more susceptible to variations in climate change.
- It is less likely that the dam could reach the Closure – Passive Care Phase and the dam may be in the Closure – Active Care Phase for perpetuity.
- The potential for creating a landform that is effectively a “walk away” closure solution is very difficult with a wet cover, more so than a dry cover.
- The regional ground water system could be affected as a result of long term seepage from the wet cover and through the tailings.
- Long term geochemical reactions and their effect on the elements within the dam will be more prevalent for a wet cover system than a dry cover system, particularly filters.

CMC states the following in its response to R110:

Casino Mining Corporation has taken a comprehensive and conservative approach to mine planning for closure to ensure that key objectives are met and that there is *no expectation of long-term active care*. (YOR 2014-0002-297-1)

CMC anticipates that closure and decommissioning activities can commence one year before the end of the operations *phase followed by a seven year active closure and decommissioning phase*. [emphasis added] (YOR 2014-0002-297-1)

CMC also states the following in its response to R111:

CMC has designed the Casino Project for a **long-term closure scenario of “passive care”, requiring only minimal management and maintenance during the post-closure period**. To this extent, an objective in designing the closure plan was to select the most well proven conventional “passive care” treatment methods that meet the Yukon Government’s requirements. [emphasis added] (YOR 2014-0002-297-1)

In light of the statements from the CDA technical bulletin above, it may prove unlikely to enter the closure - passive care phase due to the use of a water cover in perpetuity. This is contradictory to the proposed objectives of the Proponent for the post-closure phase of this project. The Executive Committee requires information regarding the level of care and maintenance required post-closure in perpetuity. Therefore, please provide the following information:

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

2.7.2 TMF Dam Failure

The Executive Committee previously requested a dam breach analysis with water and tailing inundation modeling consistent with the Canadian Dam Association’s *Dam Safety Guidelines* (R81). This request highlights “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 Proponent’s response to this request includes a commitment to “undertake a dam breach analysis and inundation model consistent with the Canadian Dam Association’s (CDA) dam safety guidelines.” The Executive

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Committee is generally satisfied with the Proponent's planned approach for conducting the dam breach/inundation study; however, the Executive Committee requires the results of this work prior to moving forward with the screening. Environment Canada echoes this requirement and notes that CMC's response defers the task to a later stage which does not:

allow for reviewers to evaluate proposed plans and mitigations during the actual environmental assessment phase. This information should be available for inclusion at the assessment stage in order to understand potential effects and significance.
(YOR 2014-0002-391-1)

The Executive Committee believes that there is a notable omission within CMC's response regarding potential environmental impacts from a TMF dam failure. Specifically, CMC notes that:

The effects of the governing (worst case) dam breach failure scenario will be assessed for the downstream environment. Within this assignment, this task will focus specifically on the impacts to downstream infrastructure, First Nation Settlement Lands, and other human impacts.

The Executive Committee requires, as per CDA guidelines, that the dam breach/inundation study also include an assessment of the environmental impacts associated with a release of tailings as "Environmental losses are often the most significant aspect of a mining dam failure" (Canadian Dam Association, 2014).

CMC also draws attention to the potential difficulty in conceiving credible failure modes. However, as noted by the Mining Association of BC, inundation studies

are based on hypothetical scenarios not connected to probability of occurrence. Any imaginable cause of failure, which has a probability greater than zero, is considered. For example, a dam with an extreme classification would be required to withstand an earthquake with a magnitude that has a probability of 0.0001% chance of occurring. However, the dam break analyses may assume this event could occur as a "hypothetical event" in the interest of being conservative when it comes to emergency preparedness and response planning. (Mining Association of British Columbia, 2015)

CMC notes that "standardized procedures and guidelines for conducting tailings dam breach modelling do not exist at this time in Canada, the US, or, to the best of our knowledge, any first world jurisdiction." As such, "the choice of what methodology is selected for tailings dam breach analyses, including whatever simplifying assumptions are made about the mode of failure and its defining characteristics, is largely reliant on the judgment and experience of the engineer." This highlights the importance of having adequate independent oversight for these tasks, which will inform the hazard classification, emergency response plans and, ultimately, the design of the TMF dam

The Executive Committee still requires the information previously requested to understand and assess potential effects within the downstream environment. Therefore, please provide the following information:

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

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

2.7.3 Quantity and Quality of Borrow Source Materials

The Executive Committee requested additional information regarding the sources and quantities of suitable borrow materials for the HLF (R43). CMC's response indicates that "Sufficient borrow materials are present on-site to satisfy the required quantities for construction of the heap leach facility." However, Appendix A.04Q Mine Site Borrow Materials Assessment Report recognizes that "additional site investigations, test work and design studies [will be] required to carry the project through to final design and construction" to "prove up suitability, availability and quantity of borrow materials for earthworks construction."

The Executive Committee has concerns that there is insufficient borrow materials at the mine site for construction. For example, the Mine Site Borrow Materials Assessment Report (Appendix A.4Q) indicates that 11 230 000 m³ of low permeability material is required for all facilities (p 11). This report further identifies that approximately 3 700 000 m³ is available on-site and states:

The borrow sources contain insufficient low permeability material for construction of the proposed project facilities at the Mine Site. The available quantities are slightly less than the amount required to construct the proposed Stage 1 (starter) dam of the Tailings Management Facility and the soil liner for the Heap Leach Facility. (YOR 2014-0002-321-1, p 11)

Based on the information provided in Appendix A.4Q, it is clear that there is insufficient low-permeability material on-site for construction of proposed mine site facilities.

Environment Canada notes that, "Given the uncertainties related to borrow sources variability and extent, and the need for these materials for several major components of the mine development, the Proponent should have all borrow sources identified and fully characterized for assessment purposes." Environment Canada highlights the importance of results from additional site investigations to evaluate potential effects as well as ensure that adequate mitigations are developed (YOR 2014-0002-391-1).

The Executive Committee requires additional information regarding the sources and quantities of suitable borrow materials for all mine site infrastructure and in particular the HLF and TMF. Therefore, please provide the following information:

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

2.7.4 Earthquakes

Saturation of Dam Components

The Adequacy Review Report requests “an explanation on the likelihood and implications of saturation of the TMF dam’s foundation, drains, and lower portions” (R69). The Proponent’s response to this request notes that, “The design objective is to maintain sand fill in an unsaturated state” and that, “Sufficient embankment drainage provisions will be provided to achieve this objective.” CMC also notes that monitoring of the embankment, including drainage conditions and provisions, will be monitored/reviewed with appropriate instrumentation for each stage of TMF expansion. The Proponent indicates that additional detail and analyses will be developed during detailed design and notes that, “The embankment drainage zones will be designed to be sufficiently oversized and robust to accommodate long-term fill settlements (with consideration of the large confining stresses) and potential deformations (e.g. due to earthquake loading).”

EcoMetrix notes that:

Monitoring of the condition of the embankment fill and the performance of the drainage system, although necessary, will not alleviate potential problems. If it is determined that the drainage system does not perform well when the dam is raised to, say, half of its final height, it will be too late in practical terms to improve the drainage measures.

The proposed design of the dam drainage system, which involves constructing of the 0.3 m thick drainage blanket under 286 m high dam constructed partly over soil foundations (that will settle, possibly differentially) with spacing of the drainage pipes at 230 m, is not considered adequate.

The SIR report does not provide adequate explanations requested in the ARR with respect to the “likelihood and implications of saturation of the TMF dam’s foundation, drains, and lower portions.” In fact, the engineering analyses presented in the 2015 Revised TMF Seepage Assessment report do not account for the downstream drainage blanket or the drainage pipes, which are conceptually designed to prevent the saturation of the lower portions of the dam. (YOR 2014-0002-399-1)

The Executive Committee understands CMC’s design objective, and necessary condition, is to maintain the sand fill in an unsaturated state through “sufficient embankment drainage provisions.” The Executive Committee also understands that additional work will be required to support detailed design. However, considering the observed site foundation conditions, including artesian conditions and potential for foundation drains below the water table, CMC has not provided information to support the assumption that the cycloned sand will remain well drained.

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

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

Earthquake Ground Motion

The Executive Committee requested “justification and rationale for using a factor of 1.5 for ground motion amplification for potential slip surfaces in the embankment foundation” in the Adequacy Review Report (R70).

SNC-Lavalin's review of CMC's response to R70 notes the following:

The site specific dynamic response to estimate potential ground motion amplification can be investigated in more detail during the detailed design. However an explanation about the similarity of the site conditions and the reviewed literature is required. (YOR 2014-0002-403-1)

The Executive Committee requires more information regarding ground motion amplification. Therefore, please provide the following information:

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

The Adequacy Review Report requests clarification if V_{s30} is site specific and how it was derived for the Project. SNC-Lavalin's review of the Proponent's response notes,

Since there is no SPT or shear wave velocity information presented in the Geotechnical Site Investigation report (2013) for the subsurface materials and based on the response to R70, it is inferred that the V_{s30} is estimated from the visual evaluation of the foundation material during the field investigation. There are not enough measured values in the TMF feasibility report to validate the assumption made by CMC for the shear velocity for the upper 30 m materials. (YOR 2014-0002-403-1)

The Executive Committee requires more information regarding estimations of shear wave velocity. Therefore, please provide the following information:

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

The Adequacy Review Report requests the mean peak ground acceleration (PGA) values as derived from the Proponent's EZ-FRISK analysis (R72). This request is not fulfilled in the Supplementary Information Report as SNC-Lavalin's review of the Proponent's response notes,

The mean PGA values for OBE and MDE were estimated using a factor of 1.2 from the median values. No explanation was provided to support this correlation factor. Since these values were used in pseudodynamic slope stability analysis, a robust calculation of them is important in feasibility study stage. (YOR 2014-0002-403-1)

The Executive Committee requires more information regarding mean peak ground acceleration. Therefore, please provide the following information:

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

2.7.5 Flood Modeling

The Executive Committee previously requested reassessment and remodeling of the inflow design flood (IDF) and probable maximum precipitation (PMP) using modern storm expansion techniques, including elaboration on methodology and rationale for a 100-year design snowpack (R75). Northland Earth and Water's (Northland) review of the Proponent's response to this request notes,

It does not appear that CMC has in fact reassessed and modelled the IDF and PMP using modern storm expansion techniques, they have merely identified how they have developed these parameters. It is noted that have used a scaling factor for PMP that is "believed to be reasonable conservative". CMC should provide or direct reviewers to evidence supporting this statement. As noted earlier it is unclear if the IDF chosen represents the worst case in terms of volume of inflow, this should be confirmed. (YOR 2014-0002-393-1)

Government of Yukon's (YG) review of CMC's response to this response notes the following:

ENV [Yukon Environment] requests the methodology for developing the 1000 year return period 24 hour precipitation value. As the precipitation regimes between California and the project site potentially differ significantly depending on the region, ENV believes it would be prudent to use more conservative values. Given the size and significant potential impact of failure of the tailings management facility (TMF), a PMP should be developed using more robust storm expansion techniques; this work should be carried out by a trained meteorologist with a background in PMP derivation.

A 100 year design snowpack of 256 mm was obtained. What is the rationale for using the 100 year return period event and not a greater return? An independent analysis suggests that 256 mm may be low for the 100 year return period event. Similarly, an independent analysis of inflow design flood (IDF) volumes suggests that the developed values may be low by a factor of 2. A more rigorous modelling approach should be used to estimate the inflow design flood.

The proponent states that the 100 year event was based on the high dam classification assigned to the TMF, for which the appropriate IDF of "one third between 1,000 years and the Probable Maximum Flood (PMF)" The PMF was computed with the PMP combined with the 100 year snowpack. This response is inadequate as it does not provide justification for using the 100 year snow water equivalent (SWE) instead of a more conservative higher return period. (YOR 2014-0002-395-1)

EcoMetrix's review of CMC's response to the related R33 notes the following: ¹

The information provided by the proponent is considered to be insufficient. A clear description has been provided of the methodology used to estimate the PMP. Notwithstanding, to mitigate the potential significance related to estimation of the

¹ R33 requests: "Detail and describe the methodology and references used to determine the probable maximum precipitation in relation to conveyance channel design and events pond standards"

PMP, given the applied methodology, the estimation could be further evaluated for validity in lieu of regional climate information with a longer period of record than that used to develop the rainfall frequency maps in the 1985 Rainfall Frequency Atlas for Canada.

With the methodology, the estimate of the PMP is sensitive to the value used for standard deviation of the annual extremes of rainfall. The potential significance is that the PMP may be greater than estimated, and the PMP is the basis for sizing of the critical water management components such as storage in the TMF and the TMF closure spillway. (YOR 2014-0002-399-1)

The Executive Committee requires more information regarding the methodology for estimating the PMP. Therefore, please provide the following information:

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

- a. An updated PMP estimate using more robust storm expansion techniques. This modelling must be done by a trained meteorologist with a background in PMP derivation;
- b. Justification for using the 100 year snowpack combined with the PMP for computing the PMF instead of a more conservative return period; and
- c. Evidence demonstrating that the IDF represents the worst case in terms of volume of inflow.

2.7.6 Spillways

The Adequacy Review Report requests “rationale for not constructing an emergency spillway for the TMF during operations” (R76). Comments received regarding the Proponent’s response express concern over the proposal’s continued exclusion of an emergency spillway for the TMF during operations. Northland’s review of CMC’s response notes the following:

Given the absence of an inundation study the selection of a consequence classification is premature; hence, the selection of the design flood during operations when no spillway is present is also premature. This should be revisited once the inundation study is completed and the classification is confirmed. (YOR 2014-0002-393-1)

EcoMetrix states:

Typically, the provision of an emergency spillway is critical in design of earthfill or rockfill dams that are not designed for overtopping. Notwithstanding the live storage proposed to be provided in the TMF and associated related assumptions, there are situations which could arise in which an emergency spillway would be required to protect the physical integrity of the dam: these could be the existence of higher operating water levels in the TMF than anticipated or unforeseen events which give rise to elevated water levels in the TMF. The reviewer further notes that this question will continue to be posed throughout evaluation of the project, and suggests that it would be to CMC’s advantage to support the proposed design in this regard at this time. (YOR 2014-0002-399-1)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Dr. Morgenstern's review of CMC's response to R76 notes the following:

I expect before this is settled, the IDF will be the PMF. The proponent should be asked for examples of major TMF's without spillings [sic]. There are many. It is common to accommodate the 100 year storm plus the PMF before violating free board (YOR 2014-0002-404-1)

The Executive Committee is pursuing information regarding the lack of an emergency spillway due to this demonstrated lack of confidence in the dam hazard classification and the potential for the chosen IDF to not be conservative. In light of the questions posed in this information request (requirements for IGRP oversight, risk assessment, updated dam hazard classification, updated predictions for PMP and PMF, and a dam breach/inundation study), the Executive Committee requires additional information about how the IDF will be protective against overtopping of the TMF, thus demonstrating that an emergency spillway is not required. Therefore, please provide the following information:

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

The Executive Committee requested a discussion of the potential for closure spillway blockages and the expected extent of maintenance and monitoring for the spillway (R79). The Proponent's response to this request indicates a low likelihood of spillway blockage "due to the large size of the spillway, the relative absence of large woody debris within the TMF catchment, and the likelihood that any such debris would be trapped within the wetlands up gradient of the spillway" (YOR 2014-0002-297-1). However, Northland highlights a deficiency in this response and suggests that CMC "address potential issues related to ice development in the spillway and post large flow event inspections that may be advisable" (YOR 2014-0002-393-1). Recognizing the importance of this spillway in perpetuity and how climate conditions may change over that timeline, the Executive Committee requires more information on maintenance and monitoring of the spillway. Therefore, please provide the following information:

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

Request 80 of the Adequacy Review Report seeks information on mitigations and monitoring activities for the closure spillway and downstream waterbodies in relation to erosion, including thresholds for any actions. The Proponent's response to this request states "details of mitigations, thresholds for implementation and monitoring activities associated with the closure spillway will be developed as part of the environmental management and monitoring plans prepared for submission for the Quartz Mining License and Water Use License applications." Northland replies "A response to the question should be requested" (YOR 2014-0002-393-1). As noted above, YG – EMR – Mineral Resources is requesting a conceptual OM&S plan for assessment purposes. Considering the importance of the closure spillway in managing extreme flood events and protecting the integrity of the embankment, the OM&S plan must include details regarding mitigations and monitoring activities for the spillway.

The Executive Committee requires a response to the original request. Therefore, please provide the following information:

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

2.7.7 HLF Failure

Request 77 of the Adequacy Review Report seeks “A discussion on potential consequences of HLF failure resulting in displacement of water in the TMF.” The Supplementary Information Report states impacts would be minimal to the HLF and that failure is unlikely and as such, no analysis of consequence to the TMF is needed.

Northland Earth and Water’s review of CMC’s response to R77 notes “This question asked for information about consequence and the response provided deals with likelihood. A response related to consequence should be provided (YOR 2014-0002-393-1).” EcoMetrix’s review of CMC’s response to this request notes, “A discussion on potential consequences of HLF failure resulting in displacement of water in the TMF. The information provided by the proponent is considered to be insufficient (YOR 2014-0002-399-1).”

The Executive Committee continues to have concerns with the potential consequence of an HLF failure that could affect the TMF, through all phases including post-closure. The Executive Committee requires additional information on this matter. Therefore, please provide the following information:

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

2.7.8 TMF Dam Core and Downstream Filter

As the Adequacy Review Report outlines, the proposed dam core and downstream filter seems thin relative to the height of the structure. The Executive Committee, in the Adequacy Review Report, requested rationale for the proposed thickness of these components, reflecting concerns raised regarding feasibility and long term performance (R82). The Proponent’s response states that deformation analysis of a 1 in 10 000 year earthquake shows that proposed core and filter widths are more than sufficient (YOR 2014-0002-297-1). Northland’s review of CMC’s response to this request notes, “CMC should be requested to expand their response related to core and filter thicknesses by providing a review of comparable designs” (YOR 2014-0002-393-1). EcoMetrix’s review of CMC’s response to this request stresses:

The information provided by the proponent is considered to be insufficient although the reviewer does not recommend requesting additional information. Because of the climatic conditions at the Casino site, the quality of dam construction (the fill placement and compaction) could be low. This points to the need to have the widths of the core and filters designed conservatively, that is, as wide as reasonably possible. The reviewer notes that given the maximum expected hydraulic head, the proposed thickness of the low permeability core is too narrow in comparison with

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

typical engineering standards. The predicted dam deformation and settlement from a 1/10,000 year earthquake at 0.5 m appears to be very low for a 286 m high dam. In summary, the SIR report does not provide convincing arguments for having such a narrow low permeability core. (YOR 2014-0002-399-1)

SNC-Lavalin's review of CMC's response to this request notes the following:

The current Feasibility Study report only evaluated the effect of a seismic load on the dam and did not consider the deformation response of the dam to the static load condition and the increase in pore pressure.

The high height/width ratio of the core and the downstream filter can cause buckling deformation during the embankment raise that may result in cracking of the core. The current Feasibility Study report only evaluated the effect of a seismic load on the dam and did not consider the deformation response of the dam to the static load condition and the increase in pore pressure. Since the feasibility of the proposed design is not supported adequately, more detailed stress-strain analysis should be performed to support the current design. (YOR 2014-0002-403-1)

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

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

CMC also states in their response to R82 that "a tailings beach will be developed upstream of the dam to accommodate subsequent raises. The tailings beach is an integral part of the design which keeps the pond at a distance from the dam. This reduces both the quantity of seepage and the hydraulic gradient."

Since the tailings beach is such an integral component of the design, the Executive Committee requires more information regarding the tailings beach design (e.g. beach length, width, slope, deposition strategies, construction QA/QC, monitoring and maintenance). It is not clear what the minimum design width is for the tailings beach and it is also not clear what the hydraulic gradient will be for the TMF dam (during operations, at closure and post-closure). If the Proponent is relying on the tailings beach as a critical design component, more information is warranted.

The Executive Committee requires further information regarding tailings beach design. Therefore, please provide the following information:

- R2-42. A comprehensive description of the tailings beach design including but not limited to: beach length, width, slope, deposition strategies, construction QA/QC and monitoring/maintenance requirements in perpetuity.
- R2-43. Quantification of the reduction of seepage and hydraulic gradient throughout the various phases of the TMF dam based on the chosen design. Provide an estimate of how the seepage and hydraulic gradient may change in perpetuity.

CMC also describes in the Feasibility Design of the Tailing Management Facility (YOR 2014-0002-243-1) report "the limitations in borrow material from the local resources for the purpose of the core

construction” and specifically on Page 66 of 279, “the borrow sources for the filter and transition zones have not been identified at this stage”.

The Executive Committee requires further information regarding borrow sources for the dam core. Please ensure that the responses to requests in sections 2.7.3 and 2.7.15 include comprehensive consideration on borrow material requirements (i.e. quantity and quality) for dam core construction.

2.7.9 Use of Cyclone Sand in Embankments

Incorporation of Fines in Embankment Material

The Adequacy Review Report notes that the presence of fines, in quantities as low as 10 percent, can cause frost susceptibility in sands and that the proposed 12 percent ceiling for fines in the TMF embankments may result in poor drainage characteristics. In relation to drainage, the Proponent's response draws on experience from other cyclone sand dams to justify the use of cycloned sand; however, EcoMetrix's review of CMC's response to R83 notes the following:

The information provided by the proponent is considered to be insufficient and the reviewer suggests that CMC provide information if laboratory tests have been conducted to assess whether 12% fines sand would be free-draining even under the very high stresses.

The 12% fines content leads to a sand that is not expected to be free-draining. Moreover, because of the very high stresses in the Casino tailings dam, the cyclone sand fill in the lower portions of the dam shell could have its less favourable drainage characteristics due to grain crushing. The 12% fines sand could also be frost susceptible. It could perhaps be shown from actual testing that the 12% fines cycloned sand would be efficiently free-draining even under the very high stresses. Laboratory testing could also be used to determine the frost susceptibility of the 12% fines sand. The results of such tests would be essential to support the use of cyclone sand tailings for the construction of the Casino tailings dam. There is no available information if such tests have been carried out or not. (YOR 2014-0002-399-1)

The Executive Committee requires more information regarding the use of cyclone sand within the TMF. Therefore, please provide the following information:

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

Cyclone Sand Physical Properties

Request 84 of the Adequacy Review Report requests testing or analysis to support the proposal's assumptions of pore pressures, shear strength, angles of friction, and contraction of cyclone sand, at all pressures found in the TMF embankments. Northland's review of CMC's response to R84 notes:

CMC comments that the stress conditions tested cover the majority of the embankment. They should be requested to specifically comment on whether the maximum anticipated stress for placed cyclone sand has been covered by completed testing. (YOR 2014-0002-393-1)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

EcoMetrix's review of CMC's response to R84 states:

The information provided by the proponent is considered to be insufficient and the reviewer suggests that CMC provide more information. As recognized in the 2010 Report on Laboratory Geotechnical Testing, the widely quoted paper by Leps (Review of Shearing Strength of Rockfill, Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 96, No. SM4, July 1970) predicts 30° angle of internal friction for angular sands while a value of 36° was assumed in the Casino dam designs based on very limited testing (four triaxial tests). Thus this value appears to be non-conservative. Also, it is not clear why this value can be assumed to apply to the tailings generated from processing of all of the three ore types. CMC should provide the information requested and address this comment (YOR 2014-0002-399-1)

The Executive Committee requires more information regarding the use of cyclone sand within the TMF. Therefore, please provide the following information:

R2-45. Information regarding sand properties including:

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

The proposal is unclear on the specific gravities of cyclone overflow and underflow as they appear higher than the combined specific gravity of the two. The Adequacy Review Report requested clarification of the specific gravities; the Proponent replies that "the inconsistency will be validated in detailed design by conducting additional specific gravity laboratory testing," and that "the specific gravity and dry density design estimate will be verified during detailed design" (YOR 2014-0002-297-1). Northland notes

The CMC response has not addressed the discrepancy that is present in the specific gravity values for the tailings sand products. It is suggested that the implications are minor. CMC should be requested to identify the actual source of the discrepancy by repeating the testing (if at all possible) or if not to explicitly identify the implications though appropriately conservative assumptions. (YOR 2014-0002-393-1)

The Executive Committee requires more information regarding the use of cyclone sand within the TMF. Therefore, please provide the following information:

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

Construction of Dam in Lifts

The Adequacy Review Report requests supporting evidence for the upper limit of 2 m for each lift of the TMF embankments (R96). EcoMetrix questions the response of the Proponent,

The information provided by the proponent is considered to be insufficient and the reviewer suggests that CMC provide more information. The proposed, up to 2.0 m thickness of the compacted tailings layer remains unjustified. The proponent's claim that the proposed 0.5 m to 2.0 m "range is based on typical lift thicknesses successfully used in existing operations with cyclone sand deposition" is not supported by revealing those existing operations. For the construction of a sand fill to be compacted to 95% standard Proctor density under summer conditions, say, in southern B.C., a typical specification would call for 0.3 m to 0.5 m lift thickness, sand moisture content within +/- 2% of the optimum and the use of 5-10 tonnes vibratory smooth drum compactor. The proponent claims that the same compaction would be achieved for a lift that is up to 2.0 m thick, the sand that is fully saturated with standing water over a lift surface and a mid-size bulldozer (see Figure A.4.9-2 included in the SIR report). This claim requires a very convincing and detailed justification that was not provided in the available information. (YOR 2014-0002-399-1)

As such, the Executive Committee requires more information regarding the use of cyclone sand within the TMF. Therefore, please provide the following information:

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

2.7.10 Faults and Shear Zones

The Adequacy Review Report requests "supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity" (R87). Natural Resources Canada's (NRCan) review of CMC's response to this request notes:

The proponent has stated that no earthquakes (>3.5M) are listed in the earthquake database within 80 km radius of the project site, as illustrated in Figure 3.1 (Appendix A.4D Report on the Feasibility Design of the TMF; R87 and R205). This indicates that faults in the project area have not been active for the period of record. Consequently, no evidence is available of any active faults. Given the long life of the proposed tailings dam, Lidar is a better method to help address the question of potentially active faults at this site. NRCan has received no response to its Round I IR # 5 in CMC's SIR. As previously requested, NRCan requests that the proponent provide information as to whether Lidar data has been collected to determine the presence or absence of young faults near the tailings dam (YOR 2014-0002-392-1)

SNC-Lavalin's review of CMC's response to R87 notes the following:

Since the dam foundation and the abutments will be on jointed rock, the preferential seepage can be formed along existing shear zones, faults or open joints. Therefore, the site investigation should be expanded to cover a detailed joint study of the abutments, foundation and more detailed geophysical analysis over the existing low velocity zones. CMC agreed to perform additional site investigation.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

CMC used a Lugeon Test and Falling head test to evaluate the permeability of the foundation rocks. The permeability in rocks depends on the joint condition and joint frequency of the rock and hence, a bulk permeability value cannot be assigned to the whole media. Also considering the rock as an isotropic medium is not normally a valid assumption and was nevertheless made in the seepage analysis report. We recommend using a geostatistical model of the permeability values at the dam foundation and classify the rock as per the seepage characteristics in the seepage model. (YOR 2014-0002-403-1)

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 information:

- R2-48. Supporting evidence for the absence or presence of faults and fractures within the TMF and embankment areas including their activity. Specifically:
- Confirm whether lidar data has been collected to determine the presence or absence of young faults near the tailings dam;
 - Provide the detailed joint surveying along the dam foundation and the abutments and update the seepage analysis report; and,
 - Provide a geostatistical model that represents the permeability characteristics of the bedrock below the dam foundation.

2.7.11 Hydraulic Conductivity of Bedrock and Overburden

In the Adequacy Review Report of January 27, 2015, R88 requests “additional drill results, with detailed analysis and discussion, to provide an accurate characterization of the hydraulic conductivity and identification of fault/shear zones within the embankment foundation.” The Executive Committee acknowledges the Proponent’s response to R88, which states

Additional work to characterize hydraulic conductivity within the embankment foundation is planned ahead of detailed design” will include “advancing new drillholes within the embankment foundation, conducting packer testing in the drillholes, and conducting response tests in standpipes. Trenching will also be conducted to identify fault/shear zones beneath the embankment foundation. (YOR 2014-0002-297-1)

Northland Earth and Water’s (Northland) review of CMC’s response to R88 states,

This question requested that additional field work (site characterization) be completed and the response has indicated that it has not been completed and will not be completed until detailed design (after the project assessment). An understanding of the issues that have been identified as needing additional data to address are important for the performance expectations of the TMF and the field work necessary should be provided to allow assessment of the project.” (YOR 2014-0002-393-1)

The Executive Committee agrees with Northland’s comments and as such requires further information on the hydraulic conductivity of bedrock and overburden beneath the TMF embankment. Therefore, please provide the following information:

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

The Executive Committee requested additional information regarding the cut off trench and seepage control for the TMF embankment including: details on the depth of the cut off trench in relation to overburden and fractured bedrock, the cut off trench's profile, implications of fractured bedrock and the potential use of a grout curtain to control seepage (R89). Northland's review of CMC's response to R89 states:

Information on the cutoff depth required in the bedrock has not been provided and would be expected to be informed by the further field work that has not been done in response to R88. In addition the response (to part "e" of the IR) suggests that some foundation grouting is expected to be necessary but that it will be challenging to complete due to the presence of permafrost. A more detailed consideration of the ability to complete the necessary grouting work should be required prior to assessment of the project. (YOR 2014-0002-393-1)

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 as well as seepage. Therefore, please provide the following information:

- R2-50. A description of how grouting can be successfully performed given the challenges presented by permafrost. Also, update the responses for R89 a – e of the ARR in accordance with the response to R2-49.
- R2-51. The rationale behind “the material is assumed to be isotropic” knowing the horizontal permeability is greater than vertical permeability in embankment dams that is constructed in several stages. Also assuming an isotropic permeability for the rock, will not be a valid assumption due to preferential seepage in the rock mass.
- R2-52. The justification on why no seepage barrier is proposed for the dam foundation despite the calculated seepage rate.
- R2-53. The anticipated seepage problems surrounding the storage area.

2.7.12 Presence of Frost-Susceptible or Frozen Materials During Construction

The Executive Committee previously requested “characterization of the dam foundation materials to confirm the presence and distribution of permafrost” (R90). In response to additional information presented by the Proponent, SCN-Lavalin comments:

Assessment of the creep and hydraulic properties of the permafrost under the embankment structures should be specifically undertaken during detailed design of the containment structures.

CMC outlined that “any delays during the construction season can be compensated by conducting construction in winter under less favourable condition”. Construction during cold season can increase the risk of material degradation due to permafrost and hence a QA/QC plan is required to present for construction in cold season.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

A detailed plan should be provided in the feasibility stage to evaluate and ensure that the foundation materials before the construction and during the embankment raise will be kept from the freezing and are clean from the frost susceptible materials. The current CMC response has not provided any information about the plan details for foundation material evaluation.

Placement of tailings in freezing months may result in segregation of solids and water fractions, with the formation of discrete ice lenses within the tailings mass. If the containment structure is constructed during freezing temperatures, is it possible that layers of frozen and unfrozen fill could co-exist within the structure. Such a situation may have occurred at a uranium mine in northern Saskatchewan. (YOR 2014-0002-403-1)

Northland Earth and Water's review of CMC's response to R90 states the following:

This IR was also a request for further site characterization and again this work has not been completed and should be required to inform the expected performance of the dam foundation. (YOR 2014-0002-393-1)

The Executive Committee also asked for details regarding plans to ensure embankment foundations do not incorporate frozen and/or frost susceptible materials during construction (R91). In response to the additional information provided by the Proponent, SCN-Lavalin notes,

The presence of frozen or frost susceptible material will degrade the strength of the foundation materials. The current CMC response has not provided any information about the plan details for foundation material evaluation (YOR 2014-0002-403-1)

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:

- R2-54. Details regarding permafrost and permafrost conditions in relation to the TMF, including:
- a. confirmation that an assessment of the hydraulic properties of the permafrost under the embankment structures studies will be conducted during the detailed design;
 - b. a winter construction execution plan that details measures and procedures for embankment placement of fill that ensures the fill soils are not frozen at the time of placement and compaction;
 - c. QA/QC plan for construction during the cold season;
 - d. details on permafrost conditions of the foundation materials before the construction and during the embankment raise;
 - e. a discussion regarding the potential segregation of solids and water fractions, with the formation of discrete ice lenses within the tailings mass and its implication for tailings management; and,
 - f. a discussion regarding the integrity implications of the potential frozen and unfrozen fill co-existing within the structure.

2.7.13 Cold Weather Construction of the TMF Dam

The Executive Committee requested a detailed schedule for the works required to construct the TMF before and during operations considering QA/QC requirements and any contingencies due to delays or weather conditions (R92). Northland Earth and Water's (Northland) response to supplementary information provided by the proponent regarding this request notes "The response to this IR does not provide the requested information. YESAB should require that the information be provided" (YOR 2013-0002-393-1). The Executive Committee agrees that the requested information is absent in the Supplementary Information Report.

SNC-Lavalin's review of CMC's response to R92 notes the following:

"CMC notes that "insulation" will be used to provide the TMF core from freezing. The properties and characteristics of this insulation and how it will be installed should be described. Given the present climatic regime of the site, and the presence of permafrost within the TMF subgrade, it is possible that permafrost aggrades into the TMF containment structure" (YOR 2014-0002-403-1)

The Executive Committee reiterates its original request in relation to the cold weather construction of the TMF embankments. Therefore, please provide the following information:

- R2-55. A detailed schedule for the works required to construct the TMF before and during operations. Consideration should be given to key QA/QC requirements and contingency planning for scheduling delays and freezing conditions.
- R2-56. QA/QC measures during the lifetime of the embankment to ensure the effectiveness of insulation and the core structure will not be affected by the action of freezing. Please also provide confirmation regarding if permafrost aggradation potential has been considered into the TMF containment structure? If permafrost aggradation has not been considered, provide a discussion regarding the potential of permafrost aggradation into the TMF.

Adherence to the proposed construction schedule appears critical to TMF storage requirements throughout operations. As such, The Executive Committee also requested information on the implications of scheduling delays and adverse weather conditions on the construction of the TMF (R93). The Executive Committee has received several comments speaking to the inadequacy the Supplementary Information Report in relation to this request. Northland, in its review of the Proponent's response to the request, notes

The response provided to this IR is insufficient and the implications of several of the high level contingency measures identified do not appear to have been reasonably examined. This IR represents an example of where a broad risk assessment process utilizing CMC's proposed independent review panel and key stakeholders should be required to provide a fulsome examination of delay risks. It is recommended that YESAB require, as part of adequacy, such as risk process related to the mine waste management plan generally and this particular concern specifically. (YOR 2014-0002-393-1)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

EcoMetrix's review of CMC's response to this request states:

The information provided by the proponent is considered to be insufficient and the reviewer suggests that CMC provide more information. According to the Updated Hydrometeorology Report, the average monthly temperatures at the Casino site are expected to be:

November -15.4°C

December -14.8°C

January -17.2°C

February -16.7°C

March -12.3°C

The assumption that winter conditions will necessitate the suspension of dam fill placement and compaction in December through February while no suspension would be required in November or March cannot be well justified from the predicted average monthly temperatures. (YOR 2014-0002-399-1)

SNC-Lavalin's review of CMC's response to R93 notes:

CMC outlined that "any delays during the construction season can be compensated by conducting construction in winter under less favourable condition". Construction during cold season can increase the risk of material degradation due to permafrost and hence a QA/QC plan is required to present for construction in cold season. (YOR 2014-0002-403-1)

While the Executive Committee is satisfied that the concerns raised by Northland are addressed by the questions on risk assessment in this report, the Executive Committee still requires additional information related to cold weather construction of the embankments. Therefore, please provide the following information:

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

The Executive Committee also requested more information on relevant examples of sand embankment dams constructed in cold weather environments and permafrost conditions, including any challenges, potential issues, or solutions regarding sand placement and QA/QC (R94). Northland comments on the Proponent's response to this request,

The response to this IR provides helpful information on the potential for cold weather cyclone operations; however, much more detail regarding the referenced examples

should be requested and a commitment to ensure the necessary infrastructure that would allow for winter operations should be identified. (YOR 2014-0002-393-1)

SNC-Lavalin's review of CMC's response this request notes,

Placement of tailings in freezing months may result in segregation of solids and water fractions, with the formation of discrete ice lenses within the tailings mass. Has this potential been considered and addressed in the tailings management plan?

If the containment structure is constructed during freezing temperatures, is it possible that layers of frozen and unfrozen fill could co-exist within the structure. Such a situation may have occurred at a uranium mine in northern Saskatchewan. Has CMC considered the integrity implications of such an event? Additional information is required. (YOR 2014-0002-403-1)

The Executive Committee requires additional information related to cold weather construction of the embankments. Therefore, please provide the following:

- R2-58. Further detail on the referenced examples provided in response to R94. Demonstrate how these examples are applicable to this project and how they support the proposed construction schedule and methodology. Include details regarding the equipment and infrastructure required to facilitate winter construction.
- R2-59. Discuss the implications of potentially incorporating frozen layers within the embankment (e.g. discrete ice lenses within the tailings mass; layers of frozen and unfrozen fill) to the stability and integrity of this infrastructure.

2.7.14 Surface Preparation

The Executive Committee requested additional information on the surface preparation needed for the TMF (R96). There are a number of concerns regarding the lack of details on this topic; for example, it was unclear if vegetation and soils would be left in place, and thus buried, by the TMF pond and embankment. In its review of the Proponent's response to this request, SNC-Lavalin advises,

CMC states "The underlying frozen soils will be excavated down to a competent bedrock or suitable overburden foundation, depending on the location relative to the embankment (as discussed in R89). Ice-rich materials are expected to be unsuitable for use as borrow in embankment construction and will be removed to spoil."

Given that the depth and extent of permafrost within the TMF area may not be completely characterized, the depth of permafrost may be many tens of meters thick, excavation of all permafrost soils may not be practical. (YOR 2014-0002-403-1)

The Executive Committee requires additional information with respect to ground surface preparation below the TMF.

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

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The lack of clarity on surface preparation also led the Executive Committee to request information on any hydrological changes expected from changing ground thermal conditions, especially in the context, if proposed, of buried vegetation and soils (R97). Northland Earth and Water's comments on the Proponents response to this request,

It is believed that CMC has misunderstood what was requested in this IR and so have not addressed the actual question. It is understood that the question related to changes in hydrological performance (for example infiltration) and not surface stability. (YOR 2014-0002-393-1)

Natural Resources Canada's (NRCan) review of CMC's response to R97 notes:

CMC discusses the effects of melting of ice rich soils and permafrost on slope stability. The only reference to hydrological changes is that "Preferential seepage paths may develop when ice filled discontinuities thaw. Bedrock may have to be steamed and grouted if this is the case."

NRCan notes that permafrost is currently present below the TMF (Appendix A.7M). NRCan's Round I information request was aimed at trying to receive more information on the potential changes in groundwater flow due to changing thermal conditions (e.g. melting permafrost in colluvial deposits and in bedrock beneath the TMF). The proponent acknowledges that "Frozen overburden and bedrock that are underlying part of the tailings impoundment and embankments are expected to thaw over time, as the tailings and water stored in the TMF will act as a heat source." However, there is little assessment of the change in groundwater flow that may result from melting permafrost.

NRCan does not believe that CMC has provided sufficient justification for not including lower (or zero) hydraulic conductivity in regions of frozen ground. The baseline hydrogeological model is calibrated to stream baseflow and groundwater levels without including any frozen ground in the model (i.e. no cells with hydraulic conductivity = 0) even though approximately 55% of the original model area is estimated to have permafrost (Appendix 7E, Table 3.2). Therefore, the baseline model calibration allows groundwater to flow through areas of permafrost which are currently barriers to groundwater flow. Consequently, the hydraulic conductivities in the unfrozen calibrated baseline model would likely be lower than those in a baseline model with 55% of the area underlain with permafrost. When the permafrost melts, the previously frozen ground in a baseline model with permafrost would have higher hydraulic conductivity and allow greater groundwater fluxes than for a baseline model calibrated without permafrost. NRCan seeks further justification of the validity of the baseline model calibration and its potential impact on groundwater flows in the Mine Effects models because the hydraulic conductivities are calibrated assuming there is no permafrost. (YOR 2014-0002-392-1)

SNC-Lavalin's review of CMC's response to R97 states:

CMC states "It is therefore recommended that all ice-rich overburden encountered during construction be removed along the entire foundation of the TMF embankments."

If the underlying ice-rich permafrost is deep, excavation of ice-rich overburden may not be practical.

CMC states “Ground ice is not expected to be significant in bedrock, and therefore the bedrock will provide a stable foundation for the embankments. Preferential seepage paths may develop when ice filled discontinuities thaw.”

Thick ice lenses within veins and fractures in otherwise competent igneous bedrock are known to exist. (For example, Raglan mine, northern Quebec; ice-rich veins were encountered to depths of about 8 m below ground surface). Has sufficient characterization of the ice content of bedrock been completed to assess the potential for ice-rich bedrock to depths up to 10 m below ground surface? (YOR 2014-0002-403-1)

The Executive Committee requires clarification on surface preparation; therefore, please provide the following information:

R2-61. Details regarding:

- a. A clear definition of ice-rich soils and rock;
- b. Characterization of the ice content of the near surface soils and rock to assess the potential volume of ice-rich materials to be excavated and disposed;
- c. A well-defined and rational methodology and decision making process to identify and characterize permafrost soils and rock that can be used to guide all excavation and stripping work;
- d. A detailed permafrost hazard map (predictive) and associated methodology that identifies type, nature, and magnitude of permafrost related hazards in the study area;
- e. If the TMF is situated on permafrost soils that are too deep to excavate, consideration of creep deformation of those permafrost soils resulting from placement of the TMF; and,
- f. Based on the map above, identification of specific risks to the Project (i.e. minesite infrastructure and the Northern Freegold Road) from identified permafrost hazards. The map should include consideration of climate change, as well, over the life of the Project.

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

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

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

2.7.15 TMF Dam Core Construction

The Adequacy Review Report requests additional data relating to the availability of non-frost susceptible materials for the construction of the dam core (R99), including demonstration that a

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

higher fines content (20 percent) is not frost susceptible. EcoMetrix's review of CMC's response to R99 notes the following:

The information provided by the proponent is considered to be insufficient. It is not clear how the core could be insulated. The proponent should indicate where insulating blankets and tarps were successfully used to prevent freezing of dam zones under winter conditions similar to those at Casino (YOR 2014-0002-399-1)

SNC-Lavalin's review of CMC's response to R99 notes the following:

CMC pointed out that adequate insulation will be made to keep the frost-susceptible core materials from freezing. Knowing the thin core thickness compared to the core height, any frost action can considerably degrade the core integrity. The properties and characteristics of this insulation and how it will be installed should be described. (YOR 2014-0002-403-1)

The Executive Committee requires additional information in relation to dam core construction methodology.

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

2.7.16 Starter Dam and Tailings Interface

The Adequacy Review Report requests additional data relating to the starter dam and tailings interface (R102). SNC-Lavalin's review of CMC's response to R102 notes the following:

CMC agreed that "additional transition zones will be required between the various construction materials to satisfy filter relationships and/or reduce differential settlement" However, all the seepage analysis and slope stability analysis in the feasibility study did not cover the presence of additional transition zones. (YOR 2014-0002-403-1)

The Executive Committee requires additional information in relation to dam transition zones. Therefore, please provide the following information:

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

2.8 LIQUEFIED NATURAL GAS AND DIESEL

2.8.1 Description of LNG Facilities

CMC provides information regarding hazards and design surrounding the LNG facilities in R105, however, no information regarding procedures or risk assessment in the case of forest fire was provided. Most information related to the precautions taken in the design of buildings to limit ignition sources within the project site, fire suppression and fire detection in the case of a small localized fire but not regarding what measures can address a risk to the facility from a wildfire such as a boiling liquid expanding vapor explosion (BLEVE). Therefore, please provide:

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

2.8.2 Description of Diesel Facilities

CMC provides some information regarding the diesel facilities in its response to R108 including the yearly and daily volume of diesel expected to be used and stored on-site. The importance of this component and the hazardous nature of diesel require that more information be provided to the Executive Committee regarding the diesel facilities and the location of the various components within the project area. Therefore, please provide the following information:

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

2.9 CONCEPTUAL CLOSURE AND RECLAMATION PLAN

2.9.1 Long-Term Closure and Ongoing Monitoring and Maintenance

In response to R111, CMC provides a discussion on various options for closure of the open pit, TMF, HLF, stockpile areas, and water management and treatment. However, there is no analysis or ranking to support or show how CMC arrived at the preferred closure option. Additionally, CMC does not respond to or provide information regarding long-term and short-term costs, care and maintenance requirements, nor long-term environmental risks.

EcoMetrix indicates that long-term feasibility of the wetland treatment remains unconfirmed and that it may not be appropriate to consider it a conventional and proven treatment method. (YOR 2014-0002-399-1) Additionally, EcoMetrix states:

The reviewer is not aware of even one example of a successful, full scale wetland treatment for uranium, molybdenum, sulphate, cadmium, copper and selenium at a flow of 220 L/s under the extremely cold climate of the Casino site. If such an example cannot be presented, stating that the proposed wetland treatment is proven and conventional appears to be misleading. (YOR 2014-0002-399-1)

In response to R112, CMC indicates that the conceptual closure plan developed is consistent with the Government of Yukon policies. CMC states that it is “of the opinion that the mine development and conceptual closure plan for the Casino Project meets the policies and objectives of the Yukon Mine Site Reclamation and Closure Policy to the extent which is practical and feasible” (YOR 2014-0002-297-1; p A.4-130). The Supplementary Information Report does not provide updated conceptual closure plan.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Government of Yukon, Energy Mines and Resources (EMR), states that it does not consider CMC's proposed approach to remotely and actively operate pit outflow throughout the closure period to be "passive" care (YOR 2014-0002-395-1). Additionally, EMR indicates that the proposed closure options related to water treatment and water management "have not been supported by feasibility assessment showing technical and economic viability in Yukon and alternatives that are proven have not been provided." Therefore, CMC's approach is not consistent with the *Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance* (Government of Yukon, 2013).

Tr'ondëk Hwëch'in consultant, Center for Science in Public Participation (CSP2), voices concern that there is insufficient detail on the proposed passive treatment system to ensure that long-term water quality will meet closure goals and regulatory requirements (YOR 2014-0002-397-1). CSP2 states that, while Government of Yukon's policy does not accept reliance on long-term active treatment, "If both the company and passive treatment fail then notwithstanding its policy the government will have no option to construct a water treatment facility that will at that point be essentially permanent" (YOR 2014-0002-397-1).

The Executive Committee requires additional information regarding the analysis of closure options including costs, care and maintenance requirements, and environmental risks. Furthermore, given comments from Government of Yukon, CSP2, and EcoMetrix, the Executive Committee requires additional information outlining how the conceptual closure plan conforms to Government of Yukon policy. Therefore, please provide the following information:

- R2-69. Further analysis of closure options including long-term and short-term costs, care and maintenance requirements, and long-term environmental risks. The options analysis should include:
 - a. open pit;
 - b. tailings management facility;
 - c. heap leach facility;
 - d. stockpile areas; and
 - e. water management and treatment.
- R2-70. Discussion and, if necessary, an update to the conceptual closure plan to take into account the most recent Government of Yukon *Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance* (Government of Yukon, 2013). Details should include:
 - a. additional closure methodology that demonstrates that the open pit water can passively flow to the TMF without continued intervention; and
 - b. identification of closure methodologies that have been demonstrated effective in northern environments, and that clearly meet the objectives described in Section 5 of the guidance document.

2.9.2 Design and Operation of Wetland Water Treatment System

In response to R116 and R117 of the Adequacy Review Report of January 27, 2015, CMC outlines a phased design and optimization program that is being used to develop the passive treatment system. This approach includes the following four phases:

1. site assessment and information gathering including technology selection and conceptual design;
2. bench/laboratory-scale and pilot-scale testing and optimization (controlled environment);
3. on-site demonstration-scale confirmation and optimization; and
4. full-scale implementation.

CMC initiated preliminary bench-scale testing and provided a report of a study conducted by the Yukon College. These results are provided in Appendix A.4K, Metal Uptake in Northern Constructed Wetlands. These results will be used to develop further bench and pilot scale studies. While the study provides results for removal of cadmium, copper, selenium and zinc uptake in two northern plant species, there are concerns with the preliminary nature of this study in relation to the broader Casino Mine and proposed passive treatment requirements. The study was conducted at a very small scale, soil substrate and water quality were synthesized using commercially available materials, and plants were sourced from wetlands in Whitehorse. The study was conducted using simulated northern summer conditions and does not account for seasonal variability. There is little to no information or discussion relating the results and recommendations of this study to proposed passive treatment system.

In response to R117, CMC states “studies are planned this year to assess the latent potential for remediation in natural wetlands at the Casino site to aid in designing the treatment wetlands in a site-specific and evidence-based manner.” (p A4-136) Given the importance of the passive treatment system for closure, the Executive Committee would expect to see more detailed and Project specific laboratory studies at this time.

The responses to R117 and R118 are conceptual. The Executive Committee recognizes that the passive treatment system, including the need for a bioreactor system as a contingency, will be determined through a phased program for design and optimization. However, details are not provided on triggers that will initiate study of contingency measures and an overall objective for the passive treatment systems. This includes details such as:

- minimum performance levels;
- clear objectives against which the performance of the passive treatment system will be compared to ensure no significant adverse effects are expected in the receiving environment; and
- additional contingency measures and the circumstances under which these treatment option would be considered.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

CMC does not provide an assessment of uncertainty in response to R119. Rather, CMC indicates that the phased approach outlined in response to R116 through R118 is designed to address uncertainties with passive treatment systems.

CMC does not provide a prediction of a worst-case scenario of downstream water quality assuming no treatment system. Rather, CMC states that it is not proposing a project without treatment of discharge prior to release and as such, have not predicted water quality without treatment. However, the intent of the request was to evaluate the potential effects related to the worst-case scenario of ineffective passive treatment.

In response to R121, CMC provides a number of additional passive contingency, alternative, or additional treatment options that could be implemented through the closure planning phase. These options are variations on the passive treatment system and water management to achieve goals. However, similar to concerns outlined above, details are not provided on triggers that will initiate study of contingency measures and an overall objective for the passive treatment systems. In response to R122, CMC does not consider conventional water treatment such as active treatment. Rather, CMC outlines the selection process and states that the proposed passive treatment system and approach are conventional treatment methods.

Various parties raise considerable concern about the level of information provided on the passive treatment system as well as the consideration of alternatives.

EcoMetrix states:

An alternative (fall back or contingency) treatment method should be identified to declare the proposed closure plan to be feasible. Considering the timeframe for developing a passive treatment system for the site, conventional treatment should also be considered in the shorter term, for cases such as temporary closure. (YOR 2014-0002-399-1, p 39)

Government of Yukon, Energy Mines and Resources (EMR) expresses similar concerns that information on the proposed passive treatment system is not supported by feasibility assessments showing technical and economic viability in Yukon (YOR 2014-0002-395-1). As such, this approach does not meet the Yukon Mine Site Reclamation and Closure Policy requirements for the use of new technologies. Additionally, EMR is concerned that the proposed use of solar powered decant valves has not been shown to be technically viable. EMR states: “Closure methodologies must be technically feasible to be supported by Yukon in a reclamation and closure plan, relying upon potential future technology is not appropriate” (YOR 2014-0002-395-1; p 26).

EMR also expresses concern that the information provided indicates that pilot scale testing will be required to develop proof-of-concept, flow-through rates, contaminant removal, and cold weather performance (YOR 2014-0002-395-1). Furthermore, EMR states:

Without sufficient testing it is not possible to determine whether or not this treatment technology will be sufficient for the site conditions and if another alternative is required. Until a pilot scale study supports the outcomes predicted, alternative treatments must also be considered in the assessment. (YOR 2014-0002-395-1; p 25)

EMR suggests that a full alternatives assessment be provided to show how alternative treatment technologies, other than wetland systems, were considered.

Similarly, Tr'ondëk Hwëch'in consultant, CSP2, notes that the proposed wetland treatment system is functionally undemonstrated and unproven (YOR 2014-0002-397-1). CSP2 states:

No reasonably demonstrated passive treatment method currently exists for the scope, scale, and conditions present at this site and until such alternative is demonstrated the company should be required to maintain a perpetual treatment option - even if only as a worst-case scenario. (YOR 2014-0002-0397-1; p 4)

CSP2 notes that the literature review submitted in response to R115 provides significant information relating to passive treatment systems in cold climates as well as the decision process for selecting the approach. However, CSP2 expresses concern that many of the systems have not performed as intended, and that there are a lack of examples with flow rates relevant to those proposed by the Project.

Additionally, even if perpetual active treatment is not an option, given Government of Yukon policy, under circumstances where the passive treatment system fails, there may be no other option than to use an active water treatment system. In order to ensure water quality is protective of the receiving environment, CSP2 suggests that CMC must either:

- 1) Demonstrate beyond a reasonable doubt that it has a viable water quality treatment method and plan.
- 2) Adjust the mine plan to ensure that all waters created and to be treated by the mine (from all sources including predicted facility effluents and seepage (such as pit, waste rock, and tailings)) are of a quality that can effectively be treated by existing, demonstrated non-perpetual technologies. The proposed passive wetland system is not sufficiently demonstrated to meet these criteria.
- 3) Include perpetual water quality treatment as a worst-case scenario.
- 4) An acknowledgement from the Yukon Government that affirmatively accepts that the CMC reclamation plan does not have a demonstrated, viable water treatment plan.

(YOR 2014-0002-397-1)

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 information:

- R2-71. In relation to examples of successful similar treatment systems provided in Appendix A.4H (Cold Climate Passive Treatment Systems Literature Review), a discussion on flow rates relative to those for the proposed project.
- R2-72. In relation to plans on field studies to support and refine the effectiveness of the wetland water treatment system, details on:
- a. what benchmarks (e.g. CCME WQO or SSWQO identified in proposal) will serve as the performance objectives for the overall passive treatment system

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

- b. what performance triggers (i.e. clear indication that the current strategy will not achieve treatment objectives) will be used during the development of the passive treatment system to identify when contingency treatment methods, such as development of bioreactors in the case of the HLF, will need to be investigated.
- R2-73. Contingency, alternative, or additional treatment options that could achieve water quality objectives should the passive treatment system not be viable or perform as required. Details should include:
- a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information;
 - b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed; and
 - c. a full alternatives assessment to demonstrate how alternative treatment technologies (that do not include wetland systems) were considered.
- R2-74. In order to evaluate the potential effects related to the worst case scenario of an ineffective passive treatment, prediction of a worst case scenario of downstream water quality assuming no treatment system. Predictions should extend as far downstream as necessary to demonstrate no further exceedances of the CCME surface water quality objectives attributed to the mine (or 90th percentile of background for those constituents that naturally exceed CCME).

In response to R123, CMC provides an explanation as to how the wetlands were sized through treatment capacity modelling. CMC indicates that the wetlands are designed and sized for critical time periods and therefore are able to accommodate for variable flow rates. It is understood that treatment efficiency is related to residence time and that the biggest possible wetland is not always the best approach. However, there remains a concern over the variability of inflow rates from the pit lake at different times. It is uncertain as to how residence time can be controlled when flows are expected to be so highly variable, and how the proposed control valves can be relied upon in such a remote area.

In response to R124, CMC states, “it is assumed that the equipment will be serviced annually, but otherwise the system will be able to operate unattended. CMC is confident that the technology to remotely operate the open pit decant system will be readily available when the open pit is predicted to overflow (i.e., 95+ years)” (YOR 2014-0002-0297-1; p A4-140). Environment Canada notes that CMC has not provided information in relation to: contingency planning related to malfunctions, inappropriate feedback and interaction; and case studies where such systems are effectively used (YOR 2014-0002-391-1).

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

- R2-75. A discussion and rationale on how the design of the north end of the tailings management facility wetlands will accommodate a range of possible flows from the pit lake. Identify how

residence time can be controlled when flows are expected to be so highly variable, and how the proposed control valves could be relied upon in such a remote area.

R2-76. Details and design considerations for the remotely operated solar powered decant valves. Details should include:

- a. contingency planning related to malfunctions, inappropriate feedback and interaction; and
- b. examples where such systems are effectively used in similar northern or cold climate conditions.

2.9.3 Open Pit Stability

CMC's response to R128 addresses concerns related to health and safety and overtopping the pit through wave action in the event of pit wall failure. Pit wall failure could also affect water quality in the pit lake due to additional rock in the pit lake and freshly exposed rock on the pit walls. Government of Yukon, Energy Mines and Resources indicates that potential impacts to pit water quality and water treatment capabilities are sufficient in the event of pit wall failure (YOR 2014-0002-395-1). The Executive Committee requires additional information to understand the risk associated with potential pit instability in post-closure. Therefore, please provide the following information:

R2-77. Details regarding potential impacts to pit water quality, and demonstrate water treatment capabilities in the TMF are sufficient, if a pit wall fails and there is a spike in metals and/or acidity in pit water.

2.9.4 HLF Closure and Cyanide

CMC does not provide any examples of successful heap rinsing at comparable sites in their response to R131. The request for examples at comparable sites where materials are of a similar nature, mass and northern location intended to provide confidence in the effectiveness of the process for rinsing the HLF.

In response to R133, CMC indicates that the HLF liner would be perforated after the rinsing stage to allow drainage to flow to the TMF. While this approach seems reasonable to prevent fluid impoundment behind the HLF embankment after closure, it is uncertain how the liner would be perforated.

The Executive Committee requires additional information to support the approach to rinsing and closing the HLF. Therefore, please provide the following information:

R2-78. Examples of successful heap rinsing at comparable sites where materials of a similar nature, mass and northern location have been encountered.

R2-79. A description how the liner in the HLF will be perforated following completion of the rinsing stage. Include a description of how drainage flowing from the HLF through the perforated liner will be captured by the TMF.

2.9.5 HLF and Cover Material

The Executive Committee requires confidence that a suitable cover can be constructed to minimize infiltration to the HLF after closure. In response to R134, CMC reiterates that it expects to achieve an annual infiltration rate of 20 percent using 0.75 m of low permeability material sourced from on-site locations. CMC indicates that this low permeability material is similar to the material required for the core of the dam.

The Mine Site Borrow Materials Assessment Report (Appendix A.4Q) provided in response to R100 indicates that 11 230 000 m³ of low permeability material is required for all facilities (p 11). Of this volume, 530 000 m³ is required for the HLF cover. This report further identifies that approximately 3 700 000 m³ is available on-site and states:

The borrow sources contain insufficient low permeability material for construction of the proposed project facilities at the Mine Site. The available quantities are slightly less than the amount required to construct the proposed Stage 1 (starter) dam of the Tailings Management Facility and the soil liner for the Heap Leach Facility. (YOR 2014-0002-321-1, p 11)

CMC indicates that a low permeability geosynthetic membrane can be used to reduce infiltration on flat areas in the event that insufficient low permeability material is available on-site. As recognized by CMC, a geosynthetic membrane used in cover design, while very effective at reducing infiltration, can have implications on the stability of the cover.

Based on the information provided in Appendix A.4Q, it is clear that there is insufficient low-permeability material on-site for construction of proposed mine site facilities. While CMC could choose to allocate the full amount of low-permeability material required for the HLF cover, this would require further changes to the TMF dam core design (as discussed under Section 2.7.3). CMC must provide feasible designs supported by on-site characterizations.

The Executive Committee requires additional information to provide confidence that a suitable HLF cover can be constructed to minimize infiltration to the HLF after closure. Therefore, please provide the following information:

- R2-80. Details on the design of the HLF cover. Details should include:
- a. details of construction materials and methods being proposed (e.g. on-site borrow material and/or geosynthetic liner) and supported by on-site characterization;
 - b. consideration of other mine-site facility requirements for low-permeability material; and
 - c. stability and long-term maintenance requirements if incorporating a geosynthetic liner.

2.9.6 TMF Winter Seepage Mitigation Pond

CMC does not provide additional details on the winter seepage mitigation pond (now referred to as “water management pond” or “WMP”) or the cut-off wall and cut-off trench/barrier as requested in R135 and R137. Rather CMC indicates that feasibility level design requires additional site investigation and will be done for future Quartz Mining License and Water Use License applications.

EcoMetrix states that since this information and level of detail is not available “the feasibility of the WMP cannot be confirmed” (YOR 2014-0002-399-1, p 48). Additionally, given that design details are not available, EcoMetrix cannot confirm that 100 percent of the seepage from the TMF can be intercepted by the water management pond.

The Executive Committee requires more information on the water management pond in order to ensure the effectiveness in capturing seepage from the tailings management facility. Therefore, please provide the following information:

- R2-81. Feasibility level design details for the water management pond cut-off wall and cut-off trench/barrier. Include a discussion of how the structures are to be constructed. Details should include:
- a. details on how CMC will ensure that all groundwater seepage is collected in the water management pond as designed and modelled;
 - b. what monitoring will be set up to ensure that the water management pond is performing as predicted, including groundwater and seepage monitoring; and
 - c. contingencies for all project phases, in case the water management pond does not perform as expected, including if groundwater/seepage is found to by-pass the water management pond.
- R2-82. Additional details about the water management pond dam should include:
- a. cross-sections;
 - b. construction materials;
 - c. consequence of failure classification;
 - d. detailed foundation characterization; and
 - e. monitoring and maintenance requirements.

2.9.7 Temporary or Early Closure

Significant detail is provided in CMC’s response to R141 with regards to measures that may be required in the event of temporary or early closure. In response to R142, CMC does not provide 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. Rather, CMC re-iterates that Government of Yukon’s policy that does not allow for a reliance on long-term active treatment. CMC intends to continue their test work to verify the effectiveness of the passive treatment system. Additionally, this test work will be completed early in operations so results are available in the event of temporary or early closure.

The same concerns outlined in section 2.9.2 are applicable to contingencies or alternatives related to temporary or early closure. In the above noted section, various parties have raised considerable concern regarding the level of information provided on the passive treatment system as well as the consideration of alternatives. Both EcoMetrix (YOR 2014-0002-399-1) and Tr’ondëk Hwëch’in

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

consultant, CSP2 (YOR 2014-0002-397-1), note that no contingency measures or alternatives to passive treatment have been provided in response to R142.

As CMC clearly outlines in their response to R141, measures required in the event of early or temporary closure will be dependent of factors such as duration and extent of mining activities and therefore may differ from final reclamation plans. Similarly, contingencies and alternatives may differ from those identified for final closure.

The Executive Committee requires more information regarding contingencies or alternatives related to the water treatment system proposed for the Project in the event of temporary or early closure. Therefore, please provide the following information:

- R2-83. Contingency measures or alternatives that may be required in the event of early closure if passive treatment system field trials have not been completed or are shown to be unsuccessful. Details should include:
- a. identification of alternative treatment methodologies that can be employed at the site with best practicable technologies that is supported by comprehensive technical information;
 - b. a conventional water treatment option within the framework of the water treatment plan for temporary and final closure. This should include the circumstances and triggers under which this treatment option would be developed.

2.9.8 Mine Reclamation and Security

The Supplementary Information Report does not update the conceptual closure and reclamation plan (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). Rather, in response to R143 and R144, CMC indicates that the CCRP will be refined through the permitting process and will include a detailed estimate of costs. CMC provides an outline of cost estimates in Table A.4.11-11 to support the \$125.9 million required.

Table A.4.11-11 (Feasibility Reclamation and Closure Cost Estimate) is general in nature and appears to exclude key mine components. Additionally, there is no consideration for temporary or early closure or accidents and malfunctions. In comparing Table A.4.11-11 with the CCRP, the following components do not seem to be accounted for in the cost estimate:

- reclamation of the heap leach facility including detoxification, draindown, and closure;
- decommissioning of the Freegold Road Extension;
- topsoil and vegetation for the tailings beach, embankment, building sites;
- removal of contaminated material from all stockpile areas; and
- landfill and waste disposal.

Tr'ondëk Hwëch'in consultant, CSP2, notes the lack estimates for HLF closure as well as a mathematical error in table A.4.11-11 (YOR 2014-0002-397-1). The building closure total does not account for all estimates under decommissioning of buildings.

Government of Yukon, Departments of Energy Mines and Resources (EMR) and Health and Social Services (HSS) (YOR 2014-0002-395-1) and CSP2 raise additional questions surrounding the estimates for post-closure monitoring and maintenance.

EMR indicates that, although costs will not be exact given the stage of the process, CMC should provide enough certainty with cost estimates related to the effort required for temporary closure, permanent closure, and long-term care and maintenance. EMR states:

In the case of the Casino Project, as proposed, there will be a requirement in perpetuity to maintain the TMF in a physically stable manner to continue to provide chemical containment, to ensure water quality from the TMF is suitable for discharge, the open pit water is suitable for discharge to the TMF, and many other elements. The estimate provided in R144 does not show that CMC fully appreciates the requirements and cost of ongoing care and maintenance for a site with these long-term liabilities. At the Minto Mine, it is expected that the ongoing care and maintenance will cost approximately \$800,000 over a one-year period and maintaining the Wolverine Mine in a state of care and maintenance is expected to cost \$2,700,000 for a three-month period. Both of these sites are substantially smaller and the level of effort is not the same scale as the Casino Project. (YOR 2014-0002-395-1, p 27)

HSS adds that details should be provided to show how estimates in post-closure monitoring and maintenance account for infrastructure repairs and maintenance as well as site caretaker requirements over a 200-year period (YOR 2014-0002-395-1). Likewise, CSP2 indicates that additional details should be provided to outline what types of monitoring and maintenance would be funded under these estimates (YOR 2014-0002-397-1).

EMR suggests:

CMC should provide detail on the care and maintenance costs in perpetuity – this estimate should be supported by a conceptual operations, maintenance, and surveillance manual for the TMF which documents the ongoing care and maintenance requirements during the closure and post-closure period. Costing should be presented as a net present value calculation using current bank interest rates for at least a 200 year period into the future, and should include periodic maintenance and repair costs as well as monitoring costs. (YOR 2014-0002-395-1, p 27)

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.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The Executive Committee requires additional information regarding mine reclamation and security within the CCRP. Therefore, please provide the following information:

- R2-84. Update the CCRP and security estimates based on the Government of Yukon's updated guidance document: Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance (Government of Yukon, 2013).
- R2-85. Additional justification and discussion on security estimates based on new information generated by questions throughout this report. Details should include:
 - a. all major mine components;
 - b. all reclamation and closure stages;
 - c. consideration of temporary or early closure;
 - d. consideration of accidents and malfunctions, including the implications of structural and non-structural failures of the TMF dam; and
 - e. consideration of effects of the environment.

2.10 WASTE MANAGEMENT

Original proposal documentation lacked details about the waste management strategy of the Project. The Supplementary Information Report provides new information about waste management for the Project; however, more information is needed in order to assess potential effects. Details regarding the use, location, size, and construction of the landfill are unknown as are certain aspects of the incinerator. The Executive Committee requires more information on waste management. Therefore, please provide the following information:

- R2-86. Location, size, volume, and hydrology of the landfill site.
- R2-87. Anticipated volume of landfill space required for different waste streams.
- R2-88. A description of the liner and/or leachate collection system proposed, including details for maintenance, operation, and closure.

3.0 TERRAIN FEATURES

3.1 PERMAFROST

R147 from the ARR requested 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. YG's review of CMC's response to R147 notes:

CMC has stated that all soils including permafrost will be removed and that mine infrastructure will be developed on solid rock foundations. However, it still remains unclear if permafrost berms will be used for tailing ponds and if so, how they will be managed to ensure they are secure. (YOR 2014-0002-395-1)

EcoMetrix's review of CMC's response to R147 notes:

Consideration should be given to the effects of permafrost degradation related to site infrastructure and climate change. The information provided by the proponent is considered to be not adequate and the reviewer suggests that CMC provide more information. The proponent states that with the mitigation measures, permafrost degradation will not affect the slopes of the Casino Creek valley. However, those mitigation measures do not seem to be identified. (YOR 2014-0002-399-1).

The Executive Committee requires additional information on permafrost. Therefore, please provide the following information:

- R2-89. Carification if permafrost berms will be used for tailing ponds and if so, how they will be managed to ensure they are secure.
- R2-90. A description of the mitigations that will be used with respect to valley slopes and permafrost.

SNC-Lavalin's review of CMC's response to R147 notes the following:

There is insufficient characterization of the ice content of the near surface soils and rock to allow assessment of the short and long-term stability of mine infrastructure and surrounding slopes. For example: Thick ice lenses within veins and fractures in otherwise competent igneous bedrock are known to exist. See Raglan mine case in northern Quebec; ice-rich veins were encountered to depths of about 8 m below ground surface.

In addition, the statement by CMC: "In general, construction and site preparation techniques on permafrost require frozen, organic and ice rich colluvium and residual soils to be ripped, blasted and/or excavated to competent, non-frost susceptible bedrock for subgrade preparation" to be overly precautionous. It is recommended that a well-defined and rational methodology and decision making process be developed to identify and characterize permafrost soils and rock that can be used to guide any excavation and stripping work.

The statement by CMC "The exposed bedrock will provide a thaw-stable foundation for mine infrastructure" may, in contrast, be overly optimistic. As noted above, ice-rich fractures and veins were encountered to depths of about [8 m] in igneous rock at the Raglan Mine in northern Quebec. (YOR 2014-0002-403-1)

The Executive Committee agrees with these comments and requires additional information on permafrost as noted in R2-91.

3.2 THERMAL EROSION MODELING

CMC has not provided 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 as requested in R149 and R150. SNC-Lavalin's review of CMC's response to R149 notes the following:

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Geothermal analysis is considered to be critical when engineering in permafrost rich terrain. In this case, the analysis should be intended to predict response to TMF and related infrastructure on permafrost terrain.

It appears that solifluction lobes are outlined individually, but as terrain units rather than hazards within terrain units, thereby negating the usefulness of the terrain polygon – the ability to predict first-time hazards by relating terrain to similar terrain that is experiencing failures. (YOR 2014-0002-403-1)

The Executive Committee requires additional information in relation to ground thermal condition and permafrost. Therefore, please provide the following:

- R2-91. A geothermal analysis and associated methodology that predicts response to the proposed TMF and associated infrastructure on permafrost conditions, considering the following:
- Heat generated from the waste rock and processed ore after disposal.
 - Potential for solifluction, active layer detachment flows and similar mass wasting processes to occur at slope adjacent areas and embankments.
 - Freezing and thawing of mine tailings and embankment soil.
 - If the TMF is founded on permafrost soils that are too deep to excavate, creep deformation of those permafrost soils a result of the placement of the TMF should be considered.
 - Characterization of the subgrade under any containment structures is critical. Issues of geothermal state (frozen or unfrozen), ground temperature, unfrozen water content, salinity, creep strength and others may be important as part of the assessment process.
 - Effects of the proposed project on geothermal regime.

SNC-Lavalin's review of CMC's response to R150 notes the following:

Increases and changes in ground temperature, will likely result in the declining of the amount and depth of permafrost. Permafrost degradation is considered to be critical when determining foundation stability. When the permafrost degrades, the load-bearing capacity of the permafrost decreases and the soil become unstable.

Processes such as (buckling, sinking, slumping, etc. can occur. These processes have the potential to cause damage to proposed facilities. (YOR 2014-0002-403-1)

The Executive Committee requires further information related to foundation stability as requested in R2-91.

3.3 GROUND THERMAL CONDITION AND PERMAFROST TEMPERATURE MONITORING

CMC provides responses to questions R151 to R153. SNC-Lavalin's review of CMC's response to R153 notes the following:

The statement by CMC "The plan includes installation of thermistors in the swamp areas on the valley floors where the permafrost table is expected to be close to ground surface and the potential is greater for massive ground ice" is simplistic. Ice-

rich soils or massive ice may exist under or within other soils, such as colluvium.
(YOR 2014-0002-403-1)

The Executive Committee requires further information in relation to R151 to R153 in terms of ground temperatures data, trends and ground temperature monitoring for the Freegold Road Extension.

Therefore, please provide the following information:

- R2-92. Additional details in relation to temperatures data, trends and ground temperature monitoring for the Freegold Road Extension including:
- A discussion regarding possible warming trend in the near surface based on the available ground temperature data. For example: Does the post 1994 ground temperature data exhibit any warming trend in the near surface temperatures? Is the active layer thickening?
 - If thermistors were installed in 2011 and 2012, up to four years of ground temperature data has been collected. Please report on this data.
 - If the 1994 thermistor cables are in the same location as the 2011 and 2012 thermistor cables. Please combine the data and provide some inferences as to long-term trends in mean annual ground temperatures.
 - The installation of thermistor strings to monitor ground temperatures and develop “trumpet curves” is an appropriate development by CMC. These data should be used to establish baseline mean annual ground temperatures values.

3.4 SURFICIAL GEOLOGY AND TERRAIN MAPPING METHOD AND MAPS

NRCan's review of CMC's response to R155 notes the following:

although the legend is better explained by the proponent (YESAB's R155), it is still a very complicated legend that could be easily simplified to make the map more legible. NRCan would like to re-iterate its Round I IR #1 (April 2014) that the proponent should provide a simpler legend with a simpler interpretation of the terrain units for a better understanding of the terrain maps. (YOR 2014-0002-392-1)

SNC-Lavalin's review of CMC's response to terrain hazard mapping and methodology notes the following:

Terrain mapping along the road is very coarse and does not include features that are resolvable even on the contour maps and that are normally linked to hazards that may affect the road or facilities (e.g. major gullies)...

No terrain hazards are considered that begin outside the buffer. For terrain hazards, a buffer approach is not recommended for this very reason. In many cases, terrain hazards that have potential to impact the proposed infrastructure (i.e. roads) from outside the buffer are likely to be as important, or more important, than those initiating from the polygon.

Snow avalanche potential has been identified but not included in the terrain hazard maps. Some attempt at creating a hazard inventory has begun, but it appears incomplete. No detailed permafrost survey has been compiled; landslides are contained in a table but not explicitly related to terrain units; no attempt to link

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

hazards to terrain polygons has occurred except for the definitions in Table 3 which appear to be largely heuristic (and occasionally incorrect). No quantitative or detailed definitions for the terrain stability classes are presented except the criteria used to create them (forming a circular definition).

- No soils erosion map is presented (including, as appropriate, thermal erosion potential).
- No risk map has been created for the proposed mine site. (YOR 2014-0002-403-1)

The Executive Committee requires additional information in relation to terrain hazard mapping.

Therefore, please provide the following information:

- R2-93. A reference to the legend used in the baseline terrain maps as well as a simpler interpretation (label) of the units, especially those with multiple capital letters and integers.
- R2-94. A Hazard Map and associated methodology that:
- a. Predicts the type, nature, frequency and magnitude of all hazards in the study area.
 - b. Where the study area is bound by moderate to steep slopes please modify the terrain map and the terrain stability map to include upslope areas (to the height of land). Note: In the case of the road, this only need apply to the side of the valley that supports the road.
 - c. Where the study area is bound by moderate to steep slopes please increase the detail of the mapping to capture areas commonly associated with hazards such as gullies but not currently mapped.
 - d. From the map above, if appropriate, identify specific risks to the project.
 - e. From the map above, if appropriate, identify specific risks to the environment from the project.
 - f. Based on the risk identified in response to the questions above, please provide general options and considerations for engineering design to mitigate the identified risks.

3.5 TERRAIN HAZARDS ASSESSMENT

R156 of the ARR asked CMC to 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).

SNC-Lavalin's review of CMC's response to R156 notes the following:

[The] terrain hazard classification scheme presented by CMC is insufficient...

Terrain mapping along the road is very coarse and does not include features that are resolvable even on the contour maps and that are normally linked to hazards that may affect the road or facilities (e.g. major gullies) The terrain stability map does not appear to be made-for-purpose, but instead is a simple transfer of a forestry-based

procedure. “Terrain stability refers to the likelihood of a landslide initiating in a polygon following road construction activities and timber harvesting”

Terrain hazard maps refer only to the potential of a hazard initiating from within a polygon and not the likelihood of a hazard from outside the polygon affecting the proposed infrastructure (road, mine, airstrip etc...) (YOR 2014-0002-403-1)

SNC-Lavalin’s review also notes that

Other fluvial hazards such as river ice buildup, ice jams, and thermokarst (thaw lakes) will also have a direct impact on the construction and continual maintenance of the road. Ice Jams will likely be a concern for the larger crossings at Nordenskiöld River, and possibly the Seymour Creek crossing.

There are a number of crossings located on areas mapped as alluvial fans. Depositional process of these fans is not discussed as being from general flooding, debris floods or debris flows. Determination of the dominant depositional process from each of these crossings across fans can be modelled using the specific drainage attributes at each crossing. This information will aid in choosing the most suitable crossing designs at each location.

Airphoto analysis was performed at each of the crossings or impingement sites with comments on relative stability of the channel. Rates of lateral migration provided in the report are ambiguous ratings of low moderate and high or other identifiers such as substantial, rapid, gradual, minor, etc. A relation to some quantitative estimate of what is meant by a low to high lateral migration rate would be useful. (YOR 2014-0002-403-1)

The Executive Committee requires additional information in relation to terrain hazards assessment. Therefore, please provide the following information:

R2-95. Additional details in relation to terrain hazards assessment including:

- a. Table 1, Table 2, Figure 1, and Figure 2 referenced to in the Fluvial Geomorphology report.
- b. More detail on river ice buildup, ice jams, and thermokarst processes in relation to the proposed Freegold Road extension, Airstrip Access Road.
- c. Watershed characteristics (watershed area, watershed length, relief, and melt ratio) for each road crossing of a side channel feeding into the main valley and provide comment on dominant depositional process at each crossing.
- d. A correlation of lateral migration rate descriptors to an actual measured rate of migration (i.e. low = 0 to 0.1 m/year).

SNC-Lavalin’s review of CMC’s response to R157 notes the following:

Permafrost is identified on several of the terrain maps and described as occurring throughout the area including “between Ch. 38+000 and Ch. 50+000 and between Ch. 58+000 and 61+500, as well as the site of the proposed Air Strip...is consequently susceptible to a shallow permafrost table with the possibility of massive ground ice”, as well as thermal erosion in a gully (10+400), pingos (9+400), polygonal ground (60+000) and the Dip Creek crossing, ice rich soils in the vicinity of the air strip alignment, and generally encountered permafrost at 0.5 m depth in hand-dug

test pit (north facing mid-slopes, colluvial aprons and floodplains). Despite the abundance of Permafrost, KP explicitly state that “Thermal erosion is not incorporated into the [Terrain Stability] classification scheme”. Additional information is required. (YOR 2014-0002-403-1)

The Executive Committee requires further information in relation to permafrost and thermal erosion. Therefore, please provide the following information:

- R2-96. A soil erosion potential analysis for the LSA that includes the component of thermal erosion where permafrost is identified as being present.

4.0 WATER QUALITY AND QUANTITY

4.1 WATER AND SEDIMENT QUALITY BASELINE

4.1.1 Water Quality

In response to R162, CMC identifies the location of data in the previously submitted Appendix B5 of the Casino Project Water and Sediment Quality Baseline Report (Appendix 7A). Appendix B5 was updated to provide sufficient decimal places for values and provided in Appendix A.7D. EcoMetrix indicates that the Proponent assumes the data are normally distributed, without presenting any analysis (YOR 2014-0002-399-1).

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

- R2-97. An analysis regarding dataset robustness. This should include verifying the distribution of the data and if necessary, characterize the data in an alternative appropriate manner (e.g. characterize the data as percentiles).

4.2 HYDROLOGY BASELINE

Environment Canada (YOR 2014-0002-391-1) stresses concerns regarding the hydrology of the Yukon River and if the proposed water removal rates will require a licence under the *International River Improvements Act*. The International River Improvement Regulation allows two exceptions to the application of the act. One is that the removal rate from the river is less than $0.3 \text{ m}^3/\text{s}$. The second exception is that the rate of water removal from the river does not lower the level of the river by more than 3 cm at the border where the water flows from Canada into the United States. According to the information presented by the Proponent there will be times when the rate of water taken from the Yukon River will exceed $0.3 \text{ m}^3/\text{s}$. The Executive Committee requires more information on hydrology baseline information. Therefore, please provide the following:

- R2-98. Clarification if at any time, the rate of water removal, for the Project, from the Yukon River will cause the water level on the river at the Canada – US border to drop by more than 3 cm.

4.3 GEOCHEMISTRY AND SOURCE TERM PREDICTIONS

4.3.1 Geochemical Characterization of Ore, Waste Rock and Tailings

As indicated in response to R182, secondary mineral assemblages, oxide leach cap and supergene zones, rather than lithologies are considered the primary drivers of acid rock drainage and metal leaching. Environment Canada suggests that, for Table A.7.6-2, samples should be broken down into alteration type rather than simply lithological unit (YOR 2014-0002-391-1). Similarly, Environment Canada suggests that Table A.7.6-3 should include data on non-acid generating (NAG) rock in addition to potential acid generating (PAG) rock and include alteration type. EC further suggests that additional statistics demonstrating variability within groupings be provided.

Environment Canada also notes that a sensitivity analysis and gap analysis of the geochemical characterization program are not provided in response to R182.

CMC does not provide the requested reports in their response to R184. CMC states that the documents are no longer relevant due to some inconsistencies in drill core logs. The Proponent indicates that the 2013 report includes additional revisions of the Phase I and Phase II data, supplemental static test-work for Phase II and IV sampling, and results of overburden samples. While this may be appropriate, there is not enough information to determine if it is reasonable to assume that the Phase I and II reports are no longer relevant. Environment Canada suggests CMC provide additional explanation of the reports and interpretation of the results within.

The Executive Committee requires additional information regarding the geochemical characterization for the mine site. Therefore, please provide the following information:

- R2-99. Update Tables A.7.6-2 and A.7.6-3 to include samples broken down by alteration type. Details should include an accounting or discussion at minimum for each of the lithology types making up the lithologic unit, not only the dominant lithology within each unit. Data in Table A.7.6-3 should include NAG rock.
- R2-100. Additional statistics (e.g. demonstrating variability within groupings) should be provided to demonstrate robustness in the geochemical data.
- R2-101. Results of sensitivity analysis and gap analysis of geochemical characterization program.
- R2-102. Additional explanation as to why the Phase I and Phase II Geochemical Assessment Reports are no longer relevant. Details should include what the old geologic interpretations (and rock units) were as related to the new geologic interpretation, and what other lithologies or rock units were and are thought to exist for the project site.

Environment Canada expresses concern regarding the mining sequence (ore/waste schedule). It appears that waste rock placed in the TMF may be unsaturated for periods of time ranging from three to seven years. Additionally, CMC proposes to layer supergene and hypogene waste rock to limit acid generation prior to subaqueous disposal. As noted by Environment Canada, there is insufficient information to support the length of time rock is exposed with the disposal methods. EC states:

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

What the proponent fails to provide is whether the waste coming out of the pit is timed sufficiently and blended according to some (numerical) criteria to meet a target waste type that is relatively geochemically-stable in the TMF until such time as that waste is inundated. This means the proponent needs to link their waste delivery schedule with geochemical data and with exposure times prior to inundation in order to demonstrate that some form of geochemical stability can actually be achieved (via a loading model, for instance). At present, while the proponent can provide pit extraction information, they only are providing qualitative statements to indicate that the blending can occur and will result with geochemical stability. (YOR 2014-0002-391-1, p11)

The Executive Committee requires additional information regarding ARD/ML associated with waste disposal in the TMF. Therefore, please provide the following information:

R2-103. Provide a quantitative analysis (e.g. using the mine plan waste delivery linked to geochemical data and loading model) to support the approach to waste disposal in the TMF. Consideration should be given to waste type, exposure times prior to inundation, and blending of waste materials.

R2-104. Provide clear criteria or targets for the "mixing criteria" identified for waste materials.

Environment Canada notes several other areas of clarification regarding information related to geochemistry including:

- Whether fault zones may introduce unique or added mineralization or alterations introduced such that the FZ "lithology" was considered as important, initially.
- Shake flask data, number of samples, and other summary statistics should be provided for each lithology and alteration type rather than just fluoride and uranium.
- Additional testing of heap leach ore and residues is proposed to be undertaken to satisfy key uncertainties with the heap leach process and decommissioning. These tests should be completed and the information presented for review.
- The Proponent should indicate when they expect results from the additional test work and provide these as part of the environmental assessment review.

The Executive Committee requires additional clarification regarding information related to geochemistry. Therefore, please provide the following information:

R2-105. Indication whether there is any veining or intrusion along fault zones introducing unique or added mineralization or alterations introduced such that the FZ "lithology" was considered as important, initially.

R2-106. Shake flask data, number of samples, and other summary statistics for each of the lithologies and alteration types. Ensure all of the tables providing pertinent data are updated.

R2-107. Identification when results of additional metallurgical test work on heap leach facility ore and residue will be available. Provide a discussion on uncertainties in the absence of this information.

4.3.2 Geochemical Characterization of Borrow Sources and Access Road

In response to R192 with regards to geochemical characterization along the Freegold Road, CMC reiterated results from the report titled Site Access Road ML/ARD Risk Assessment – Update (Appendix 7D to the proposal, Lorax, November 5, 2013). Additional information was provided in the missing report titled Casino Road: Preliminary Risk Assessment Metal Leaching and Acid Rock Drainage (Appendix A.7J to the SIR, Lorax, January 2012). While there are some additional details and context provided in Appendix A.7J, including estimates of volumes of material that will be exposed through rock cuts, there is no new information on geochemical characterization.

Environment Canada expresses concern with the level of detail and geochemical characterization provided (YOR 2014-0002-391-1). EC notes that the information provided and the approach is conceptual in nature and provides several options based on available guidelines rather than site specific information. There are no details on what CMC is committing to do to further the geochemical characterization along the Freegold Road. Environment Canada notes that there are many outstanding recommendations in the reports provided by CMC to conduct additional sampling, testing, and interpretation prior to detailed design. Environment Canada states:

The supplementary information does not provide clear detail of those areas of development requiring special attention, and exactly what the proponent plans to do in each case to mitigate for potential impacts to the receiving environment. The work is not complete and therefore the IR by the Executive Committee has not been fulfilled. (YOR 2014-0002-391-1, p 8)

Environment Canada has indicated that additional geochemical characterization should be provided at the assessment stage rather than the subsequent permitting stages. EC states:

Given that the proponent is suggesting that additional sampling/testing/analysis will come as a part of the detail design, and which appears to be contemplated for after the EA process and decision, we cannot determine significance and adequacy of mitigation with the information at hand at this time. (YOR 2014-0002-391-1, p 8)

In response to R192 with regards to geochemical characterization of borrow sources, airstrip, and airstrip access road, CMC provided a preliminary evaluation in Appendix A.7K (Casino Mine Site Borrow Sites ML/ARD Potential). This appendix provides results for 49 test pit samples from various areas on the Casino Mine property including.

The report provides a preliminary geochemical characterization borrow source materials. The report recommends that CMC develop an ARD/ML Management Plan for each borrow area prior to excavation. This plan should include an accounting of quantity of material excavated as well as additional static test work to be completed on at least three test pit samples for each location.

Environment Canada has indicated concern with the geochemical characterization of the borrow sources at the mine site. Specific concerns were raised with regards to the airstrip including:

- Unclear why the airstrip borrow samples and the barge landing borrow samples (four samples and five samples respectively) were grouped together in the summary description of geochemical results.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

- Unclear how representative borrow samples are, particularly borrow materials for the airstrip construction.
- Unclear what the short-term metal leaching potential is from borrow materials for the airstrip construction.

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

R2-108. For the Freegold Road upgrade and extension provide additional details and information on:

- a. all geological materials, including estimates of volumes, that will be excavated, exposed or otherwise disturbed;
- b. geochemical characterization, analysis, and interpretation on representative samples for those geological materials; and,
- c. consideration of potential effects and appropriate mitigation measures associated with excavating, exposing, or disturbing those materials.

R2-109. For airstrip borrow sources provide additional details and information on:

- a. why airstrip borrow samples and barge landing borrow samples were grouped together in the summary description of geochemical results given their location at opposite ends of the project footprint;
- b. provide justification on how representative these samples are of the borrow material specifically intended for airstrip construction and expansion (i.e. does the geochemical analysis of the airstrip borrow site account for areas which will be disturbed in the construction of the airstrip?);
- c. details on the short-term metal leaching potential for the material proposed for use at the airstrip; and
- d. details on mitigation is being proposed to prevent release of metals and sediments to local receiving water.

Environment Canada identifies concern related to the potential use of waste rock from other previous mining operations for construction material along the Freegold Road. EC indicates that, should any of this material be used, it should be characterized with results and interpretations provided in the screening process. The Executive Committee requires clarification on whether waste rock will be used in construction of the Freegold Road. Therefore, please provide the following information:

R2-110. Clarify whether waste rock from previous mining operations will be used in construction of the Freegold Road. If yes, outline a plan to characterize the ARD/ML potential with results provided during the assessment process.

The Executive Committee also requires further information on the quality and quantity of borrow material required for upgrades and construction of the Freegold Road upgrade and extension. Consideration of this matter is required in responding to the questions in section 2.7.3.

4.4 NUMERICAL GROUNDWATER MODEL

The proposal establishes groundwater flow baseline data through use of a numerical groundwater model using MODFLOW-SURFACT to simulate baseline hydrogeological conditions at the Project site. The Executive Committee previously asked a number of questions surrounding the methods, inputs, outputs, and design of the model in the Adequacy Review Report. The Proponent provides considerable information regarding this requests; however, the Executive Committee still requires additional information on the numerical groundwater model. These concerns are touched on in several different questions but involve a few distinct themes regarding permafrost, groundwater flow directions, and model methods.

The baseline groundwater model does not account for permafrost. The Proponent explains that this is due to the discontinuous nature of permafrost in the project area and local topography. The Proponent states that at the presented scale, “the net volume of groundwater discharge to creek valleys is expected to be independent of permafrost distribution, particularly considering the relatively steep valley slopes that drive groundwater flow at the project site. It is considered sufficient for the purpose of this regional hydrogeology assessment to consider the subsurface as a homogeneous unit that is permafrost-free.” The Proponent does suggest, however, that any smaller-scale studies “should consider the spatial distribution of permafrost.” In the Supplementary Information Report the Proponent states that incorporating permafrost into the model would compound and conflate error as permafrost distribution is not known in sufficient detail.

Permafrost

The Executive Committee believes that the prevalence of permafrost in the study area, in addition to its scale, warrants further consideration of inclusion of permafrost in the model, or alternatively, justification of the exclusion of permafrost in the model. Natural Resources Canada voices several concerns in this regard. Model calibration may have resulted in inaccurate hydraulic conductivity values as “baseline model calibration allows groundwater to flow through significant areas of permafrost which are currently barriers to ground water flow” (YOR 2014-0002-392-2). In addition, it is unclear how the model can be used to account for permafrost degradation, which will affect hydraulic conductivity, as the model does not incorporate permafrost in its baseline calculations. The Proponent’s response in relation to the previous request regarding permafrost degradation does not sufficiently consider changes in hydraulic conductivity.

Natural Resources Canada expresses concern that the proposal is unclear as to which permafrost distribution figure provided is the most current.

The Executive Committee requires additional information on the exclusion of permafrost from groundwater modeling. Therefore, please provide the following information:

- R2-111. An analysis or model of how groundwater movement and hydraulic conductivity results from the groundwater model may be influenced by permafrost at the model’s scale.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

R2-112. An analysis of the effects of permafrost degradation to groundwater movement and hydraulic conductivity, building off of R2-111 above.

R2-113. Clarification on the most recent inferred permafrost spatial distribution (figure 2.3 of appendix 7C or figure 3.4 of appendix 7E).

Groundwater flow directions

Natural Resources Canada notes that the creation of the open pit may change flow directions in the upper reaches of Canadian, Brynolson, and Casino creeks due to areas upgradient of the pit driving current groundwater flows. Further, Natural Resources Canada notes that the Proponent has updated its knowledge of recharge and permafrost areas and that if the model were rerun, it would yield different outputs and may require further calibration. The Executive Committee requires additional information to clarify the implications of this newer data. Therefore, please provide the following information:

R2-114. Discussion and display of how the recharge and permafrost areas differ between the data used in the groundwater model and the most recent data.

R2-115. Analysis of potential effects due to the loss of upgradient areas due to the creation of the open pit.

Model methods

Environment Canada (YOR 2014-0002-391-1) indicates its reviewers are not satisfied with the completeness of responses related to hydrogeology questions R179, R210, R217, and R221 of the Adequacy Review Report. Namely, Environment Canada notes that the use of a groundwater model such as MODFLOW, which was designed for primarily modelling porous media, can lead to very large errors in the understanding of a baseline hydrogeologic system as well as the predictions generated with the use of the model. The required number and placement of monitoring wells at the mine site will vary depending on the complexity of the system being monitored. Recent versions of the model do allow the incorporation of high or low permeability structures into the model which, in some geologic settings, can greatly improve the predictive capability of the model. However, the use of such models still needs to be justified. In order to have confidence in the construction of baseline data and conditions, the Executive Committee requires more information on the methods used to model baseline hydrogeological conditions. Therefore, please provide the following information:

R2-116. An analysis to justify modelling the hydrogeologic system at the Casino Mine using a porous media approach rather than a discrete fracture system approach.

The Executive Committee is concerned that the filling of the TMF may lead to groundwater influxes to Brynolson Creek and that these influxes are not fully described. NRCan echoes these concerns requesting additional details on the nature of seepages to Brynolson Creek and its tributaries. The Executive Committee requires additional information on groundwater movements in relation to Brynolson Creek. Therefore, please provide the following information:

R2-117. Clarification on if, and how much, groundwater will flow into Brynolson Creek and its tributaries from the TMF and an analysis of any potential effects.

4.5 TRANSPARENCY OF WATER QUALITY PREDICTIONS

In response to R231, CMC did not re-run the water quality model with updated water quality baseline data as requested. CMC indicates that additional water quality and hydrological baseline data was collected in 2013 and 2014 and that it will be provided during the licensing process. EcoMetrix indicates that it is not required to re-run the models unless the original baseline data is not representative (YOR 2014-0002-399-1). SFN consultant, Northland Earth and Water, states:

CMC should provide an assessment of how the more recent baseline data compares to that used in the model to ensure the data set being used is still representative of the current conditions. Where there are any variations, the model should be updated to reflect the changes in baseline conditions. (YOR 2014-0002-393-1, p 13)

The Executive Committee requires additional information regarding whether water quality data used in the water quality model is representative of baseline conditions in order to ensure accurate predictions of water quality. Therefore, please provide the following information:

- R2-118. Discussion and comparison of 2013 and 2014 water quality baseline data collected with water quality baseline data used in the water quality model. Discuss variations in the data and where necessary, implications to the predictions from the water quality model.

4.6 METAL MINING EFFLUENT REGULATIONS

In response to R240, CMC does not provide predictions for radium-226. Rather, CMC indicates that it does not expect radium-226 in the receiving environment because there is no radioactivity in the ore body and there were no detectable concentrations of radium-226 in 2011 baseline data collected in Casino Creek, Proctor Gulch, the historical adit, and Canadian Creek.

Environment Canada again raises concerns regarding the lack of radium-226 predictions (YOR 2014-0002-391-1). EC indicates that the water quality prediction report (Appendix A.7B) predicts uranium will exceed CCME guidelines at various times. Environment Canada states:

Ra226 is a daughter isotope resulting from the radioactive disintegration series (decay) of uranium. Given that uranium is a parameter of concern (also brought up in R188 of the ARR) and has been shown to be present and in exceedance as per the above-mentioned report, it is not without reason to assume that Ra226 concentrations may end up in the receiving environment throughout the life of the project. Ra226 is a deleterious substance as set out in Schedule 4 of the MMER. Effluent discharged from the TMF spillway and the WSMP will need to meet the effluent monitoring conditions of the MMER. Accordingly, the proponent should provide predictive analysis for Ra226 as part of their submission for this environmental assessment. (YOR 2014-0002-391-1, p 7)

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:

- R2-119. Provide a discussion on how water quality predictions in the tailings management facility pond and water management pond will address the requirements under the Metal Mining Effluent Regulations with regards to radium-226.

4.7 SUBMERSION OF PAG MATERIALS

In their response to R243, CMC reiterates that PAG waste rock will remain unsaturated for an average of three years. It provides several conservative assumptions that were used when developing the waste rock source terms in order to predict water quality.

CMC reasons that humidity cells and unsaturated column tests were conservative given that they were created using core that was exposed to weathering for several years, thereby exhibiting a relatively advanced state of weathering. Environment Canada indicates that the state of weathering is not apparent given that “[w]ithout a detailed understanding of the storage conditions (exposure to the elements) for each of the cores used, it is uncertain how “conservative” the weathered core is as related to the modelled condition.” (YOR 2014-0002-391-1, p10) In addition, Environment Canada indicates that certain contaminants of potential concern may have weathered to a point that values for those parameters have diminished or become exhausted prior to use in kinetic testing. Environment Canada states, “using ‘weathered core’ for characterizing ML may not be conservative whatsoever.” (YOR 2014-0002-391-1, p10)

The Executive Committee requires more information on the use of weathered core for source term development in order to predict potential effects related to the submersion of PAG waste rock. Therefore, please provide the following information:

- R2-120. A detailed description and characterization of the conditions of core material used in kinetic test work. Details should include:
- a. storage conditions (e.g. degree of exposure to moisture); and
 - b. state of weathered core relative to release of contaminants of potential concern.

5.0 CLIMATE CHANGE REPORT

The Executive Committee is concerned that the uncertainty associated with climate change is not adequately addressed in proposal documents. Tr’ondëk Hwëch’in consultant, CSP2, notes that use of limited data (both spatially and temporally) for the Baseline Climate Report necessitates the consideration of a greater range of climatic scenarios (YOR 2014-0002-398-1). Similarly, the rationale provided for a 15 percent uplift factor for peak discharge in consideration of climate change is still seen by Yukon government (YG) and CSP2 as too low due to the lack of predictability when it comes to the impacts of climate change in the project region. YG has consistently recommended use of a maximum range of 25 percent increase in flow for all mine design in order to account for climate change variability.

The Executive Committee agrees with both comments. In the absence of a more robust dataset, the uncertainty posed by climate change necessitates a more pre-cautionary uplift factor for peak discharge. In order to have an adequate proposal for screening purposes, mine infrastructure and planning needs to account fully for climate change variability.

In its response to the Adequacy Review Report (ARR) R259, CMC states that wetter conditions than expected could be mitigated through adjustments to the construction schedule. Issues of construction

are addressed in section 2.7.13. Government of Yukon notes that this does not “address variability and increases in precipitation for the lifetime of the tailings (perpetuity) after the construction phase and mine operations are completed” (YOR 2014-0002-395-1).

Government of Yukon and CSP2 express continued concern related to the lack of detail provided on how climate change and its effects on the environment are considered in project design with specific emphasis on permafrost melt and water flow changes, especially since CMC focused on providing information only for the TMF.

In consideration of the above, the Executive Committee requires further information. Please provide the following information:

- R2-121. Clarification on how the design for the TMF accounts for climate variation in perpetuity, beyond the construction and operation phases of the mine.
- R2-122. After the application of a maximum 25 percent increase in flow to all relevant baseline information, a comprehensive description of resulting changes to the tailings management facility, open pit, water management pond, heap leach facility, and diversion ditches. This should include consideration of project effects, and mitigations.

6.0 AIR QUALITY

6.1 AIR QUALITY MODELING

6.1.1 Model Inputs

The Executive Committee previously requested information regarding the air quality model used by the Proponent. While the Supplementary Information Report provides an inventory of air emission sources, the request for materials required in order to sufficiently understand or recreate the model was not fulfilled. ARCADIS seeks to evaluate the model by using model inputs in a digital format (YOR 2014-0002-402-1). These model inputs include:

- | | | |
|---------------|---------------|---------------|
| • CALMET.inp | • Makegeo.dat | • Baemarb.dat |
| • CALPUFF.inp | • Precip.dat | • Lnemarb.dat |
| • Surf.dat | • Ptemarb.dat | • BPIP.dat |
| • Up.dat | • Volmarb.dat | |

ARCADIS also requests wind data, in the form of windroses, to further evaluate model inputs with nearby datasets. The Executive Committee requires more information on the inputs and parameters of the air quality model. Therefore, please provide the following information:

- R2-123. The data inputs, as requested by ARCADIS and noted above, for the air quality model.

6.1.2 Mitigations

The original proposal indicated exceedances of a number of air quality parameters throughout the site. Modeled exceedances exist through much of the site, for different time scales, and different parameters. For example, annual levels, during operations, for $PM_{2.5}$ indicate only $10 \mu\text{g}/\text{m}^3$; however, the gradient chosen for representation appears steep, peaking at the maximum classification, of $10 \mu\text{g}/\text{m}^3$ over most of the mine site. This appears to mask the upper limit of the exceedance as most of the site is classified as the highest classification. Actual model results could help clarify the magnitude of exceedances. This is also the air quality standard for Canada for 2015, by 2020, this standard will be $8.8 \mu\text{g}/\text{m}^3$ (Canadian Council of Ministers of the Environment, 2012).

Exceedances are mitigated in the proposal in a variety of ways. For example, mitigations proposed include the use of ultra-low sulfur fuel and using equipment that meets the latest applicable emissions standards. These mitigations are predicted to eliminate any significant adverse effects; however, ultra-low sulfur fuel is required for non-marine applications as is equipment that meets applicable emissions standards. These mitigations were included in model parameters for the air quality model of the Project; yet, these mitigations are provided for exceedances predicted by the same air quality model. In essence, the air quality model demonstrates that these mitigations are insufficient to reduce effects but in table 8.4-7 of the proposal, many of these mitigations are expected to have a high effectiveness.

Effects of poor air quality are concerning with a permanent workforce at the project site and the extended period of project operations. Government of Yukon, Health and Social services assert the applicability of air quality standards at the project site. Given that these standards and others are based on empirical risk based studies, it is unclear why the Proponent states that there will not be significant adverse effects resulting from air quality exceedances. An HHRA (as requested in section 16.4) may help in identifying potential effects to receptors at the project site. The Executive Committee reiterates its request for more information regarding mitigations to air quality exceedances and modeling. Therefore, please provide the following information:

R2-124. Mitigations to reduce or eliminate the frequency and extent of air quality exceedances modeled including evidence for each mitigation's effectiveness.

R2-125. Unclassed air quality model outputs in a standard GIS format.

6.2 DUST AND DUSTFALL

The Adequacy Review Report of January 27, 2015, requested information regarding dust and dustfall at the mine site (R. 270, R. 271). The Supplementary Information Report does not satisfy these requests. New information is also required based on comments from stakeholders and further review of presented information.

The Supplementary Information Report identifies the consumption of LNG and processing of rock and tailings as primary sources of dust, during operation. TH's consultant CSP2 states that available information "fails to consider the potentially high level of dust created by truck/motor traffic in and around the pit and other facilities." Likewise, there exists potential for aeolian erosion from project

components such as the TMF embankments. Government of Yukon, departments of Health and Social Services and Environment, require further information on dust composition during operations. The Supplementary Information Report states “operational dust would be less likely to resemble baseline dust”, to which Human and Social Services replies that the Proponent “does not identify if there are additional risks to human health due to the composition of that particulate matter”.

It is also unclear what water consumption will be required for dust suppression. While the Proponent does not include dust suppression in the water balance due to its small relative size, water sources and dust management remain unclear. The Executive Committee requires more information regarding dust at the project site and the Freegold Road. Therefore, please provide the following information:

- R2-126. Predicted change in dust composition during construction and operations.
- R2-127. Discussion on additional dust sources such as project induced wind-based erosion, blasting, and traffic in relation to dust quantity, including details on the inclusion of these sources in air quality modeling.
- R2-128. Water requirements for dust management and dust prevention strategies and details on any water additives.

7.0 FISH AND AQUATIC RESOURCES

7.1 FISHERIES ACT – FISHERIES PROTECTION PROVISIONS

The Department of Fisheries and Oceans (DFO) raises concerns regarding the Proponent's document revisions in light of changes to the *Fisheries Act* (YOR 2014-0002-389-1). The Proponent does not respond to the second half of the request regarding *Fisheries Act* authorizations. In light of this observation, the Executive Committee requires further information. Please provide the following information:

- R2-129. Discuss how the Project affects each of the commercial, recreation, or Aboriginal (CRA) fisheries and the species supporting those fisheries, which includes an understanding of the habitats but also the fish populations utilizing those habitats.
- R2-130. Identification of project components likely requiring a paragraph 35(2)(b) Fisheries Act authorization.

7.2 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.

Section A.10.3.1.1, of the Supplementary Information Report, uses Wright and Hopky (1998) to demonstrate that charge weights being used for blasting in the Casino pit will not be large enough to yield lethal impacts on fish eggs and fish based on a 1.2 km setback from fish-bearing habitat in Upper Canadian Creek. However, other blasting related to the construction of other site infrastructure is occurring in closer proximity to fish bearing waters. DFO and the Executive Committee continue to have concerns regarding the lack of information and proposed mitigations for preventing serious harm to fish during construction of infrastructure sites and along the access roads. Section 10 of the proposal includes reference to the proximity of these sites to fish-bearing watercourses but this is not considered in the SIR response. The Executive Committee requires more information regarding charge weights in relation to fish. Therefore, please provide the following information:

- R2-131. Demonstrate that proposed charge weights to be used in construction of the access road and infrastructure pads will not cause harm to fish and fish eggs.

7.3 BASELINE DATA

EcoMetrix (YOR 2014-0002-399-1) and Selkirk First Nation's consultant, Northland Earth and Water (YOR 2014-0002-393-1), both note the lack of clarity for the location of the fish passage barrier on Taylor Creek; the SIR uses 275 m above the confluence with Casino Creek while Appendix A.10.B refers to the barrier being 400 m upstream. EcoMetrix further observes that there is insufficient information provided on the fish barrier to make a determination that it is truly a barrier to the passage of fish, particularly because of minimal sampling in the creek. Considering the conflicting information and lack of clarity on the fish barrier, in order to provide confidence in the determination of fish-bearing status for Taylor Creek, the Executive Committee requests that the Proponent demonstrate that the effort used is in line with sampling protocol set out by the Fisheries and Oceans Canada's Sciences division. Therefore, please provide the following information:

- R2-132. More information on the fish passage barrier in Taylor Creek, including clarification of its location and documentation that there are no upstream fish. If it is not available, the habitat upstream of the potential barrier in Taylor Creek should be included in calculation of habitat losses. This should follow the advice provided in Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (Research Document 2008/026): Protocol for the Protection of Fish Species at Risk in Ontario Great Lakes Area (Fisheries and Oceans Canada, 2008).

The Department of Fisheries and Oceans (DFO) raises multiple concerns about the layout and availability of baseline information, observing that the fish presence maps provided in response to R276 are in reference only to Chinook salmon with no consideration of freshwater species and that baseline conditions within Casino Creek are not summarized sufficiently to quantify existing habitat value. Furthermore, DFO suggests that Table A.10.4-2 of the SIR response by Casino should be updated to include the "wetted period of ephemeral channels and likelihood of fish species presence at those times" (YOR 2014-0002-389-1). The Executive Committee requires additional information on

fish presence fish habitat in order to predict potential effects. Therefore, please provide the following information:

- R2-133. Fish presence and habitat suitability maps that include information on freshwater species.
- R2-134. A table including information on ephemeral channels and the likelihood of fish species presence during wetted periods.
- R2-135. Additional information that allows for quantification of existing habitat value in Casino Creek.

Tr'ondëk Hwëch'in consultant, CSP2, voices concern that habitat loss due to flow reduction has been underestimated because the potential for flow reductions north of the open pit (from dewatering) is not well understood. This would have an impact on lost overwintering habitat, spawning habitat, and fish stranding. (YOR 2014-0002-386-1) In order to assess effects of changed flows and to ensure the reliability of monitoring, the Executive Committee requires additional information on the quantitative baseline information for fish in areas where flows are likely to be disrupted. Therefore, please provide the following information:

- R2-136. Additional quantitative baseline data including fish population and density estimates for all areas that will be impacted by changes in flows (reduced flows, changes in flow due to discharge and timing changes in flows). This should include a description of data quality objectives for both precision and accuracy relative to CPUE abundance estimates and how the data will be used to determine relative number of fish present for future comparisons (e.g. monitoring for change).

CSP2 questions the process of choosing reference sites for the Project and the selections made, suggesting that the lack of fish identified in Victor Creek and its proximity to Dip Creek make it an unsuitable site for monitoring. Similarly, Coffee Creek, which is an area undergoing mine exploration, does not provide a long-term reference site (YOR 2014-0002-386-1). In order to have confidence in the reference site and its value for monitoring into the future, the Executive Committee requires more information on the rationale for site selection and consideration of alternative sites. Therefore, please provide the following information:

- R2-137. Rationale and justification for the selection of reference sites and a description for how the data from the reference sites will be used for future comparisons (i.e. monitoring through all project phases).

7.3.1 Missing Appendices Documenting Baseline Data

EcoMetrix notes that, while information provided in the provided Appendices appears to be adequate, Appendices A, C, and D have been issues as drafts. In addition, Appendix A is missing several figures. As such, the Executive Committee requires the following:

- R2-138. Final reports related to baseline data, if available, of appendices A – E for appendix 10A - Casino Project Fish and Aquatic Resources Baseline Report, November 12, 2013, by Palmer Environmental Consulting Group Inc.

7.4 PHYSICAL HABITAT SIMULATION MODEL AND HABITAT EVALUATION PROCEDURE

The Executive Committee requested in R292 a description of the habitat evaluation procedure (HEP) incorporated into the proposal, including details on methods and assumption, habitat suitability index values for each variable, the identification of habitat types included, and data and methods used to calculate habitat gains. While the Proponent does provide a description of the habitat evaluation procedure, EcoMetrix identifies several information gaps in the response. EcoMetrix notes,

- The evaluation only includes the spawning and egg incubation life stages and does not include fry or juvenile/adult stages as in the habitat simulation model;
- Data and methods used to calculate habitat gains are not provided;
- Seasonal use by life stage for Arctic grayling is not considered in the HEP; and,
- It is unclear if the same procedures were used to calculate habitat gains as were used to calculate habitat losses. (YOR 2014-0002-399-1)

Certainty and confidence in habitat modeling is central to characterizing the significance of effects. The Executive Committee requires more information regarding the HEP. Therefore, please provide the following information:

R2-139. Additional information regarding the HEP including:

- a. methods and data used to calculate habitat gains;
- b. seasonal use by life stage for Arctic grayling; and
- c. incorporation of all life stages into the HEP.

Tr'ondëk Hwëch'in consultant, CSP2, voices concern that habitat loss due to flow reduction has been underestimated because the potential for flow reductions north of the open pit (from dewatering) is not well understood. This would have an impact on lost overwintering habitat, spawning habitat, and fish stranding. (YOR 2014-0002-386-1) The hydrology assessment completed by Knight Piésold appears to be different than what has been used in the PHABSIM model. In order to have confidence in the modeling that has been done, the Executive Committee requires additional information on the PHABSIM model and data that was incorporated into it. Therefore, please provide the following:

R2-140. More information on information used in the PHABSIM model. This should include:

- a. A comparison of the streamflows from Knight-Piésold and that used in the PHABSIM model including tables and figures to illustrate the comparison;
- b. Clarity on assumptions and objectives of the modelling process regarding the estimation of impacts on fish habitat (e.g. average conditions, extreme flows, time periods etc.);
- c. Clarity around the consideration of fish stranding in the assessment (i.e. were extreme low flows considered in the assessment); and
- d. All sources of data used in the hydrology assessment and a detailed description of methods.

7.5 WATERCOURSE CROSSINGS

7.5.1 Embedded Culverts on Fish Bearing Streams

The Executive Committee previously requested details on the effects and use of culverts along the Freegold Road (R297). The Proponent indicates that clear-span bridges will be the preferred design at all fish bearing crossings, however, some crossings may not be suitable. Regarding the Proponent's response, DFO comments that an estimation of fish-bearing streams requiring culverted crossing design should be provided with a corresponding estimate of impacted habitat (YOR 2014-0002-389-1). EcoMetrix adds further, regarding this request, that an assessment of impacts to fish and fish habitat (and offsetting if necessary) must be conducted prior to construction. The Executive Committee requires more information regarding culverted stream crossings on the Freegold Road. Therefore, please provide the following information:

- R2-141. An assessment of impacts to fish habitat related to culverted stream crossings on the Freegold Road.

7.5.2 Existing Stream Crossings

The Executive Committee previously requested details regarding structures along the existing Freegold Road that are not within the proposed alignment (R298). CMC in its response indicates that upgrades to the Freegold Road will be the responsibility of Government of Yukon. The Executive Committee requires more information regarding existing stream crossings. This unfulfilled information request is addressed in R2-8 under section 2.4.1 of this report along with other concerns regarding the upgrade to existing Freegold Road.

7.5.3 Nordenskiöld River Bridge

The Executive Committee previously requested details regarding the proposed Nordenskiöld River bridge (R299). The Supplementary Information Report responds that the bridge design will be the responsibility of Government of Yukon. DFO comments that upon reviewing the bridge design provided in section 4 of the proposal, more information is required (YOR 2014-0002-389-1). EcoMetrix also comments in their report to the Executive Committee that the information provided by the Proponent is insufficient and adds that construction details must be provided prior to construction so that impacts to fish and fish habitat can be assessed and offset, if necessary. The Executive Committee requires more information regarding the proposed Nordenskiöld River bridge. This unfulfilled information request is addressed in R2-8 under section 2.4.1 of this report along with other concerns regarding the upgrade to existing Freegold Road.

The Executive Committee requested information on how the Nordenskiöld River bridge's proposed design and pier will affect existing habitat (R300). Regarding the Proponent's response to this request, DFO comments that little information is provided on how the proposed pier will affect existing habitat and for what species (YOR 2014-0002-389-1). Specifically, DFO questions "how will the pier construction and hydraulic faces alter this habitat and over what area? If rearing habitat is present,

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

how will the pier construction and hydraulic forces alter this habitat and over what area? What is rationale for overwintering habitat to be discounted for this site, is it simply the absence of pool habitat? What is likelihood [sic] of juvenile fish species overwintering within substrate?” This baseline information is necessary to understand the context of possible effects to fish.

The Executive Committee requires more information regarding baseline and potential effects of the Nordenskiöld River bridge pier. Therefore, please provide the following information:

R2-142. For each, if present, of spawning and rearing habitat, details regarding how pier construction and hydraulic forces will alter the habitat and over what area.

R2-143. The rationale for discounting this location as winter habitat, including consideration of juvenile fish species overwintering within substrate.

The Executive Committee previously sought information regarding “fish species (and their life stages) present in the area potentially affected by the Nordenskiöld River bridge. Discussion should include identification of potential effects of the bridge and the pier” (R301). Regarding the Proponent’s response, DFO notes

the application should provide a design that avoids a pier placement into the Nordenskiöld River. Where this design is not possible, a rationale detailing the options considered is required. The submitted design should detail the habitat impacted and for what species and life stage. Those impacts should be identified and accounted for and included as impacts to be offset. (YOR 2014-0002-389-1)

Further DFO notes that no fish sampling was conducted at the crossing location and is not clear about present habitat types.

The Executive Committee requires more information regarding the Nordenskiöld River and the potential effects of the bridge. Therefore, please provide the following information:

R2-144. Discussion of possible options for the bridge, including a no-pier option. This discussion should include a rationale detailing the options and alternatives considered if a no-pier option is not possible.

7.5.4 Classification of Crossings

R302 of the Adequacy Review Report of January 27, 2015, requests “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 a clear-span crossing.” The Supplementary Information response refers back to appendix 10B of the original proposal, which provides some of the requested information; however, it is unclear what crossings will be clear-span and which crossings may use “rip-rap placed within the high water mark where necessary to reduce slope failure” probabilities. The Executive Committee requires information on crossing types. Therefore, please provide the following information:

R2-145. A list of crossing details noting crossing properties and type of crossing, index by location as indicated in appendix 10B.

8.0 RARE PLANTS AND VEGETATION HEALTH

An understanding of effects to vegetation communities and habitats sensitive to change is not possible currently without more detailed information than is presented in the Supplementary Information Report. In the Adequacy Review Report, R308 requests information on potential project effects to habitat with elevated potential for rare species. The response focuses on fens and tors, despite other habitats in the area which fit this description. In its response, CMC provides a table of background and baseline studies for other organisms and states that this is “adequate to detect potential for occurrence of rare species.” (YOR 2014-0002-354-1) However, SLR notes most were aerial surveys, which would not be sufficient to identify rare plant species, particularly when performed out of breeding or flowering season (YOR 2014-0002-400-1).

Although mitigation and monitoring activities are provided, a lack of baseline and effects description means that the application of these plans could be difficult. The Executive Committee requires more information to determine the impacts of the Project on vegetation communities and sensitive habitats. Therefore, please provide the following information:

- R2-146. A discussion of the potential effects of the construction, operation, and possible decommissioning of project infrastructure in areas with elevated potential for rare plant species. Details should include:
- how the lack of baseline data will be addressed;
 - how effects would be detected; and
 - what adaptive management measures would be undertaken if effects occur.

SLR also notes that the large scale of mapping could lead to underrepresenting the frequency of wetlands and other habitat features. This, paired with information on only three of eight wetland types in the project area, may lead to profound impacts on species, such as the rusty blackbird, that rely on these habitats. The labelling of the previously unidentified polygon, which overlaps the centre of the airstrip, on the map as 60 percent “wet shrub” and 40 percent “shrubby fen”, makes the suggested mitigation of buffer zones seem insufficient as portions of that habitat will be entirely removed and the remains altered as a result of construction.

SLR further states that the impacts of altered groundwater flows can affect wetlands beyond the immediate project area (YOR 2014-0002-400-1). As the construction of the airstrip and airstrip access road will require clearing, infilling and water management, proximate vegetation and wetlands may cause adverse effects. Alteration of the terrain, ground and water flows could potentially affect downslope wetlands. The response to these concerns, as outlined in R309, does not adequately address these impacts, as such the Executive Committee requires further information in relation to this request. Therefore, please provide the following information:

- R2-147. An analysis of the potential effects of the construction, operation, and possible decommissioning of the airstrip and airstrip access road on proximate vegetation and wetlands, with a focus on downslope wetland impacts due to changes in ground and surface water flows. This analysis should consider all wetland types occurring in the LSA.

- R2-148. An analysis of the potential effects to wetlands and suggested mitigation measures related to the construction and use of the airstrip.

Environment Canada (EC) draws attention to the Yukon Podistera (*Podistera yukonensis*) which was listed as a Species of Concern by COSEWIC in November 2014 (YOR 2014-0002-391-1). EC notes that it may be found in alpine and sub-alpine habitats of the LSA and, as a best practice, it should be addressed in the project proposal.

The Executive Committee requires additional information on the potential effects to the Yukon Podistera. Therefore, please provide the following information:

- R2-149. An assessment of critical habitat, potential project effects, and proposed mitigations to Yukon Podistera (*Podistera yukonensis*).

9.0 WILDLIFE

9.1 FREEGOLD ROAD AND OTHER ACCESS ROADS

9.1.1 Population Dynamics

Request R315 of the Adequacy Review Report requests an analysis of the effects to 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. The Proponent reasserts that the Freegold Road will not interact with Dall's sheep or wood bison populations and provides a brief overview of potential effects to sheep due to air traffic and focuses on caribou predation. Indirect mortality risk to caribou through increased predation is not considered in the proposal, the Proponent states "there is no known technique of quantifying the Project's effects on predator-prey dynamics and there is no strong evidence suggesting that the Project will have an effect on wolf access to caribou or moose in this area."

Yukon Environment notes the following regarding the Proponent's response,

The proponent's response to the concern about increased mortality rates of caribou from facilitated predation is inadequate. ... ENV would like to clarify that the existing winter road is seldom used until late winter (March) and the Casino project's year-round road will lead to a substantial change in the amount of time a packed travel route will be available for wolves. Also, while the road is on the northern edge of the winter range, it also bisects one of the three major areas of concentration of caribou in the winter range. Enhanced predation is a documented effect of developing new linear features and it should be a part of the proponent's risk assessment. (YOR 2014-0002-395-1)

SLR adds,

Although the proponent argues that there will be no direct effect on caribou, wood bison and Dall's sheep, they do not adequately account for the potential combination of attractants due to the road and increased predator access and efficiency. Although a trail currently exists, it is not ploughed and salted and maintained as a year-round road.

The suggestion that monitoring and mitigation of predator access and efficiency may be brought forward by the Wildlife Working Group (WWG) is a potential solution, but shifts responsibility to a multi-party research endeavour rather from a project mitigation and monitoring condition. The value of using population dynamics data was dismissed by CMC.

....

Although not listed, regionally important species such as Dall's sheep and wood bison should be reconsidered as additional Key Indicator species. They occur in the Local Study Area (LSA) and Regional Study Area (RSA) in the vicinity of the Freegold Road extension and are potentially affected by changes in both predator access and access-related mortality.

...

Due to the size/length of the road, there is potential for significant changes in wildlife dynamics and mortality risk (from road-kill and, more likely, increased hunter access). In particular, the road comes close to some areas of wildlife concentration, such as wintering areas for caribou and moose, Dall's sheep and wood bison, and mineral licks. Areas of concentration close to roads pose a greater risk of population-level impacts or mortality sinks due to their importance to the various wildlife species. In addition to mortality, noise associated with the road may displace wildlife from road-side habitats rather than just downgrade the habitat effectiveness, as indicated in the models.

(YOR 2014-0002-400-1)

SLR concludes, "Failing to include potential indirect effects on predators and alternate prey may result in the potential to underestimate project effects on wildlife near the road" (YOR 2014-0002-400-1). The Executive Committee requires additional information regarding effects to wildlife as a result of the Freegold Road upgrade and extension. Therefore, please provide the following information:

R2-150. Initiatives that CMC will lead to monitor and address the issue of potential increased predation, mortality, and disturbance to caribou and Dall's sheep in relation to the Freegold Road.

R2-151. An analysis of how baseline data will be established and how predation mortality will be monitored and addressed.

9.1.2 Wildlife Crossing Areas

The Executive Committee previously requested supporting information on the implementation and effectiveness of wildlife crossing areas along the Freegold Road (R316). The Proponent intends to address barriers to movement "through fixed project design features (e.g. road embankment construction considerations) and through measures such as driver awareness training, road signage, and other forms of communication." The Proponent continues, "other than the broad sections of the Freegold Road extension described above, there are no specific spots in the project area known to be consistently used as 'wildlife crossings'"; this appears to limit the effectiveness of the proposed mitigation. Further wildlife crossings will involve infrastructure modifications such as gentler contouring.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Wildlife monitoring in relation to effects to wildlife populations due to the road is proposed for three to five years. SLR, in its report to the Executive Committee (YOR 2014-0002-400-1), states that monitoring caribou movements for only three to five years may result in the potential to underestimate project effects on wildlife over the lifetime of the mine. A commitment to monitoring for the life of the mine is an important condition for effective mitigation and monitoring. Environment Yukon also notes that CMC does not fully address this request and that the provided analysis of the barrier effects of the road is inadequate (YOR 2014-0002-395-1). Specifically, Environment Yukon notes:

In their response to R317 about management of road activities, the proponent emphasizes that they have assessed potential effects of estimated traffic volumes and frequency as not significant, so further mitigations are not necessary; their analysis of the barrier effect of the road is a large part of the assessment that concludes there will be no significant effect. For this reason, ENV recommends that the proponent be asked to provide rationale for why the assessment of potential barrier or filter effects of the road to caribou is reasonable.

(YOR 2014-0002-395-1)

The Executive Committee agrees with comments on the potential significance of the barrier effects of the road to wildlife populations. The Executive Committee requires more information on the effects of the Freegold Road. Therefore, please provide the following information:

- R2-152. Supporting evidence for the assertion that road design is a sufficient mitigation to the barrier effects of the Freegold Road.

9.1.3 Road Management

The Executive Committee previously asked for further information on road maintenance activities and potential mitigations, with a particular focus on key wildlife areas (R317). Further requests sought information related to alternative mitigation measures if full legal authority was unavailable for the Freegold Road (R319) and effects to wildlife from induced hunting (R320). The Proponent provides information on a proposed wildlife mitigation and monitoring plan (WMMP), concerns regarding this plan are discussed in section 9.4 of this report. However, the Proponent does not provide information regarding the potential effects due to a possible increase in wildlife harvesting. SLR also raises concerns regarding the Freegold Road in relation to wildlife,

Due to the size / length of the road, there is potential for significant changes in wildlife dynamics and mortality risk (from road-kill and more likely increased hunter access). In particular, the road comes close to some areas of wildlife concentration such as wintering areas for caribou and moose, Dall's sheep, wood bison and mineral licks. Areas of concentration close to roads pose a greater risk of population level impacts or mortality sinks due to their importance to the various wildlife species. In addition to mortality, noise associated with the road may displace wildlife from road-side habitats rather than just downgrade the habitat effectiveness as indicated in the models. This information is considered necessary to proceed with screening.

Changes in vegetation along the road corridor, and the presence of the open road year-round and maintenance practices (e.g. use of salts, presence of road-kill) may result in changes of several inter-species dynamics that could detrimentally affect

species of concern near roads. Road salts and vegetation near roads (especially if rich forage species for ungulates) could attract ungulates closer to roads which increases mortality risk. Increased ease of access for wolves along the road and potential attraction to road-kill or presence of ungulates may result in increased predation risk. From an ecosystem perspective, if roadside vegetation is extensive, there may be increases in distribution of some prey species and the resultant response of predators might increase predation of caribou, moose, Dall's sheep and wood bison. A commitment to monitoring predation for the life of the mine is an important condition for effective mitigation and monitoring. (YOR 2014-0002-400-1)

In relation to current and induced harvest, SLR states, "Use of demographic data for harvest and surveys will provide valuable insight into the sensitivity of regional populations to potential impacts from harvest." (YOR 2014-0002-400-1) The Executive Committee requires baseline information to assess potential effects to wildlife due to harvesting, road management activities, and road development. Therefore, please provide the following information:

- R2-153. A review of available data for population demographics (sex and age ratios related to surveys in the RSA). Use of demographic data for harvest and surveys will provide valuable insight into the sensitivity of regional populations to potential impacts from road maintenance and operations

9.2 EFFECTS ASSESSMENT FOR MAMMALS

9.2.1 Caribou

9.2.1.1 Klaza Caribou Herd

The caribou habitat suitability model and rationale provided by CMC does not clearly delineate how the noise impacts of blasting, traffic, etc. have been factored in to the habitat model, referring to "varying reduced habitat uses presumed correlated with distance from Project facilities." Information provided in Proposal Section 12.3.3.2 cites research on caribou disturbance, but does not demonstrate how CMC has incorporated these findings in its models. Similar and additional concerns regarding noise are also raised in section 15, regarding noise and wildlife.

SLR suggests that analyzing demographic data on the population (sex and age ratios in the RSA) would allow for an assessment of the resiliency of the population to project effects (YOR 2014-0002-400-1).

Both Yukon government and SLR note that the objectives for evaluating model assumptions, monitoring, and adaptive management thresholds are not discussed by CMC.

The Executive Committee requires more information to assess project impacts to caribou. Therefore, please provide the following information:

- R2-154. A discussion of the proposed Klaza caribou model based on draft components. This should include how the model supports project effects assessment and determination of significance. The review should include available population demographic data from harvest and surveys.

R2-155. A discussion of noise associated with the Project in relation to the habitat suitability model using the most recent reference materials available. This discussion should include consideration of noise from all project activities and baseline conditions (see R2-212, R2-213, R2-314).

R2-156. A discussion of objectives for evaluating model assumptions for caribou disturbance, monitoring movement and potential changes in predation, and setting adaptive management thresholds for actions which may mitigate adverse effects.

9.2.1.2 Fortymile Caribou Herd

The response to R323 identifies the potential for the Project to result in spatial and temporal overlap with the Fortymile caribou herd, causing minor loss of winter habitat. SLR notes that there is no discussion of the actual effects that may be experienced through the spatial and temporal overlap, including extent, duration, magnitude, and significance. (YOR 2014-0002-400-1) Furthermore, without documentation on the historic winter range, the Executive Committee cannot confirm the assertion that winter habitat loss will be minor.

Active monitoring of the herd through track surveys is suggested for the first three to five years of road operation. The Fortymile caribou herd may undergo expansion and claim use of former range throughout the life of mine operations; short term monitoring may lead to under-recognition of project impacts. (YOR 2014-0002-400-1)

The Executive Committee requires more information related to the Fortymile caribou herd. Therefore, please provide the following information:

R2-157. Discussion on the effects to the Fortymile caribou herd in the event of overlap, including extend, duration, magnitude, and significance. The analysis should consider herd size and demographics.

9.2.1.3 Klaza Caribou Herd Winter Habitat Suitability Model & Range Distribution

The Executive Committee previously requested data on the historical distribution of the Klaza caribou herd, this was intended to support and help validate the design of the RSF model used in the proposal. The RSF model was designed relying on a limited data set, both in time and space, and may not be representative of longer term patterns of habitat use by the Klaza caribou herd. YG notes that this approach may not identify factors that influence variance in distribution across time (YOR 2014-0002-395-1).

The Executive Committee requires a greater understanding of the validation of the RSF on a larger scale, in time and space, and an analysis of influencing factors in changes to habitat availability to properly assess effects to caribou. Therefore, please provide the following:

R2-158. Discuss how the RSF model accounts for variability in caribou distribution based on environmental conditions and among years. This should include consideration of available data on actual caribou distribution from the 1980's – present.

9.2.2 Moose

9.2.2.1 Baseline Moose Demographics

The Executive Committee requested additional baseline information on the moose population in the project area to assess resiliency and potential project impacts. CMC responds that measures of population resiliency to additional predation or hunting pressure are not relevant to project effects.

Government of Yukon (YG) (YOR 2014-0002-395-1) and SLR (YOR 2014-0002-400-1) do not agree with this statement. YG notes that harvest pressure is expected to change directly as a result of the proposed road. SLR writes that the absence of this baseline information will make it difficult to assess the effects of increased predation based on population resiliency, potentially leading to underestimating the project impacts due to additional female mortality.

In R331, the Executive Committee requested moose harvest data by sex, including an estimate of First Nations harvest. The Proponent's response indicates that licensed hunters can only take males and that no information on moose harvest by First Nation hunters is available and that the absence of harvest data from First Nations would lead to the incorporation of conjecture in determining moose harvest through modeling.

SLR notes that population modelling assuming a First Nation harvest of zero is more likely to be inaccurate than the use of an estimate. SLR recommends the use of models or information available from surrounding jurisdictions. (YOR 2014-0002-400-1) The Executive Committee agrees with this suggestion.

In order to assess project impacts to moose, the Executive Committee requires information previously requested in R330 and R331. Therefore, please provide the following information:

R2-159. Population survey data and demographic models for moose to determine sensitivity to change from potential additional predation or hunting pressure.

R2-160. Moose harvest data by sex, including an estimate of First Nations harvest, as well as a population model and sensitivity analysis.

9.2.2.2 Water Pipeline

In the Adequacy Review Report, the Executive Committee expresses concern with the suggested mitigations for moose in relation to the water pipeline. The Supplementary Information Request's response focuses on additional monitoring going prior to final design and a commitment to a pipeline that does not impede wildlife passage. However, there are no indications on the frequency or extent of monitoring to determine areas with high wildlife usage or impacts of the infrastructure once built.

Government of Yukon notes that no new information is provided and it is still unclear whether there are geotechnical or topographical constraints to building a pipeline that accommodates wildlife passage (YOR 2014-0002-395-1). This is particularly relevant because the proposal indicates the possibility that some portions of the pipeline could be buried.

The Executive Committee requires more information to assess the impacts of the water pipeline on moose. Therefore, please provide the following information:

R2-161. Information on the frequency, extent, and methods for monitoring of the pipeline route including:

- a. Prior to construction to inform the route, and
- b. During construction and operations
- c. Geotechnical and topographical information that will be used to determine which (if any) sections of the pipeline are buried.

9.2.3 Grizzly Bear

9.2.3.1 Grizzly Bear Denning

The Executive Committee requested additional information on baseline survey efforts, bear den distribution, and bear denning time periods. The SIR response provides information on surveys completed, but cites low snow accumulation as rationale for a lack of results. No further den surveys are planned prior to construction. In lieu of these results, a denning suitability analysis is provided.

Government of Yukon (YG) does not accept that conditions were prohibitive for den surveys, as nine dens were found in prior years when the Proponent says snow conditions were similar. YG suggests that further, more in-depth studies could be done – including fall surveys – to gather further information on bear den presence.

The ARR also requested discussion on the consideration of longer periods of denning. While the response acknowledges variability in dates, it reiterates the use of a shorter denning period. SLR suggests that not adopting a longer period could result in underestimating impacts to the species; bears may be more susceptible to disturbance during early emergence without sufficient forage. This is especially important because of a lack of information on the locations of bear dens in the area.

In order to assess effects to grizzly bears, particularly in relation to denning, the Executive Committee requires additional information. Therefore, please provide the following information:

R2-162. Initiate additional bear den surveys, utilizing suggestions by Government of Yukon, and indicate when information will be available during the screening process.

R2-163. A discussion of how denning may affect or be affected by project activity and suggested mitigations to prevent disturbance.

9.2.3.2 Grizzly Bear Habitat Models

Additional information and clarification provided relating to grizzly bear habitat models have led to further questions. Yukon government disputes the classification of alpine habitat as unsuitable or zero, citing bear tenacity in digging through snow, presence of carcasses, and areas of little to no snow (as evidenced by the lack of snow cover during spring den surveys.)

With respect to the incorporation of seasonality into the model, Yukon Environment comments that typical modelling is based around the availability of food sources (pre-berry vs. berry). How modeling considers these, and other aspects of habitat, can alter model outcomes.

Further, SLR notes that road traffic modelling should not be limited to only loaded trucks. This has the potential to artificially reduce the modelled impacts of the road on bears. This concern is also reflected in general in section 15 and related to caribou disturbance in section 9.2.1.

Regarding the security modelling, Yukon Environment notes the requirement in Purves and Doering (1998) that areas below 2300 m need vegetation to be considered as a secure area. The decision to include the entire study area in the model seems unrealistic because of a lack of vegetation in many areas. Environment Yukon suggests an upper limit of 1900 m based on general findings of collared bear behaviour in the territory (YOR 2014-0002-395-1).

In light of the above, the Executive Committee requests additional details related to the grizzly bear modeling. Therefore, please provide the following information:

- R2-164. Updated habitat suitability and effectiveness which take into consideration the comments from Yukon government and SLR.
- R2-165. Detailed information on how timing of food sources has been incorporated into the models.
- R2-166. An updated security areas model using a maximum altitude of 1 900 m and incorporating low intensity disturbance.

9.2.3.3 Grizzly Bear Mortality Estimates

The Executive Committee requested more information on effects to grizzly bear in requests relating to population density, qualitative vs. quantitative assessment, the proposal's effects assessment, and mortality estimates. The response from the Proponent is inadequate to allow the Executive Committee to assess impacts.

The use of qualitative assessment for grizzly bear mortality leaves outstanding concerns. SLR notes that further information should be collected (in a quantitative format) to document high risk areas and that bear spatial distribution is needed to assess both the effects and suitability of proposed monitoring and mitigation activities. Further, Government of Yukon notes that bear kill data are available by game management subzone (GMS); these figures should be incorporated into the assessment (YOR 2014-0002-395-1). This would follow other jurisdictions, where survey data are also utilized to assess sensitivity of the population to additional mortality (YOR 2014-0002-400-1). In response to R343, the Proponent does not provide demographic information, suggesting instead that this is the responsibility of Yukon government and is not required to assess project effects. SLR disagrees, stating: "Understanding the baseline population demography and trend is important, so that sensitivity of the local population to additional mortality risk can be put in context (YOR 2014-0002-400-1)." The requirement for demographic information is amplified by the need to corroborate conclusions in response to R344, which are that "mortality risk will more than likely remain below sustainable harvest limits." (YOR 2014-0002-355-1)

Both SLR and Yukon government see the continued use of a grizzly bear density of 15 bears/1000 km² as leading to potential overestimation of bears in the area, thus underestimating the impacts of the Project on the species.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

SLR also notes that the traffic modeling used in response to Part B of R344 does not include all traffic, only loaded vehicles. That may cause underestimation of traffic-related impacts.

The Executive Committee requires more information to assess the impacts of the Project on grizzly bears. Therefore, please provide the following information:

- R2-167. Additional information on Table 8.1 of the grizzly bear effects assessment, including:
 - a. proportion of males and females harvested;
 - b. a discussion of how the numbers in part a relate to the population estimate; and
 - c. a discussion of the population-level effects of direct mortality.
- R2-168. a discussion and analysis of the significance of mortality estimates based on population density estimate of 11 bears/1 000 km² and annual allowable mortality rate of 4 percent.
- R2-169. Revised traffic effect analysis, including road kills, using all project traffic not just loaded vehicles.

9.2.4 Collared Pika

Additional baseline data provided in response to R345 has identified areas of known pika occupancy, leading to additional questions on mitigation and monitoring of effects on the species in order to assess project effects. SLR notes that information provided does not provide clarity on how identified monitoring will be effective. Habitat removal and negative sensory stimuli potentially have negative impacts on local pika populations. (YOR 2014-0002-400-1)

The Executive Committee requires more information in order to assess impacts of the Project on collared pika. Therefore, please provide the following information:

- R2-170. Information on how effects on known sites of collared pika occupancy will be avoided or minimized. This should include mitigation measures to ensure the health of the population.

9.2.5 Wolverine

R346 and R347 asked for the development of a habitat suitability model, analysis, and subsequent project risk analysis for wolverines. The response re-iterates the decision not to include wolverine as a key indicator species. SLR emphasizes, however, that the official status of wolverine under COSEWIC is still “Special Concern” and proposed project activities are associated with identified threats to the species (YOR 2014-0002-400-1).

In order for the Executive Committee to assess the impacts of the Project to the species, the original requests need to be answered. Therefore, please provide the following information:

- R2-171. A habitat suitability model and related analyses, which identifies potential denning habitat of wolverines in the local study area and regional study area.

- R2-172. A risk assessment for wolverines which considers the habitat suitability model. The assessment should identify potential effects to natal and maternal den sites and proposed measures for avoiding disturbance of females with kits.

9.2.6 Little Brown Myotis

The Executive Committee requested additional information to deal on the endangered little brown myotis. The response indicates that bat surveys were completed, with no bats found. This has led to a laissez-faire approach for monitoring and mitigation. This may be inappropriate as it is unclear how and under what environmental conditions the survey was conducted; consequently, the validity of the survey results is unknown. SLR notes this in particular with respect to whether or not the area was searched for hibernacula and roosts.

Furthermore, the outlined mitigation and monitoring rely on incidental observations of roosts, which is likely to be ineffective. Additional surveys for potential hibernacula and roosting sites would provide clarity on the use of the site by the species. SLR provides suggestions on methodologies that would be appropriate to provide a conclusion on bat presence (YOR 2014-0002-400-1).

The Executive Committee requires additional information to understand project impacts on the little brown myotis. Therefore, please provide the following information:

- R2-173. Detailed information on study methodology for the July, 2014, bat survey.
- R2-174. Results and discussion of additional field work needed to determine the presence of little brown myotis and its roosts and hibernacula.
- R2-175. Monitoring and mitigation measures that will be undertaken for this species if their presence is determined. This will require more detailed information in the Wildlife Mitigation and Monitoring Plan.

9.2.7 Dall Sheep

In the January 27, 2015 Adequacy Review Report, the Executive Committee requested additional information on Dall sheep because of their regional importance and the likelihood of project effects through access-related mortality and predator access. The Proponent stands by the baseline information provided and proposes no monitoring or mitigation activities.

This does not respond to the request. The Proponent may be underestimating the potential effects of the Freegold road upgrade and extension on Dall sheep; in addition to predator efficiency and improved hunter access, changes in vegetation and ecological system dynamics may also impact foraging behaviors and predator distribution.

The Executive Committee requires additional information to assess the impacts of the Project on Dall sheep. Please provide the following information:

- R2-176. Additional baseline information on Dall sheep that will allow for population and demographic monitoring in the future.

R2-177. A discussion of the indirect effects to Dall sheep based on:

- a. Increased hunter access;
- b. Disturbance related to land and air traffic; and
- c. Changes in predator-prey dynamics.
- d. The discussion should include seasonal variation as well as proposed mitigation and monitoring measures.

9.3 EFFECTS ASSESSMENT FOR BIRDS

9.3.1 Species of Concern and Baseline data

Request R351 of the Adequacy Review Report sought additional information regarding alpine breeders at risk in relation to the Project. The Proponent responded that

All terrestrial wildlife and birds were considered candidates for a focused effects assessment. However, the determination of effects on all species likely to interact with the Project is unrealistic, and unlikely to provide information upon which to assess effects on wildlife as a whole. Therefore, several criteria were used which identified Key Indicators (KIs) to focus the wildlife effects assessment.

(YOR 2014-0002-291-1)

Environment Canada notes that it “is best practice to consider species assessed by COSEWIC as being listed under SARA” (YOR 2014-0002-391-1). SLR suggests that it may be possible to group together several species together to form an aggregate key indicator for wildlife purposes (YOR 2014-0002-400-1). SLR notes that rock ptarmigan and white-tailed ptarmigan were reported in the alpine and subalpine habitats and that CWS lists these two species as priority land birds for the Yukon Region. It is also possible that short-eared owl are present in the LSA within alpine meadows.

In relation to short-eared owl, the Executive Committee previously requested baseline information regarding this species and horned grebe, and common nighthawk (R353). Environment Canada notes that the Executive Committee should also include a request for available information on the red-necked phalarope, as it is a recently listed (November 2014) species of special concern.

The Executive Committee requires more information on the noted species of concern above. Therefore, please provide the following information:

R2-178. Rationale on the exclusion of the identified species (rock ptarmigan, white-tailed ptarmigan, and short-eared owl) as key indicators as compared against other species of concern, including available baseline information, or the inclusion of these species as key indicator species (either as a group or individually).

R2-179. Baseline data and assessment of effects in relation to red-necked phalarope.

Request 352 of the Adequacy Review Report sought additional information regarding the location of alpine meadow habitats in the project area. The Proponent replies that alpine meadows, “were not identified within the detailed ecological land classification study area.” SLR notes that without

baseline information on habitat availability, it will not be possible to estimate effects to alpine species due to habitat loss or disturbance (YOR 2014-0002-400-1). Therefore, please provide the following information:

R2-180. Spatial information on the presence of alpine meadows or alpine open areas.

9.3.2 Disturbance, Mitigations and Monitoring

As indicated above, the Adequacy Review Report sought additional baseline information on short-eared owl, horned grebe, and the common nighthawk (R353). It appears as though the Proponent does not have more baseline data. While SLR identifies a lack of baseline data regarding these species, SLR suggests description and elaboration of how the wildlife mitigation and monitoring plan will incorporate concerns about these species (YOR 2014-0002-400-1). SLR suggests a similar line of inquiry regarding the responses to requests 355, 356, and 357 which sought additional information on olive sided fly-catcher, rusty blackbird, and horned grebes.

The Executive Committee also requested information on the proposed mitigations for chronic noise (R359). Again, SLR suggests that details to ensure that the WMMP adequately protect “human intolerant bird species at risk” (YOR 2014-0002-400-1).

The Executive Committee requires additional information on potential interactions between the Project, horned grebe, common nighthawk, and short-eared owl. Therefore, please provide the following information:

R2-181. Description of how the WMMP will address and protect the identified species (e.g. olive sided fly catcher, rusty blackbird, common nighthawk, short-eared owl, horned grebe, and other human intolerant species of concern.)

9.3.3 Waterfowl – Presence of Wetlands

The Executive Committee previously requested information on how wetlands were identified, including open-water wetlands and small ponds. While SLR identifies concerns with the identification method, the Executive Committee is satisfied with available data including imagery which it currently has access to in order to verify baseline information on wetlands. However, SLR also notes that the WMMP should include site verification of small mapped wetlands prior to construction, including surveying for nesting activity for species of concern prior to disturbance (YOR 2014-0002-400-1).

Further, the Executive Committee requested additional information on the spatial distribution of wetlands in the project area (R365). The Proponent refers reviewers to a map in the baseline information that is of a sufficiently small scale to hinder understanding of the spatial distribution of wetlands and ponds.

The Executive Committee requires additional information regarding mitigations in relation to how the WMMP will address concerns regarding wetlands and waterfowl. Therefore, please provide the following information:

R2-182. A description of how the WMMP will address and protect wetland habitats and their occupants.

9.3.4 Mine Infrastructure and Birds

In R 367-370, the Executive Committee requested additional information on the effects of mine infrastructure and birds, with particular focus on the TMF wetland and the proposed monitoring and mitigation of effects to birds.

In response to R 368-370, the Proponent states that there is ‘little evidence to predict what level of effect exposure to water in the TMF may have on wildlife, or the ultimate result of that exposure’ (YOR 2014-0002-355-1). SLR acknowledges that information particularly related to tailings management facilities, but suggests that broader information is available in literature and would be valuable for effects assessment (YOR 2014-0002-400-1).

The Proponent concludes that the TMF wetland will, at year 35+, have water quality measures at or lower than CCME guidelines and expects no toxicological effects. It is suggested that prior to closure, when levels of constituents of potential concern (COPCs) may be higher, the presence of active mining activity will act as a deterrent to wildlife. In addition, the Proponent states that practical deterrents will be used to prevent migratory birds from contacting the water if it is known to contain harmful substances. However, the thresholds at which substances are considered ‘harmful’ are not provided.

SLR questions the use of monitoring as a mitigation strategy several times. Referring to the reliance on mine noise to deter waterfowl use of the TMF wetland, SLR notes that over the 35 year period, it is possible that there will be times when the areas of concern will not be subject to sufficient noise for this to be an effective mitigation strategy.

The Proponent states that it is not economically feasible to ensure that there is no wildlife contact with the TMF wetland, listing possible deterrence measures that could be used in areas specified as high-risk. SLR suggests that vegetation removal along the facility perimeter could be an effective mitigation to reduce the attractiveness of the facility.

The Executive Committee requires additional information to determine the effects of mine infrastructure on birds. Therefore, please provide the following information:

R2-183. Effects assessment of the TMF wetland on waterfowl. This should include:

- a. Discussion of pathways by which waterfowl accumulate detrimental levels of metals and negative effects of trace metals, particularly with respect to bioaccumulation;
- b. Inclusion of other trace metals found in elevated levels according to baseline surveys; and
- c. Consideration of the availability of open water bodies in the LSA relative to the RSA (i.e. likelihood of waterfowl staging in the project footprint.)

R2-184. Thresholds for trace metal (e.g. selenium, arsenic, lead) concentrations at which waterfowl/TMF wetland monitoring would occur during the construction, operation, and

decommissioning phases and a discussion of how this information will be factored into mitigation measures. This should include a discussion of additional deterrence measures that would be utilized if thresholds are crossed and an analysis of their effectiveness.

- R2-185. A discussion of amending the Wildlife Mitigation and Monitoring Plan to include a vegetation monitoring and management plan aimed at removing/minimizing plant growth around the TMF and Pit pond.

9.4 WILDLIFE MITIGATION AND MONITORING PLAN

The Executive Committee requested detailed information on the monitoring surveys to be conducted for wildlife. The WMMP provided by the Proponent includes requested information, with a caveat that it is a living document and adaptive management techniques will be used to change the plan as needs evolve. SLR agrees that an adaptive management approach is appropriate, but notes that a lack of details such as survey design, cost estimates, and schedules, makes it difficult to assess the effectiveness of the plans.

The WMMP is described as preliminary, with many details and further action being deferred to the Wildlife Working Group. Examples include whether or not to pursue monitoring of improved predator efficiency due to the Freegold Road extension, methods of monitoring along the water pipeline, and mitigation activities for the little brown myotis. This group is also listed as being the sole group in charge of reviewing the effectiveness of monitoring and mitigations, providing recommendations for changes to the steering committee.

Due to the extent of responsibility being delegated to this group, the Executive Committee requires more information on the authority of the Wildlife Working Group.

The WMMP proposes three to five years of regional monitoring of habitat loss for caribou and moose, den monitoring for grizzly bear, black bear, wolverine, and wolves, and pika habitat. For all of these species, SLR questions both the rationale of the short time period and what triggers would be used to extend monitoring. Although thresholds are listed in the WMMP, actions are unclear in the event thresholds are crossed. It is also unclear how the plan will continue to adapt to changes after the five year mark, when most proposed monitoring activities cease.

SLR also notes that the use of a 10km buffer for monitoring may be insufficient to assess the population impacts on caribou and moose, species with large seasonal ranges. These surveys may be valuable in the long term for seasonal dispersion, but not to address demographic changes.

The Executive Committee requires more information to assess the effectiveness of the WMMP. Therefore, please provide the following information.

- R2-186. Information on the authority of the Wildlife Working Group (i.e. how are recommendations from the group incorporated into future planning and action?)
- R2-187. Details on what triggers will be used, by species, to determine whether to cease or extend monitoring at the 3-5 year mark.
- R2-188. Details on if, and how, impacts to species with large ranges will be monitored beyond the 10 km buffer of the project area.

10.0 ECONOMY

10.1 BOOM AND BUST CYCLES

The Executive Committee requested further information on the Project's contribution to boom and bust cycles in Yukon, mitigation measures for these effects, and scenarios that the Project might operate on a reduced scale.

The response to R376, describing measures that will be put in place to reduce the effects of this cycle, has led to additional questions from the Executive Committee. To mitigate loss of employment through closure, CMC identifies on-the-job training, seed funding to develop new economic opportunities, and job placement assistance etc. It is unclear how the Proponent will guarantee that these programs occur, particularly with respect to unplanned closures or reduced operations.

In recognition of the potential loss of operational employment to other sectors in Yukon, the response indicates that CMC will "use reasonable best efforts to draw workers from the existing unemployed or underemployed regional labour pool." It is unclear how this will be implemented.

The Executive Committee requires further information to assess employment impacts in light of boom and bust cycles. Therefore, please provide the following information:

R2-189. Further information on the implementation of employment strategies to mitigate for effects of closure or unplanned closure.

R2-190. Clarification on efforts that will be used to draw employees from unemployed or underemployed populations.

11.0 EMPLOYABILITY AND EMPLOYMENT

11.1 AFFECTED COMMUNITIES' ACCESS

The Proponent provides the requested details of a priority hiring policy in response to R384. The policy identifies four priorities for hiring: First Nations, Yukoners, northerners from B.C. and NWT, and Canadians. The rationale for these priorities, particularly the third, is unclear.

The Executive Committee requests additional information on the application and implementation of priority hiring policy outlined in response to R384. Therefore, please provide the following information:

R2-191. Details on implementation of the hiring policy

11.2 EMPLOYMENT AND MIGRATION

The Executive Committee requested additional information on the migration estimates and a breakdown of expected project employment by community. The response includes supporting information on the migration estimates, but did not provide an employment breakdown.

Recognizing the difficulty in providing this information, Morrison Hershfield suggests using information from the Minto mine experience as a basis for projections (YOR 2014-0002-401-1).

The Executive Committee requires more information to assess migration effects of the Project. Therefore, please provide the following information:

- R2-192. Projected direct Project employment for affected communities based on actual employment information from mines in neighbouring jurisdictions and/or Minto mine. Please indicate if employees are new, existing, or returning residents or from other communities in Yukon.

11.3 FLY IN-FLY OUT AND SHIFT STRUCTURE

The Executive Committee requested additional information on identified measures to reduce the effects of a fly in – fly out shift structure and accommodation of cultural and community events.

Requested details on flexible rotations, counselling services, and adaptive management strategies are not provided. In order to assess the effectiveness of these mitigation strategies, the requested detail must be provided.

CMC proposes to promote, maintain and protect traditional activities through several methods. The response to the question of how potlatches and other community events will be accommodated is that a First Nation community liaison will be hired to “work with the local communities on community well-being matters including cultural events.” This individual will propose practical opportunities for accommodation. Morrison Hershfield considers this response to be very general, where specific details are requested, especially for events that cannot be scheduled (YOR 2014-0002-401-1). The Proponent should develop this plan through referencing experiences of other mines in Yukon or neighbouring jurisdictions in dealing with this.

The Executive Committee requires further information to assess effectiveness of mitigations for the fly in - fly out shift structure. Please provide the following information:

- R2-193. Details on the proposed mitigation strategies (flexible rotations, counselling services, and adaptive management) for the shift structure identified in the proposal.
- R2-194. Details on how unscheduled community/cultural events will be accommodated in the shift structure. This should include references to experiences in Yukon and neighbouring jurisdictions.

12.0 COMMUNITY VITALITY AND WELLBEING

Community vitality and wellbeing involves a wide array of subcomponents. Related and overlapping valued components include traditional land use, other land use, heritage resources, health, employment, and economics. In addition to requests regarding these valued components, the Executive Committee requested additional information about community vitality and wellbeing in its Adequacy Review Report of January 27, 2015. The Executive Committee believes that effects to community vitality and wellbeing are likely greater in communities other than Whitehorse due to the potential scale of the Project when contrasted with smaller communities.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

Evaluating effects to community vitality and wellbeing requires an understanding of how local values may be affected by the Project. Where effects are difficult to predict, monitoring and management of those effects is essential. The Proponent provides a good foundation for a monitoring approach that can be effectively used during a screening. However, monitoring and management should flow from an effects assessment. The Executive Committee does not have sufficient information to evaluate potential effects. R390 of the Adequacy Review Report requested clear evidence of consideration of community involvement in the proposal's definition and assessment of community vitality and wellbeing, but it is still unclear how community collaboration is incorporated in the proposal. This input is critical to understand on what values an effects assessment must focus, as "community vitality and wellbeing" is as much an aggregate valued component as "wildlife". Where subcomponents or constituent values are provided for different aspects of wildlife, subcomponents for community vitality and wellbeing are not clear. Furthermore, these subcomponents for community vitality and wellbeing are specific to the community in question, and require community input in order to be identified with an appropriate level of confidence.

While effects of traffic, land use and water quality are discussed in other sections, these facets of the Project have the potential for effects to community vitality and wellbeing in communities not identified in proposal documents. White River First Nation and Carcross/Tagish First Nation raise concerns about potential effects outside Pelly Crossing, Carmacks, and Whitehorse. Values for other communities should be identified where there exists a potential for interaction with the project effects, to allow for a proper assessment.

At the very least, in order to evaluate effects to identified values, the Executive Committee believes that a discussion of available analogs, particularly within a northern environment is appropriate. This point has been reiterated by Selkirk First Nation's consultants Lois Craig & Lindsay Staples, "an examination of a number of relevant cases would establish that there are reasonable grounds for predicting significant adverse socio-economic effects from a project of this size, scope, duration, and nature" (YOR 2014-0002-393-1). The assessment of effects to community vitality and wellbeing also requires an understanding of baseline conditions. The socio-economic monitoring data from the Minto mine may help inform an effects assessment of the Project within Pelly Crossing with recent, relevant, and parallel data. Baseline data is required for each affected community.

The Executive Committee requires more information on project effects to community vitality and wellbeing; therefore, please provide the following information:

- R2-195. Identify local values within the category of community vitality and wellbeing as informed by communities and First Nations, including communities outside of Carmacks, Pelly Crossing, and Whitehorse where there is potential for significant project effects.
- R2-196. Provide baseline data, and relevant indicators, for identified local values within the category of community vitality and wellbeing.
- R2-197. An assessment of potential effects due to project activities to local values within the category of community vitality and wellbeing, relying where possible on relevant analogs.

13.0 HERITAGE MANAGEMENT PLAN

CMC provides a significant amount of information on heritage resources in its response to R392. However, Yukon government and Morrison Hershfield identify some gaps.

Government of Yukon identifies the following gaps in its comment (YOR 2014-0002-395-1). The Proponent does not provide, in R392 a), a description of input from First Nations including traditional knowledge or why it was not included. In response to R392 b) and c), no specific details were provided regarding how the mitigations will be implemented throughout the life of the Project. CMC does not provide a monitoring and evaluation mechanism in its response for R392 e).

Morrison Hershfield also notes the absence of an emergency management plan for archaeological or historic resources outside of but immediately adjacent to the project footprint in case of accidents or design failure (YOR 2014-0002-401-1).

The Executive Committee requires more information regarding its Heritage Resources Management Plan to understand how the potential effects to heritage resources will be addressed. Therefore, please provide the following:

- R2-198. A description of input from First Nations including traditional knowledge and how it will inform the plan
- R2-199. A description on how mitigations regarding heritage resources will be implemented throughout the life of the Project
- R2-200. A monitoring and evaluation mechanism.

14.0 LAND USE

14.1 TRADITIONAL KNOWLEDGE AND TRADITIONAL LAND USE

CMC provides a partial response to the requests regarding traditional knowledge (TK) and traditional land use (TLU). Baseline information on TLU, including TK, is necessary in order to adequately assess the effects of the Project on TLU. The need for baseline information on the impacts of the Project on TLU is echoed by Selkirk First Nation and White River First Nation in their comment submissions as well as by Morrison Hershfield in its memorandum to the Executive Committee.

Section 50(2) of YESAA describes that the Proponent needs to consider section 42 in its proposal "(g) the need to protect the rights of Yukon Indian persons under final agreements, the special relationship between Yukon Indian persons and the wilderness environment of Yukon, and the cultures, traditions, health and lifestyles of Yukon Indian persons and other residents of Yukon".

Project activities and their effects are anticipated to occur in several First Nations' traditional territories over the lifespan of the Project. TLU information is specific to individual First Nations as noted by White River First Nation:

It is standard practice that TK/TLU studies are Nation-specific, given that different First Nations have distinct land, water, and resource uses, cultural practices and traditions. (YOR 2014-0002-398-1, p3)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

An excerpt from Chief Kerry's Moose (Tobias, 2000), a guidebook to land use and occupancy mapping, research design and data collection, describes examples of the types of land use and occupancy information that have been mapped by aboriginal groups across Canada:

- Places where animals are harvested for food, clothing, medicines, tools, and other purposes.
- Places where plant materials are harvested for food, clothing, medicines, tools, shelter and fuel.
- Places where rocks, minerals, and soils are collected for making tools, conducting ceremonies, and other purposes.
- Ecological knowledge of habitats and sites critical to the survival of important animal populations; for instance, caribou migration corridors, islands where moose calve, waterfowl breeding grounds and staging areas, and spawning beds.
- Habitation sites, such as settlements, trading posts, cabins, camps, and burial grounds.
- Spiritual or sacred places such as ceremony sites, rock paintings, areas inhabited by non-human or supernatural beings, and birth and death sites.
- Legends and other accounts about specific places.
- Travel and trade routes.
- Aboriginal place names.

In its response to R399, CMC provides little information regarding the baseline of TLU, therefore the effects of the Project on traditional economies cannot be determined. The assessment of impacts on traditional economies must be based upon baseline information on traditional harvesting activities, and the extent to which such activities contribute to local First Nation economies.

Regarding R396 and R399, the information provided by CMC is insufficient. The Executive Committee requires information regarding baseline TLU, including TK, and an effects assessment of the Project on TLU. Therefore, please provide the following information:

R2-201. A comprehensive TLU study including traditional knowledge. The information provided shall cover traditional land use activities identified by First Nations.

R2-202. An assessment of effects of the Project on TLU.

R2-203. An assessment of effects of the Project on traditional economies.

14.2 FISHERIES

In its response to R400, CMC does not fully answer the question. As noted by DFO in its comment,

The information contained in SIR 400 does not appear to answer the information request. As a general statement, where the application is lacking information about existing CRA fisheries values (including support species) it may prove difficult to adequately assess the potential effects of the various project components to those fisheries. The expectation of the application is for the Proponent to clearly detail the project components; the interaction (positive or negative) of the project components on the fisheries values; the quantification of the proposed serious harm to fish; and finally an offsetting plan to counterbalance the unavoidable serious harm to a CRA

fishery that is consistent with the goal of maintaining or improving the productivity of the CRA fishery.

(YOR 2014-0002-389-1)

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 information:

- R2-204. A discussion of the potential effects of the Project to commercial, recreational and Aboriginal fisheries (e.g. Arctic grayling and Chinook salmon). This discussion should include:
- a. 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.

14.3 HARVESTING OF PLANTS

CMC indicates in its response to R401 and R402 that no information was gathered on the traditional harvesting of plants since it was not identified by LSCFN and SFN. The

The Executive Committee requires more information regarding baseline data on traditional, cultural or economically important plant species within the project area. Therefore, please provide the following:

- R2-205. A description of plant species of traditional, cultural, or economic importance within the Project footprint. Include a description of any efforts to engage First Nations or other land users in identifying plants of concern and any ground studies that sought to identify and map plants of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1

14.4 HARVESTING OF ANIMALS

In its response to R403, CMC identifies that discussions are ongoing to carry out a traditional land use study with LSCFN and SFN, which would address concerns regarding the importance of those sites and of protecting their location. The locations of important areas of wildlife harvest can inform mitigation strategies to reduce the effects of the Project on those areas.

The Executive Committee requires more information regarding the impacts of the Project on hunting and traditional harvest areas. Therefore, please provide the following information:

- R2-206. Provide a description of concerns raised regarding effects to traditional harvest areas and indicate the location of the areas of concern. This information shall be provided as part of a Traditional Land Use study as requested in Section 15.1.

14.5 TRAPPING AND OUTFITTING

In its response to R405, CMC provides a partial response to this request by submitting the information available. CMC further indicated that three of the eleven trapping concession holders have been interviewed. Morrison-Hershfield identifies in its report to the Executive Committee that concessions #150 and #408 are likely to be the most affected by the Project.

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 is required in order for the Executive Committee to incorporate these perspectives and potential effects in the screening. Therefore, please provide the following information:

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

In its comment on R406, Yukon government notes that “the proponent's response did not fulfill the request wherein the Tourism Branch identifies they wanted to know the outcomes of discussions with outfitting concession holders and how the issues or concerns from this group were addressed by the Proponent in the project proposal.” (YOR 2014-0002-395-1)

This information is required in order for the Executive Committee to incorporate these perspectives and potential effects in the screening. Therefore, please provide the following information:

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

14.6 QUARTZ AND PLACER CLAIM HOLDERS

In its memorandum to the Executive Committee, Morrison-Hershfield indicated for R408 that “the number of mineral claim holders contacted and how many responded to the outreach is not clear in CMC's response.” The Executive Committee agrees that it is not clear how many of the 28 placer miner holder CMC spoke to.

The Executive Committee requires more information on how mineral rights holders have been informed of the proposal and how many have responded including their specific concerns. Therefore, please provide the following information:

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

14.7 OTHER LAND USERS

R410 requested information regarding the mitigation strategy for a cabin located on the edge of a proposed borrow pit identified in the heritage resources section of the proposal. CMC has not

responded to this question but deferred to Yukon government. The Executive Committee requires more information regarding the mitigation strategy for this cabin. This unfulfilled information request is addressed in section 2.4.1 of this report along with other concerns regarding the upgrade to existing Freegold Road.

Several comments received during the adequacy period speak to concerns regarding the Yukon Quest sled dog race. Considering the overlap between the Yukon Quest route and the proposed upgrade of the Freegold Road, the Executive Committee requires additional information on the potential effects to this event. Therefore, please provide the following:

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

15.0 NOISE

The Supplementary Information Report of March 16, 2015, did not answer all Executive Committee concerns regarding noise. While the Proponent identifies and supports noise predictions well, there were inconsistencies within the presented data. One notable inconsistency is the presentation of different reference sound pressures for mine infrastructure and equipment when compared to the original proposal. It is unclear which values have been used within the model.

While the Proponent's Supplementary Information Report better documents and supports the noise model, it remains unclear how noise predictions relate to wildlife values in the proposal. Morrison Hershfield and TH's consultant, CSP2, both cite concerns in this regard. Morrison Hershfield questions the exclusion of discontinuous noise sources, such as air traffic and blasting, from noise predictions (YOR 2014-0002-401-1). CSP2 identifies that baseline levels used for noise may be high, reducing the impact of project noise, and that A-weighted sound levels, which are intended for human perception of loudness, may be inappropriate for wildlife receptors (YOR 2014-0002-397-1).

Intermittent noise, including air traffic and blasting, may have considerable detrimental effects to wildlife use of areas affected by these noise sources. The unknown expected peak sound pressures of blasting and air traffic further restricts the ability of the Executive Committee to assess potential effects resulting from noise for both human and wildlife receptors. The Proponent states that only a few flights will land each week at Casino; however, the original proposal, table 4.3.2, indicates over one arrival and departure per day during construction years. The use of a baseline noise level of 45 dBA appears to be high as well, considering the average daytime noise levels measured near the community of Carmacks were 40.3 dBA for daytime and 33.9 dBA for nighttime. The Executive Committee requires more information on how noise predictions were incorporated into the Proponent's effects assessment of wildlife values, including how un-modeled noise was incorporated into this assessment.

Furthermore, it is unclear why the Proponent does not model noises that are specific to individual project stages, in particular the cyclone sand plant and concrete batch plant, given that these components have a presence that will last periods measured in years.

The Executive Committee requires more information regarding project noise. Therefore, please provide the following information.

- R2-211. Clarification of differences between the reference noise levels presented in the original proposal and the Supplementary Information Report.
- R2-212. An assessment of effects, and any proposed monitoring and mitigations, due to non-modeled noise, in relation to wildlife, due to: air traffic; blasting; and cycloning.
- R2-213. Rationale for a 45 dBA background sound level.
- R2-214. Rationale for the use of A-weightings for assessing effects to wildlife and human annoyance (in relation to low frequency sounds), including how the use of A-weightings influence an effects assessment.

Carcross/Tagish First Nation also raises concerns resulting from project traffic (YOR 2014-0002-394-1). Noise from project traffic may adversely affect the community of Carcross through effects to ambience. Section 2.4.2 also considers effects due to traffic.

The Executive Committee requires more information on the effects of noise due to project and project induced traffic on the Village of Carmacks and in Carcross. Therefore, please provide the following information:

- R2-215. Discussion on the temporal distribution of noise effects in communities, including Carmacks and Carcross, on a seasonal and diurnal basis
- R2-216. Any anticipated effects, proposed mitigations, and monitoring to noise effects in communities including Carmacks and Carcross.

16.0 EMERGENCIES AND HUMAN HEALTH

16.1 EVACUATION

Morrison Hershfield notes that information for R422 is inadequate. While the Proponent provides transportation times for individual vehicles, it remains unclear how long it would take to evacuate the site. Nor is it clear if there would be seasonal conditions to an evacuation (YOR 2014-0002-401-1). The Executive Committee requires more information regarding evacuation. Therefore, please provide the following information:

- R2-217. Details on evacuation including anticipated timelines and seasonal considerations.

16.2 FIRE

The Executive Committee requested the rationale for two hours, or 682 m³, as the minimum capacity for water storage on-site for firefighting. The Supplementary Information Report indicates “The fire water requirement is 341 m³/hr for two hours. This demand is satisfied by a fire reserve capacity of 682 m³ in the lower portion of the freshwater pond that will be unavailable for other uses.” This statement is not rationale for the identification of the specified amount as a minimum water requirement for firefighting. Further, reliance on the Yukon River freshwater pipeline may not be possible in event of an emergency, adding to difficulties in ascertaining the proposed capacities’

appropriateness. The Executive Committee requests rationale for the selected firefighting minimum requirements. Therefore, please provide the following information:

R2-218. Rationale for the two hours, or 682m³, as the minimum capacity for water storage on-site for firefighting capacity.

16.3 DANGEROUS GOODS, SPILLS AND LEAKS

Environment Canada notes that the proposal should include a risk assessment for major water crossings in relation to LNG and explosive constituents. Regarding explosive constituents, Environment Canada requests hydrologic trajectory modeling to help inform spill response plans. Effects due to LNG spills may be less likely than other cargoes, Environment Canada states “LNG spills to freshwater environments have the potential to result in fresh water habitat loss, avoidance of habitat, and direct mortality of freshwater species” (YOR 2014-0002-391-1). Provided the quantities and varieties of hazardous materials required for project activities, the Executive Committee requires additional information on risks due to spills. Therefore, please provide the following:

R2-219. A risk assessment of the transportation route that considers all major water crossings in relation to the transportation of hazardous materials.

16.4 HUMAN HEALTH RISKS

The Executive Committee previously requested a human health risk assessment (HHRA) for the Project. The Proponent did not provide a HHRA, as it believes that legal standards represent empirical approaches to human health risk, with receptors limited to the workforce. The Executive Committee is not convinced that reliance on regulations and legislation captures all pathways, nor that accidents and malfunctions are considered with this approach. Further, projected exceedances make reliance on regulations and legislation to avoid adverse effects of limited effectiveness.

Given the extended period of operation, wide range of transmission pathways, projected exceedances of various environmental standards, and lack of baseline data surrounding land use, including harvesting, in areas adjacent and overlapping with the Project, the Executive Committee still requires a human health risk assessment.

Morrison Hershfield notes the limited information provided by the Proponent does consider some effects due to air quality and noise, but does not consider other pathways such as deposition of dust, water contamination, or ingestion through land use activities (YOR 2014-0002-401-1). Government of Yukon, Health and Social Services, notes that the Proponent ought to provide a HHRA, though this could use a staged approach (YOR 2014-0002-395-1). Further, while the Proponent suggests that monitoring of health effects is unrequired due to application of regulations and legislation in relation to workers, a monitoring plan may still be required. Health and Social Services suggests that a monitoring plan may help mitigate effects downstream effects such as stress, disease, etc. The exclusion of a human health monitoring plan is concerning without the results of an HHRA. An HHRA would also allow an assessment of effects to workers more generally, in camp or on the job site.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

The Executive Committee refers back to Adequacy Review Report in that the expected scope of an HHRA for the Project, in that it should include an analysis of potential effects resulting from the consumption of wildlife, fish, and traditional foods.

The Executive Committee requires more information on risks to and monitoring of human health. Therefore, please provide the following information:

R2-220. A human health risk assessment for the Project. Details should include:

- a. identify hazardous materials present on-site;
- b. evaluation of toxicity of hazardous materials;
- c. identify and assess pathways, including consumption of wildlife, fish, and traditional foods; and
- d. characterize risk to human health.

R2-221. Rationale based on an HHRA for the exclusion of a human health monitoring plan, or, alternatively, details on a human health monitoring plan.

16.5 EMERGENCY SERVICES

A number of information requests in the Adequacy Review Report of January 27, 2015, sought information related to the interaction between the Project, communities, and first responders in the event of an emergency. The Proponent intends to incorporate input from first responders and government during construction into their emergency response plan. Currently the emergency response plan remains largely conceptual. TH's consultant CSP2 notes the conceptual nature of the emergency response plan may limit possible input during the assessment phase, while it is also unclear if any conversations have taken place or how emergency plans may incorporate First Nation governments (YOR 2014-0002-397-1). Morrison Hershfield also identifies information gaps on the expected provision of emergency services from outside parties (YOR 2014-0002-401-1).

Along highways, the Proponent anticipates no significant effects. Again, as Government of Yukon, Health and Social Services, indicates, it is unclear what conversations have taken place between potential first responders regarding the increased potential for accidents and their effects (YOR 2014-0002-395-1). Without information on these conversations it is unclear how the significance determination is supported. As discussed in section 2.4.2 project related traffic does constitute a significant portion of traffic along the Klondike Highway. Freegold Road traffic, meanwhile, will mostly consist of project related traffic.

The Executive Committee requires more information on the interaction between emergency services and the Project. Therefore, please provide the following information:

R2-222. Summaries of discussions that support the proposed emergency response plans with emergency service providers, communities, and governments.

In relation to LNG management and potential spills, ARCADIS requests more detail on emergency response in relation to LNG fire or explosion which may require specialized response teams (YOR 2014-0002-402-1). Specifically, the Proponent should provide details on “emergency response teams,

emergency response equipment, particularly for fire and explosion, and their location.” The Executive Committee requires more information on LNG emergency response. Therefore, please provide the following information:

- R2-223. Details on emergency response for LNG accidents or emergencies in relation to the response team and their equipment including details on training, composition, availability, and location.

17.0 ACCIDENTS AND MALFUNCTIONS

The Executive Committee requested additional information regarding potential major mine infrastructure failures and proposed responses to these events (R447 and R449).

In their response, CMC states that:

dam inundation mapping will be conducted to evaluate the proposed design, and determine credible modes of failure, tailings outflow volume, peak discharge, aximum downstream distance for the initial water driven flood wave, maximum downstream distance for tailings slumping, and the width of the zone of influence resulting from the dam break analysis. The risk assessment process enables a quantitative assessment of potential risks and their effects and provides for the development of appropriate mitigation and management plans, as well as emergency response measures.

Environment Canada notes, in their review of CMC’s response to R447:

Effectively, such responses differs [sic] concerns raised by stakeholders and the Executive Committee to later stages (i.e. permitting) and do not allow for reviewers to evaluate proposed plans and mitigations during the actual environmental assessment phase. This information should be available for inclusion at the assessment stage in order to understand potential effects and significance.

Though we understand that environmental management plans will be developed to be dynamic documents and will be refined as mine planning and building designs are advanced, as per our original comment, Environment Canada recommends that sufficient details contained within conceptual or draft plans be provided as part of this environmental assessment so that stakeholders may evaluate the suggested approaches and mitigations, and possibly the costs associated with their implementation. (YOR 2014-0002-391-1)

CMC is required under s.50 to consider the significant adverse environmental and socio-economic effects of accidents and malfunctions. This consideration is required for all stages of the Project, which includes not only during construction and operation of the TMF dam but also through closure and post-closure.

- R2-224. Please provide a comprehensive emergency response plan that addresses accidents and malfunctions related to major mine infrastructure. This must include consideration of structural and non-structural failure of the TMF dam as informed by the risk assessment and the dam breach and inundation study.

The Executive Committee requested an updated discussion regarding the likelihood and consequence of a TMF dam failure that considered the entire lifetime of the facility (i.e. in perpetuity)

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

and in consideration of updated site condition characterization and dam break/inundation analysis. (R448).

DFO notes in their review of CMC's response to R448 that this "response does not detail the potential TMF modes of failure nor does it identify what the short and long-term consequences of a given TMF failure would have on the CRA fishery or fish that support a CRA fishery at or downstream of the TMF" (YOR 2014-0002-389-1).

The Executive Committee agrees and requires a risk assessment and dam breach and inundation study as requested in R2-4 and R 2-30.

Appendix A BIBLIOGRAPHY

- Analytical Methods Inc. (1998). *SBF 30 M Catamaran Wake Wash Evaluation*. Redmond, Washington: Analytical Methods Inc.
- Bjelkevick, A. (2005). *Water Cover Closure Design for Tailings Dams*. Lulea University of Technology, Department of Civil and Environmental Engineering.
- British Columbia Ministry of Forests and Range. (1999). Mapping and Assessing Terrain Stability Guidebook, Forest Practices Code, 2nd Edition. 43.
- Canadian Council of Ministers of the Environment. (2012). *Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone*.
- Canadian Dam Association. (2007). *Dam Safety Guidelines*. Toronto.
- Canadian Dam Association. (2014). *Application of Dam Safety Guidelines to Mining Dams*. Technical Bulletin.
- Canadian Dam Association. (2014, December 7). *Submission to the Mount Polley Independent Expert Engineering Investigation and Review Panel*. Retrieved March 3, 2015, from Canadian Dam Association:
http://www.imis100.ca1.ca/CDA/CDA/Announcements/CDA_responds_to_Mt._Polley_Panel_report.aspx
- Chamberlain, E. (1981). Frost Susceptibility of Soil. Review of Index Tests. *CRREL Monograph*, 81-82.
- CMC, Casino Mining Corp. (2014). Casino Project - Proposal for Executive Committee Review Pursuant to the Yukon Environmental and Socio-Economic Assessment Act. Appendices 2-23.
- COSEWIC. (2003). *COSEWIC Assessment - Wolverine*. Ottawa: Canadian Wildlife Service.
- COSEWIC. (2014). *COSEWIC assessment and status report on the wolverine Gulo gulo in Canada*. Ottawa: Committee on the Status of Endangered Wildlife in Canada.
- Department of Fisheries and Oceans Canada. (2007). *Operational Statement on Clear Span Bridges*.
- Dunne, B. M., & Quinn, M. S. (2009). Effectiveness of above-ground pipeline mitigation for moose (*Alces alces*) and other large mammals. *Biological Conservation*, 332-343.
- EcoMetrix. (2014). Casino Mine Project Proposal: Suggested Requests for Supplementary Information Relating to Hydrology and Aquatic Resources, and Engineering Design and Geotechnical Considerations. 73 pp. YOR #2014-0002-235-1.
- EDI Environmental Dynamics Inc. (2007). *Yukon Queen II Fisheries Study (2006)*. Whitehorse, Yukon: EDI.

Adequacy Review Report – Information Request No. 2

Project No. 2014-0002 – Casino Mine

- Environment Canada. (n.d.). *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*. Retrieved May 6, 2015, from <http://ec.gc.ca/pollution/default.asp?lang=En&n=125349F7-1&printfullpage=true>
- European Commission. (2009). *Best Available Techniques for Management of Tailings and Waste Rock in Mining Activities*. Reference Document.
- Fisheries and Oceans Canada. (2008). *Protocol for the detection of fish Species at Risk in Ontario Great Lakes Area (OGLA)*. Canadian Science Advisory Secretariat.
- Geertsema, M. a. (2006). Challenges with terrain Stability Mapping in Northern British Columbia. *Streamline Watershed Management Bulletin*, Vol. 10/No. 1. British Columbia.
- Government of Yukon. (2013). *Reclamation and Closure Planning for Quartz Mining Projects, Plan Requirements and Closure Costing Guidance*. Energy Mines and Resources.
- Howes, D. E., & Kenk, E. (1997). *Terrain Classification System for British Columbia (Version 2)*. Victoria, BC: Surveys and resource mapping Branch, Ministry of Crowns land.
- Macfarlane, G. R. (1999). *Wave Wake - A Rational Method For Assessment*. Australian Maritime College, Department of Naval Architecture and Ocean Engineering. Launceston: Presented at the Roayl Institutional of Naval Architects International conference on Coastal Ships and Inland Waterways.
- Mining Association of British Columbia. (2015). *Mount Polley & Tailings Facility Review Update - Tailings FAQ*. Retrieved May 6, 2015, from Mining Association of British Columbia: <http://www.mining.bc.ca/our-focus/mount-polley-tailings-facility-review-update>
- Pearse, T. D., & Weinstein, M. (1988). *A Study of the Impacts of the Casino Trail on the Northern Tutchone of Pelly Crossing and Carmacks, Yukon Territory*.
- SRK Consulting. (2009). *Mine Waste Covers in Cold Regions*. Vancouver: Mine Environment Neutral Drainage Program.
- Tobias, T. N. (2000). *Chief Kerry's Moose*. Vancouver: Union of BC Indian Chiefs and Ecotrust Canada.
- YESAB. (2011). *Proponent's Guide – Water Information Requirements for Quartz Mining Project Proposals*. Whitehorse.
- YESAB. (2014). *Draft for Review - Geohazards and Risk: A Proponents Guide to Linear Infrastructure*. Whitehorse.
- YESAB and Yukon Environment. (2012). *Dam Guide*. Whitehorse: YESAB and Yukon Environment.
- Yukon Bureau of Statistics. (2012). *Gross Domestic Product by Industry at Basic Prices*. Whitehorse: Government of Yukon.