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Appendix B **Mine Closure and Reclamation Planning** **Guidelines, Regulations and** **Lease Requirements**

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The following tables provide cross-referencing to where responses to key Mine Closure and Reclamation Planning guidelines, regulations or lease requirements can be found in this document. The referenced section of this ICRP provides an outline, at a conceptual level, of how the proponent plans to address the particular requirement.

Table B-1: Territorial Lands Act

Territorial Land Use Regulations (TLUR 2010)		
Key Mine Closure and Reclamation Plan Guidelines	TLUR Section	ICRP (Section)
All closure work shall be carried out in accordance with permit requirements as stated in the <i>Territorial Land Use Regulations</i> .	s. 8 through 10, 31	2.6
"Subject to the terms and conditions of his permit or the express written authority of an inspector, every permittee shall replace all materials removed by him in the course of excavating, other than rock trenching, and shall level and compact the area of excavation."	s. 12	Table 5.1
"Restore the channel and bed of the stream to their original alignment and cross-section."	s. 13.(1 b)	Table 5.1
"Subject to the terms and conditions of his permit, every permittee shall, after completion of a land use operation, restore the permit area as nearly as possible to the same condition as it was prior to commencement of the land use operation."	s. 18	Table 5.1
Remove all buildings equipment, machinery, and storage equipment/containers and materials onsite.	s. 19.(1)	5.2.4
A final plan will be issued to the "engineer" within 60 days following completion of the land use operation or expiration of the permit.	s. 33	2.3.1.4
All plan drawings shall be: • Drawn to scale that clearly illustrates all mine features. • Shows the scale on the drawing. and • Provide geographic co-ordinates.	s.35	Appendix A
"In order to ensure that a permittee complies with the terms and conditions of his permit with these Regulations, the engineer may include in the permit a condition that the permittee deposit with the Minister a security deposit not exceeding \$100,000."	s. 36	10

Table B-2: Nunavut Impact Review Board

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Guidelines for the Preparation of an Environmental Impact Statement for Baffinland Iron Mines Corporation's Mary River Project (2009)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP (Section)
"To ensure that issues associated with the effective closure and reclamation of all Project Components is considered at the earliest possible stage in the mine development process, thereby influencing mine design to take into account environmental issues related to mine closure and reclamation."	All
"To establish major targets for reclamation of lands potentially affected by the Project."	Table 5.1
"Description of reclamation methods, time frames and schedules, including proposed notice periods to employees and public."	5
"Description of temporary closure measures and a discussion of at what point a temporary closure should be considered permanent for the purposes of requiring implementation."	0
"Discussion of research programs to address challenges to reclamation, given the local conditions."	Appendix D
"Considerations for the Projection of public health and safety."	7.1.1, & 7.3.1
"Description of closure and post - closure monitoring of environmental components."	9
"Discussion of the need for long - term monitoring and maintenance by establishing physical and chemical stability."	9
"Discussion on reduction or elimination of environmental effects once the mine ceases operation."	Table 5.1 & 9
"Discussion regarding re-establish conditions that permit the land to return to similar pre-mining land use."	Table 5.1 & 5.1.1
"Consideration for ML/ARD potential of rocks, in association with related waste rock management strategies."	5.2.1.9 & 5.2.2.7
"Any considerations for the restoration of the natural aesthetics of the Project."	Table 5.1

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Table B-3: AANDC (CIRNAC) Guidelines

Mine Site Reclamation Guidelines for the Northwest Territories (2007)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP Report Section
Develop and implement preventive and control strategies to effectively minimize the potential for ARD and ML to occur.	5.2.2
Where ARD and ML are occurring as a result of mine activities, mitigate and minimize impacts to the environment.	5.2.1.9 & 5.2.2.9
Re-establish the pre-mining ground cover, which may involve encouraging self-sustainable indigenous vegetation growth.	5
Remediate any sources of contamination that may have been created during the development and operation of the mine site in order to protect humans, wildlife, and environmental health.	Table 5.1
Ensure physical stability of residual earth structures for environmental, human, and wildlife safety.	Table 5.1
Open Pit: - Minimize access to protect human and wildlife safety. - Implement water management strategies to minimize and control migration and discharge of contaminated drainage, and if required, collect and treat contaminated water. - Stabilize slopes to minimize erosion and slumping.	5.2.1
Waste Rock: Minimize erosion, thaw settlement, slope failure, collapse or the release of contaminants or sediments.	5.2.2
Buildings and infrastructure, equipment: Return area to its original state or to a condition compatible with the end land-use targets.	5.2.4
Restore natural drainage patterns where surface infrastructure has been removed.	Table 5.1
Landfills: Control erosion and effects to the ground thermal regime.	5.2.7
Water Management Systems: - Dismantle and remove/dispose of as much of the system as possible and restore natural or established new drainage patterns. - Stabilize and protect from erosion and failure for the long term.	Table 5.1 & 5.2.8

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Table B-4: AANDC (CIRNAC) Policies

Mine Site Reclamation Policy for Nunavut (2002) and Mine Site Reclamation Policy for the Northwest Territories (2002)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP Report Section
Areas should be returned to viable and self sustaining areas where practical.	5.1.1
Use best management principles such as progressive reclamation and reduce the environmental risk.	6
Communication and consultation shall be undertaken with all applicable parties.	2.3.1.3 & 2.4
Closure impacts for all mine components.	Table 5.1
Closure costs estimates should be undertaken by a third party using a recognized methodology such as RECLAIM. Closure cost estimates should include contingency factors.	10
Inclusion of a progressive reclamation plan.	6
Removal/stabilization of all structures.	5.2.4 & 5.2.5
Reclaim and stabilize waste rock stockpiles remaining on site.	5.2.2
Reclaim the disturbed surface areas to acceptable standards.	Table 5.1
Water quality at closure shall meet or exceed the accepted standards.	Table 5.1
Temporary Closure measures shall be included in the Preliminary Closure Plan and cost estimate.	7
Inclusion of a post - closure monitoring program.	9
Detailed closure and decommissioning of the following: • Buildings and other structures. • Roads. • Airstrips. • Waste rock stockpiles. • Ore stockpiles • Quarries. • Open pit. • Petroleum and chemical storage areas and facilities. • Pipelines. • Power corridors. • Sewage and waste disposal areas and Mine drainage.	5.2
Re-vegetation of the site where practical.	5
Meet or exceed applicable water standards.	Table 5.1
Recycle materials where practical.	5.2.7
Closure cost estimate to be calculated for the total financial security for final closure.	10
Utilization of a recognized methodology for calculating the closure costs (i.e. RECLAIM model).	10

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Mine Site Reclamation Policy for Nunavut (2002) and Mine Site Reclamation Policy for the Northwest Territories (2002)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP Report Section
Establish financial security to be provided to the Minister of Aboriginal Affairs and Northern Development Canada (previously Indian Affairs and Northern Development).	10

Table B-5: AANDC (CIRNAC) Guideline

Mine Reclamation in the Northwest Territories and Yukon (1992)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP Report Section
Preliminary Closure Plan objectives are to: • Protect the public health and safety. • Prevent and/or reduce the environmental deterioration. • Return all disturbed areas to the original state or an accepted level of reclamation.	N/A
Ensure post-closure physical and chemical stability.	5.1.1
Development of a monitoring program to assess the effectiveness of the restoration to be undertaken between the Proponent and Indian and Northern Affairs Canada.	9
Reclaimed areas should be returned to previous land use and aesthetics, to the extent possible.	Table 5.1
Include temporary closure and indefinite (long-term) Preliminary Closure Plans.	7
Mine features should be closed in accordance with the guidelines provided in Tables 5.2 through Table 5.8 (Robertson and Kirsten 1992).	5
Inclusion of a fully developed closure cost estimate.	10
Re-vegetation where practical. Local arctic species and distributions should be considered.	5.2

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Table B-6: Northwest Territories Water Board Guidelines

Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories (1990)	
Key Mine Closure and Reclamation Plan Guidelines	ICRP Plan Report Section
Evaluation of ML/ARD potential for open pit, waste rock stockpiles and disturbed areas.	5.2.1 & 5.2.2 (ongoing process)
Cover design for waste rock stockpiles, if required. Stockpiles should be designed and contoured to ensure stability.	5.2.2
Re-vegetation of disturbed areas, where practical.	5.2
Open pit closure preferably backfilling or flooding.	5.2.1
Stability of open pit should be investigated.	5.2.1
Quarries should be backfilled and contoured to match the surrounding topography.	5.2.3
Removal of fuel and chemical storage tanks and associated piping and plumbing if applicable.	5.2.7
Fuel contaminated soils should be remediated.	5.2.7 & 9.4
Chemical storage facilities should be removed from site.	7.1.5 & 7.3.5
Soils surrounding chemical facilities should be tested for contamination and where present be removed from site.	9.4
Culverts should be removed from site.	5.2.8
Airstrips should be left intact, unless deemed unsafe.	5.2.6
Natural drainage should be restored to the site. Roads that do not impede the natural drainage may remain intact.	5.2.6 & 5.2.8
Solid wastes should be dealt with in responsible manner.	5.2.7
Hazardous wastes are to be disposed at an approved facility.	5.2.7
Buildings and structures should be removed from the site.	5.2.4
Concrete foundations may be left in a safe condition.	5.2.4
The Preliminary Closure Plan should include a planned shutdown/temporary closure scenario.	7.1
The Preliminary Closure Plan should include a long-term shutdown/Long-term Closure scenario.	7
The Preliminary Closure Plan should include a final abandonment/final closure scenario.	5
It is encouraged that site closure include phased plan development (progressive closure).	6
A monitoring program should be devised to measure the effectiveness of the site closure.	9
Financial security is required for the closure phase.	10

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Appendix C

Site Photos of Current Site Condition (2017/2018)

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Mary River Mine Site

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Mary River Mine Site – View South



Mary River Mine Site – Close-up of Accommodations Complex and Tank Farm

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Mary River Mine Site – View West of Accommodation Complex and Tank Farm



Mary River Mine – 800 Person Camp (September 2018)

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Mary River Mine

Mary River Mine (September 2018)

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Waste Rock Facility, facing northeast

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Milne Port

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Milne Port – View South



Milne Port – View Southeast

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Milne Port – View Northwest



Close-up of Milne Port Tank Farm and Ore Stockpiles

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Tote Road

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Tote Road Water Crossing



Tote Road

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Steensby Camp

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Steensby Camp – View Northwest

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Mid-Rail Camp

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Mid Rail Camp – View West

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Appendix D Reclamation Research Plans

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The following is an overview of the reclamation research plans that are proposed to reduce uncertainties associated with closure planning. Progress updates for these research programs will be provided in standalone reports that will be included within each following ICRP submission. In addition to the individual research program objectives, a summary of planned research tasks and timelines and findings from completed work to date are included in this Appendix.

Research plans described below have been identified by BIM and/or stakeholders as key topics of uncertainty and/or risk with respect to closure. Research tasks may focus on confirming and/or refining initial predictions for residual effects, improving understanding on what achievable levels of reclamation success are to inform closure criteria, and developing site-specific closure techniques or other efforts needed to address notable gaps in advancing the ICRP to a final closure design.

Additional research plans may be included in future ICRPs as appropriate. New plans will be considered by BIM and project stakeholders as the project advances and uncertainties relating to closure arise. Baffinland implements a robust collection of monitoring programs, which include reporting components for stakeholder review and the opportunity to present questions/concerns related to closure. In particular, the NIRB Annual Monitoring Report is developed to assess the accuracy of predictions contained in the Project's environmental impact statements. This submission allows for comment by Project stakeholders and is followed closely by Baffinland's closure planning staff to identify environmental changes during mining that could impact the adequacy of the existing ICRP. Tracking and understanding of project impacts/effects is a focus of the MEWG and the TEWG, who will communicate findings/discussions with the MCWG. These regulatory reporting requirements and working groups provide a mechanism for identifying key uncertainties for closure and assessing the need for new research topics. Recommendations from the MEWG, TEWG and the various regulatory stakeholders will be assessed by the MCWG, which will provide final recommendations on the reclamation research programs.

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D.1 Reclamation Research Program - Open Pit Runoff Water Quality

Background

At the end of mining, the open pit will gradually fill with water from precipitation; time is estimated at 85 to 150 years, depending on annual precipitation, evaporation and other factors (Knight Piésold, 2008). Baffinland has since committed to reducing this time period using alternatives for enhanced flooding of the open pit (addressed under the “Open Pit Flooding Timeline” research program).

AMEC (2012c) developed water quality estimates for pit water for the final year of mining (Year 21), which were utilized as input in the water quality mass loading model under the assumption that, once the pit has filled, in each subsequent (post-closure) year all precipitation into the open pit will accumulate and that excess water will discharge via a spillway during the open water period according to the natural hydrograph.

The mass loading modelling indicated that Level I magnitude effects to water quality will occur under low flow conditions, with a calculated HQ between 1 and 10 for mercury, selenium and silver. It is noted that an HQ >10 was calculated for mercury within the F0 tributary, upstream of fish presence or habitat; however, since the assessment of water and sediment quality is based on fish as the receptor, the effects assessment considers the resultant water quality at fish habitat within the Mary River, where all parameters have an HQ value less than 10.

Based on pit water quality for Year 21 of mining, it is possible the water will have a pH of around 4.2, which is outside of the pH range of the MDMER (6.0 to 9.0) however the mass loading modelling carried out is based on conservative assumptions and Baffinland is continuing to study the geochemistry of waste rock and ore to further refine predictions and management plans.

Uncertainty

Due to the early stage of project development and the fact only conceptual geochemical modelling (mass loadings assessment) has been completed to date, there is uncertainty with respect to the Open Pit water quality predictions.

Inflows to the open pit include: direct precipitation, runoff, groundwater inflow, and any enhanced flooding flows. Outflows include evaporation/sublimation, groundwater seepage discharge, and overflow discharge (once fully flooded). Chemistry of water in the open pit will be influenced by both the chemistry of the inflows, as well as the pit walls, residues from the mining process (blasting, etc.), and seasonal or temporary stratification of the water column into waters of differing chemistry and temperature (such as a chemocline or thermocline) that may be affected by bathymetry, climatic conditions, quality and temperature of inflows, wind, influence of permafrost, ice over (formation) and ice off (melting).

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Research/Study Objective

This research plan aims to:

- improve predictions for water quality within the open pit during flooding operations and to inform decision making with respect to enhanced flooding alternatives, and
- to improve long-term water quality predictions for open pit (pit lake) effluent flows with respect to meeting applicable closure objectives and criteria in Post-Closure, and to assess the effectiveness of water treatment options in modifying Open Pit runoff water quality, if necessary.

Overview of Tasks and Project Research Schedule

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Task 1 – Pit Lake Miromixis

Deep pit lakes are often subject to a stratification of the water column into waters of differing chemistry typically due to strong density gradients within the water due to salinity or temperature. While permeant stratification of the pit lake can result in the long-term storage of salts within the pit, a seasonal turnover of the lake could result in poor water quality conditions at certain times of the year.

Based on the predicted water quality within the lake and data collected from the site weather station, an assessment will be carried out to evaluate if the pit lake will likely be meromictic or if it will become seasonally stratified. In support to this evaluation, a focused review of scientific literature relating to meromictic pit lakes in cold regions should be carried out. Further, analyses of the temperature gradients, wind conditions, precipitation, groundwater inflows, and other conditions will be carried out as site conditions allow (i.e. presence of an open pit) to evaluate the likelihood of the pit lake becoming stratified and subsequently becoming mixed.

Task 2 – Water Monitoring and Comparison against Water Quality Predictions

The quality and flow of key inflows to the open pit should be monitored (or otherwise estimated) and compared against water quality predictions.

It is, however, not advised that runoff from the pit walls is used as an analogue for future water quality in the open pit. The chemistry of the pit wall runoff will differ from the longer-term pit wall runoff with respect to the proportions of various rock types that comprise the pit walls, the degree of weathering of those faces, and that samples will likely be impacted by other (potentially significantly larger) open pit inflows.

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Should the measured chemistry or flow of any of the key pit inflows deviate significantly from predicted values over a 5-year basis, the water quality prediction model will be updated in light of the results of water quality modelling, and updates to the mine plan or geochemical analyses.

Task 3 – Update Water Quality Predictions

As per above (Task 2), the predictive water quality model will be updated not later than 5 years prior to the planned cessation of mining operations. In addition to evaluating the long-term water quality of the flooded open pit (pit lake), the effects of mine flooding rates will be considered with regards to the short-term water quality of the pit lake (at initial discharge).

Task 4 – Water Treatment Options Analysis

Water treatment alternatives will be considered if it is found that the predicted water quality in the Pit Lake (at initial discharge, or long term) is not anticipated to meet effluent water quality.

Table D-1: Overview of Tasks for Reclamation Research - Open Pit Runoff Water Quality

Task	Reference Document	Status Anticipated Start and/or End Date
Establish initial water quality predictions and review relevant baseline conditions	FEIS Volume 7, Section 3.4	Completed (2013)
- Conduct literature review and analyze long-term predicted conditions to assess if permanent meromictic conditions are anticipated. - Should long-term meromictic conditions be anticipated, this characteristic should be incorporated into the open pit predictive water quality model. - Should it be possible to create long-term permanent meromictic conditions in the open pit, designs should be developed so that these measures could be incorporated into the ICRP if justified.	N/A	2019-2020
- Monitor water quality within the open pit, runoff to the open pit, groundwater surrounding the open pit, and other inflows to the open pit. Water quality data should be compared against the assumptions made in the initial water quality predictions. - The water quality predictive model should be assessed for updating on the basis of findings every 5-years, in the event that unexpected water quality conditions are encountered - Follow up investigation of unknown sources of contaminants may be required.	N/A	Onset of open pit dewatering activities to Life of Project

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Task	Reference Document	Status Anticipated Start and/or End Date
Results and collected data are to be presented in the research program progress reports.		
- Not less than 5 years prior to the end of operations, the water quality predictive model will be updated and predicted water quality should be compared against the criteria set out in Table 5.1. - Modelling will include an assessment of the influence of filling time on open pit water chemistry. (<i>Reclamation Research Program: Open Pit Flooding Timeline</i>) - Should additional humidity cell data become available, the results of these analyses will be incorporated into the geochemical aspects of the water quality model.	N/A	Five years prior to Life of Project (duration 1 year)
If required, suitable contingencies should be identified and assessed for addressing long-term water quality.	N/A	One year prior to Life of Project (duration 1 year)

Findings of Research Completed

Research into meromictic pit lakes has not yet been completed. This work is scheduled to start in 2019.

Open Pit Water Quality Research Results

No results have been provided yet as the mine has not advanced into the open pit stage. Ore has, to date, been extracted from the hillslope, rather than the future open pit.

Linkages to Other Research/Studies

This research will be linked to the research being completed regarding pit flooding timelines. Findings of waste rock stockpile runoff water quality reclamation research will be considered. Updates on open pit prediction of runoff water quality will be provided in future updates of the ICRP.

Costs

TBD

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D.2 Reclamation Research Program - Open Pit Flooding Timeline

Background

The mining plan and the ongoing waste rock characterization plan will inform the prediction modeling of the mine pit water quality at the end of mine life (addressed under the “Open Pit Runoff Water Quality” research program). The results of the Open Pit Runoff Water Quality research program will be summarized in the annual NIRB and NWB reports which will subsequently be reviewed and discussed by the MCWG.

Based on passive inflows alone (seepage into the pit, direct precipitation, and surface runoff), it is anticipated that the open pit will take an estimated 85 to 150 years to passively fill (Knight Piésold, 2008). The flooding of the open pit could be accelerated by pumping water from a nearby water source (i.e. accelerated flooding). At a conceptual level, four potential water sources have been identified: Sheardown Lake, Camp Lake, Mary Lake, and Mary River. It was estimated that withdrawal from these sources could reduce the flooding time to as little as 2 years (based on a total withdrawal of 10% of the annual volume, although this would require very specific and ideal conditions to achieve. Section 5.2.1.4 of this document presents some preliminary assumptions and calculations regarding the enhanced pit infilling alternative.

Uncertainty

With respect to natural flooding, the rate of groundwater inflow is the primary source of uncertainty with respect to open pit flooding time prediction.

With respect to the enhanced flooding schemes, the primary source of uncertainties are:

- the maximum rate of water taking from the water sources; and
- the practical limit of pumping water from those sources to the open pit (feasibility and financial viability).

Research/Study Objective

The goal of this program is to better assess the timelines for Open Pit flooding for both natural flooding and the enhanced pit infilling alternative and develop a flooding program that will meet closure objectives and criteria in Post-Closure within an appropriate timeline relative to the proposed monitoring.

Overview of Tasks and Project Research Schedule

The key tasks of the study are as follows:

- Updating the accuracy of the open pit flooding timeline under passive conditions.
- Assessing the potential water sources for enhanced pit infilled in greater detail, and increase the accuracy of the enhanced pit infilling timelines.

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- Enhancing the understanding of the impacts of the pit flooding time on the overall closure plan and monitoring timeline.

Task 1 - Pit Flooding Timeline Predictions (passive conditions)

To better understand the rate of natural flooding of the open pit, pit dewatering flows (monthly volumes) will be recorded throughout operations to provide an estimate of the overall net inflows to the open pit, including all inflows (groundwater inflow, direct precipitation, and runoff) and outflows (evaporation and seepage).

It was estimated in 2009 that natural flooding would take between 85 and 150 years. Using the open pit dewatering flows as a basis of calibration, this estimate can be refined at a later time.

To complete this task, pumping records and data from the site weather station will be recorded during operations. The pit flooding model will then be updated with acquired site data.

Task 2 - Assessment of potential water sources / enhanced flooding

Assisted pit filling is governed by two parameters – technical limitations that drive pumping costs, and water source locations/drawdown limits. Costs are driven by materials and equipment required for the operation (e.g., heat-traced piping, pumps, generators, and fuel requirements) as well as the construction and maintenance of the necessary roads and berms. Pumping water to the pit is uphill and therefore significant elevation head will provide technical challenges to any pumping design. Water source drawdown limits are designed to ensure that the volume of water extracted from a given source has minimal impact on the aquatic ecosystem. Key factors to consider when calculating maximum acceptable drawdown of a lake include issues such as the potential disturbance of spawning habitat, as well as the residency time of the water body.

In order to better understand alternatives for enhanced pit filling, the following steps are planned:

- A desktop review of regional hydrological and potential spawning habitat data will be conducted to support the development of a waterbody-specific assessments for the maximum allowable water taking rate;
- a feasibility level engineering assessment will be carried out for pumping water from each of the potential water sources to confirm the feasibility of each alternative; and
- the estimated flooding times will be updated for each enhanced flooding scenario.

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Task 3 – Enhancing the understanding of the impacts of the pit flooding time on the overall closure plan and monitoring timeline.

Following the completion of Tasks 1 & 2, the integrated schedule of closure activities would be reviewed in light of the updated natural and enhanced flooding scenarios and summarized for discussion with the MCWG. The flooding timeline would also impact post-closure monitoring durations at the Open Pit and down gradient areas.

Table D-2: Overview of Tasks for Reclamation Research - Open Pit Runoff Water Quality

Task		Reference Document	Status Anticipated Start and/or End Date
	Establish initial flooding time estimates.	KP 2008	Completed
Task 1	Monitor mine dewatering flow rates.		Ongoing (2013-Life of Project)
	Use mine dewatering flow rates to update mine flooding model to estimate passive (natural) flooding time.		5-years following onset of mine dewatering.
Task 2	Assess regional hydrology flows and retention times in each potential water source.		Should be completed during first 5 years of dewatering. Duration of task: 1 year
	Evaluate maximum allowable water taking with respect to protection of aquatic life.		
	Prefeasibility assessment of practicability of pumping from each water source.		
	Estimated flooding times from each water source to be updated using mine flooding model.		
Task 3	Review the impacts of enhanced open pit flooding on the mine closure activities and monitoring with Mine Closure Working Group.		Task to commence following completion of Task 2. Duration of task: 6 months

Findings of Research Completed

Initial predictions for filling times (natural and enhanced) have been previously estimated, as described in Section 5.2.1.4. Additional research that is to be carried out will be reported here.

Pit Flooding Timeline Predictions (passive conditions)

As no significant dewatering has taken place in the open pit to date, no update of the flooding model has been completed to date.

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Open pit dewatering flows will be recorded once active dewatering (pumping) starts.

Results to Date

TBD

Linkages to Other Research/Studies

This research will be linked to the research being conducted on open pit water quality.

Costs

TBD

References

Knight Piésold Ltd. 2008. Mine Site Infrastructure, Pit Overburden & Waste Dumps - 2007 Site Investigations and Foundation Recommendations Summary Report. Ref. No. NB102-00181/8-2, Rev. 1. North Bay: Knight Piésold Ltd. February 20, 2008.

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D.3 Reclamation Research Program - Waste Rock Stockpile Seepage/Runoff Water Quality

Background

Metal leaching and acid rock drainage (ML/ARD) characterization studies in support of the Life-of-Mine pit waste rock are provided in the report entitled “Mine Rock ML/ARD Characterization Report Deposit 1, Mary River Project”, March 2014 as appended to the Life-of-Mine Waste Rock Management Plan.

The waste rock was subdivided based on broad geo-structural categories about the iron ore zone, mainly by hanging wall and footwall zones. A total of 776 waste rock samples were selected as representing the waste rock categories and broad spatial coverage of non-ore mine rock in the vicinity of the Life-of-Mine open pit development. All 776 waste rock samples were analyzed for modified Sobek acid base accounting (ABA), NAG pH and elemental content. Subsets of drillcore samples were also analyzed for downhole variability, NAG leachate, short-term metal leaching, whole rock elemental content, detailed mineralogical analysis, and long-term kinetic testing.

Results of ABA testing determined that waste rock is generally characterized as having low neutralization potentials (NP) and low acid potentials (AP). Data suggests that the waste rock is dominated by non-carbonate sources of NP (e.g. silicates) with lesser NP derived from carbonate sources. Sulphide was the primary form of sulphur. Approximately 85% of waste rock samples had neutralization potential ratios (NPR) greater than 2 and are classified as non-potentially acid generating (Non-PAG) and are unlikely to generate acidic drainage. Approximately 10% of the samples had NPR values of less than 1, and 5% of the samples were classified as having uncertain acid generating potential ($1 < \text{NPR} < 2$). Extrapolating these results to the project waste rock model, indicates that approximately 11% of the Life-of-Mine in-pit waste rock is expected to have $\text{NPR} < 2$ and is considered potentially acid generating (PAG). Proximity to ore appears to correlate to increased PAG quantities (defined as $\text{NPR} < 2$) with the hanging wall schist (HWS) and footwall schist (FWS) zones identified with the greatest proportion of PAG of the major waste units.

Analysis of a set of samples proximal to the proposed five-year pit indicates a lower sulphur and sulphide content is likely to be encountered in the shallower HWS and FWS rock of early development than at depth during later production. This lower sulphide content is expected to result in a lower percentage of PAG rock being encountered during early operations than would be predicted by extrapolating the overall (including deeper) HWS and FWS waste rock data to near surface.

For planning, 10% PAG rock plus allowances for expansion due to field screening limitations and dilution has been assumed.

Ten waste rock samples were run in humidity cells for 53 weeks in 2008 and 2009. A further 17 waste rock samples were initiated in humidity cell tests in May 2011 for between 109 and 120 weeks of reported data. Nine of these samples were standard humidity cells and eight were NP depleted humidity cells

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designed to assess drainage quality in the absence of carbonate NP. The pH of most cells was in the range of 5.5 to 7 throughout testing. Of the 17 cells in operation since 2011, three cells exhibited slowly declining pH throughout testing reaching a minimum measured weakly acidic pH between 4.5 and 5 after approximately two (2) years of operation (under laboratory conditions). Metal release rates from humidity cells were generally low. Kinetic testing results and cold climate conditions at site suggest the lag time to acid on-set in PAG rock with potentially increased metal release rates would be on the order of five years or longer.

Waste characterization, volume estimation, and monitoring of the Waste Rock ML/ARD is ongoing. The design of the waste rock facility will be updated periodically as necessary throughout the LOM.

The deposition strategy for the water rock area is to promote permafrost aggradation. Studies of waste rock in permafrost demonstrate that permafrost forms an effective long-term barrier to water and oxygen, thereby preventing significant oxidation of sulphidic waste rock located below the surficial active zone. The surficial “active” zone, which will be subject to seasonal freeze-thaw.

For this reason, the PAG, Non-PAG, and Overburden are handled as three separate streams and are placed in zones within the Waste Rock Facility. PAG material will effectively encapsulated in non-PAG material.

The “active” zone is not anticipated to extend into the PAG material through 50 m non-PAG shell in the long-term (within 200 years) under the influence of climate change (Intergovernmental Panel on Climate Change, 2007). Therefore, over the long term, seepage water quality which is influenced by contact water that flows through the active layer in the waste rock stockpile will not be affected. Following closure, generation of ML/ARD is not anticipated.

Seepage and drainage is anticipated to discharge from the active layer and from portions of the waste rock pile that have not yet aggraded of permafrost.

Uncertainty

Due to the early stage of project development and only conceptual modelling done to date, there is uncertainty in the final composition of the waste rock stockpile. In particular, the composition may vary with respect to the proportion of waste rock by lithology, geochemistry, and the associated seepage/drainage conditions. Climactic conditions may also heavily impact the volume and quality of seepage, as thermal conditions within the pile can affect the rate of chemical release and reactions, permafrost develop creating low permeability conditions in an otherwise free draining media, and wetting-up time may impact the period of time for precipitation to report as seepage.

As more information becomes available, the conceptual modelling completed as part of the FEIS will be updated.

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Research/ Study Objective

This research plan is designed to improve understanding of the expected performance of the waste rock stockpile closure concept in an effort to confidently characterize predicted waste rock effluent discharge quality and assess if waste rock stockpile seepage water quality can be expected to meet closure objectives and criteria (MDMER, CCME PAL) in Post-Closure.

Specific objectives include:

- Determination of quantity of waste rock stockpile seepage that can be expected post-closure.
- Determination of quality of waste rock stockpile seepage that can be expected post-closure.
- Greater understanding of the thermal evolution of the waste rock stockpile and permafrost development to determine impact on geochemical reactions and, therefore, seepage water quality.

Overview of Tasks and Project Research Schedule

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Task 1 – Monitor Drainage from Waste Rock Stockpiles and Additional Humidity Cell Testing

Water quality should be monitored at selected locations around the waste rock stockpile. Where seepage can be reliably associated with a particular area of the waste rock stockpile, careful records should be kept of the schedule, volumes, and lithology of waste rock that is deposited in that area.

Waste rock samples should be collected regularly from each type of lithology of waste rock. A small number of representative samples should be set up as humidity cells and run continuously.

Tasks 2 and 3 – Field Test Pad Construction and Monitoring

In the absence of completed areas at the Waste Rock Stockpile representative of closure conditions, field Test pads should be constructed of known materials to support various assessments, most notably including estimating leachate volume. The volume of seepage will be affected by wetting up time and permafrost aggradation. Waste rock piles in many climates may take years to decades to accumulate sufficient water (wetting up) to have precipitation report as seepage. While it may not be practical to establish Test pads greater than 50 m high to simulate the design conditions, test pads should be significantly larger than the maximum depth of the active layer.

Tasks 3 – Geochemical Modelling

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With regards to modelling, the test pads would serve as controlled scenarios, from which the behaviour of the wastes can be extrapolated to the overall Waste Rock Stockpile. As a first step, the test pads would be studied for basic hydrogeologic function, with an aim to resolve the effects of wetting-up time and advancement of permafrost (also Research Program: Waste Rock Thermal Modelling). Subsequently, seepage from the test pads could be investigated with respect to chemistry, making allowances for composition of the test pads (lithology, grain size, etc.), thermal conditions, and hydrogeologic function.

The functionality of the test pads should be modelled based on the available climactic conditions (based on site weather data), mine production data, and geochemical assays and humidity cells. The model will then be calibrated using the leachate from the test pads, and subsequently then expanded to encompass the monitored locations of the waste rock stockpile. Water quality predictions will then be compared against the criteria set out in Table 5.1.1.

Should additional studies be required, recommendations for these studies would be included within the Reclamation Research Progress Reports.

Table D-3: Overview of Tasks for Reclamation Research - Waste Rock Stockpile Water Quality

Task	Reference Document	Status Anticipated Start and/or End Date
- Monitor drainage water quality from waste rock stockpile. Conduct focused review of seepage quality monitoring results to predicted leachate values. - Set up additional humidity cells for each type of waste rock lithology.	N/A	Life of Project (as necessary)
- Confirm the feasibility of developing field test pads or equivalent area for instrumentation in a completed section of the Waste Rock Stockpile. - Development of study design for field test pads (some including application of cover material) at the site using selected waste rock material generated during early mine development. - Construct, operate and monitor test piles (if feasible) to inform the project about projected drainage quality and water quality modeling assumptions under site-specific cold climate conditions	Phase 1 Waste Rock Management Plan (BAF-PH1-830-P16-0029)	Designed/constructed in 2019. Monitored from 2019-Life of Project
Modelling, interpretation and documentation of monitoring results (initially calibrating to field test pad data, and then extrapolating to the waste rock stockpile) to assess confidence if waste rock stockpile runoff water quality can be reasonably expected to meet closure objectives and criteria (MDMER, CCME PAL) in Post-Closure	N/A	Scheduled for 2024, then updated every 10 years

Findings of Research Completed

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Seepage from the Waste Rock Stockpile has been monitored as part of regular site operation. As reported by Golder in the Interim Waste Rock Management Plan (IWRMP) (March 2018), in the summer of 2017, seepage conditions from the Waste Rock Stockpile pond were found to be more acidic than was anticipated. A water treatment facility has been installed in the interim to address short-term issues with respect to water quality.

An updated water quality model will be prepared following collection and analysis of the 2018 instrumentation data (thermistor, oxygen sensor, and geochemical samples) and 2019 test pitting data.

A mass-balance based model approach will be used to develop water quality predictions that take into consideration the waste rock deposition plan, water balance and geochemical data. Infiltration and runoff flow estimates will be assigned water quality source terms to predict seepage and runoff water quality corresponding to the 1-5 Year WRMP. Existing data and new results from laboratory-scale geochemical tests will be used to develop mass loading source terms for each of the main material types present in the WRF. The results of laboratory scale tests will be used to develop specific scenarios in terms of particle size distribution, water-to-rock ratios, temperature, and availability of atmospheric gases that could influence material reaction rates (e.g., oxygen and carbon dioxide).

The results of the water quality modelling will be included with the 1-5 Year WRMP submitted in December 2019. These results will also be used to inform the need for supplemental instrumentation and/or monitoring locations to support this research plan and better assess the need to re-evaluate effluent quality under the closure design (i.e. following construction of a cover and establishment of permafrost within the waste).

Linkages to Other Research/Studies

Predicted leaching rates for various waste rock lithologies will be shared between this study and of the Open Pit Runoff Water Quality research program.

Findings of natural re-vegetation reclamation research will be considered related to colonization of cover material.

Regular updates on waste rock characterization and prediction of runoff water quality will be provided in future updates of the Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031) and ICRP.

Costs

TBD

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- Baffinland Iron Mines Corporation. 2012. Mary River Project – Final Environmental Impact Statement. February 2012.
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D.4 Reclamation Research Program - Waste Rock Thermal Modelling

Background

Thermal analyses of the waste rock stockpile to predict the long-term distribution of permafrost within the dump will be required. The heat transfer processes can be simulated with available computer models; however, none of the models can confirm that permafrost will develop within the dump without more reliable input data regarding the method of placing the waste rock and the resulting properties of the waste rock in the dump. In addition, it will be important to compare the thermal analyses against existing case histories including the Nanisivik mine.

Uncertainty

It is unclear at what rate the waste rock stockpile will experience permafrost aggradation during operations and closure, and/or what the eventual active layer thickness will be.

In addition, a better understanding of the exothermic nature of the acid generating materials currently in the PAG pile is required to predict aggradation.

Research/Study Objective

Thermal monitoring and evaluation is required as part of the current LOM Waste Rock Management Plan and to support the prediction of aggradation rates and estimation of the active layer thickness.

The objective of the thermal modelling program is to monitor ground temperatures and confirm the aggradation of permafrost within the waste rock stockpile and active layer thickness in order to update long-term ground temperature predictions.

Overview of Tasks and Project Research Schedule

Task 1 – Thermistor Data Collection

Data from temperature sensors installed to monitor the ground temperatures will be collected on a regular basis and used to ensure that frozen conditions are maintained below the waste rock stockpile.

Task 2 – Thermal Model Development

Based on the results of the geochemical sampling program and the thermal instrumentation program a thermal model for the pile will be developed. If substantial heat generation from oxidation is expected based on geochemical results, the thermal model may incorporate heat generation from sulphide oxidation in the pile to model the impact of heat generation on the pile freeze-back process. Climate change will also be included to account for warming temperatures after closure.

Table D-4: Overview of Tasks for Reclamation Research - Waste Rock Stockpile Thermal Modelling

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Task	Reference Document	Status Anticipated Start and/or End Date
Task 1 – Thermistor Data Collection	N/A	Life of Project (as necessary)
Task 2 – Thermal Model Update	N/A	Following at least 5 years of data collection.

Findings of Research Completed

During the December 2018 program thermistors were installed at locations T1 through T5 and BH1, BH2 and BH3, as well as oxygen sensors at BH1 and BH2. All installed instruments are recording readings on 8h intervals. The instruments are currently equilibrating and therefore limited data are currently available. Preliminary data from BH1 and BH2 indicate that the WRF is frozen to depth, and that there is no indication of oxygen depletion associated with potential reactions within the WRF.

A thermal model of the WRF will be completed once sufficient site data has been collected for model calibration. The thermal model will consider the waste rock deposition plan, atmospheric conditions, and stockpile chemistry. The thermal model is expected to provide an estimate of the freeze-back time for the WRF and ability to maintain the WRF in a frozen state. The results of the available thermal modelling will be included in the 1 to 5 year WRMP submitted in December 2019.

For the current interim update preliminary thermal models were prepared to assess the time for waste rock to freeze under varying deposition and climatic conditions. The model results were used as a guideline for the waste rock deposition plan updated with the IWRMP. Transient one-dimensional thermal models were prepared using the finite element software TEMPW2018 (version 9), developed by Geoslope International Ltd. A description of the different model components are discussed in the the IWRMP and TSD 2 (Appendix I) of the Phase 2 Proposal.

Linkages to Other Research/Studies

The thickness of the active layer will be considered in the development of the Waste Rock water quality predictions.

Costs

TBD

References

TBD

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D.5 Reclamation Research Program - Natural Re-Vegetation

Background

A review of baseline data collection results applicable to re-vegetation during reclamation was conducted based on the findings of the vegetation baseline studies associated with FEIS development (FEIS Appendix 6C – Vegetation Baseline Report). Findings indicated approximately 20 plots were established on the old road surface or adjacent to it, in sites disturbed in the past. These sites were surveyed to contribute to the knowledge of natural succession and the plant species that can become re-established without intervention. Observations from baseline work applicable to reclamation include:

- Natural re vegetation in this general environment is slow, but not as slow as expected. Based on observations on an old silver mine near the Doris North Project in the Kitikmeot Region, researchers expected little re-vegetation in the Mary River study area thirty years after use, but were surprised to find that considerable re-vegetation had occurred along the old tote road, particularly in damp areas. The difference is that much of the area traversed by the tote road is on sandy soils, whereas the Roberts Bay Silver Mine is located mostly on fractured gravels (Burt, 2003).
- Colonization of dry areas along the old roads, paths, and campsite areas is occurring slowly, so slowly as to be almost immeasurable in the time since the disturbance.
- Plant communities around the old mining camp near Sheardown Lake have been slightly affected by the addition of nutrients, and are, as expected, richer than normal, with more lush growth and more species of grasses and forbs.
- This colonization (around the old camp) may be on the wane, due to depletion of nutrients and lack of enrichment in the ensuing years.
- There are plenty of local species that can be utilized for reclamation; it is neither necessary nor advisable to obtain plant stocks for reclamation from elsewhere. Use local/regional plant stocks and seed sources for any active revegetation being done on the Mary River Project.

Uncertainty

Due to limited research conducted to date for mines in the Canadian Arctic, there is uncertainty in the rates of natural re-vegetation at disturbed areas Post-Closure. This research will focus on development of methods to promote accelerated recovery of a sustainable vegetation cover that also benefits the desired land use for the Project sites over these long expected timelines. These sites include gravel roads, gravel pads, waste rock stockpile, and other priority areas identified during closure planning.

It should be noted that vegetation is naturally sparse or nonexistent (e.g., waste rock stockpile footprint) over much of the Project Area, and therefore the potential for natural re-vegetation of disturbed Project areas is uncertain. Re-vegetation by reseeding or replanting is not currently being considered by the

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Project based on the current site conditions and the potential for success in areas not historically vegetated.

Research/Study Objective

The goal of this program is to identify methods to successfully promote natural re-vegetation in an effort to achieve a sustainable vegetation cover that meets the desired aesthetic conditions for the Project site post-closure in the shortest duration possible. Specific objectives may include:

1. Identify Site Preparation Techniques Best Suited/Tailored for Natural Revegetation:
 - a. Characterize control/undisturbed landscape conditions as a template for reclaimed environments.
 - b. Examine landscape preparation approaches that will increase the availability of micro-habitats conducive to plant early-establishment.
 - c. Determine timelines and measurables for reclamation success.
2. Identify Indicator Species Best Suited for Natural Revegetation:
 - a. Characterize control/undisturbed vegetation conditions as a template for reclaimed environments.
 - b. Examine landscape preparation approaches that will increase the suitability of micro-habitats for plant early-establishment and development of cover vegetation.
 - c. Determine timelines and measurables for reclamation success.

Overview of Tasks and Project Research Schedule

Because it is too early to establish experimental reclamation plots within the Project footprint, Baffinland will, in 2019, conduct a detailed desktop study of reclamation efforts, successes and lessons learned in Arctic Canada in 2019 (EDI, 2019). The review included work completed at other Arctic sites, including mine, municipality, and contaminated site (e.g., DEW line site) reclamation and remediation.

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Table D-5: Overview of Tasks for Reclamation Research - Natural Re-Vegetation

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Task	Reference Document	Status Anticipated Start and/or End Date
Review of baseline data collection results applicable to re-vegetation during reclamation	FEIS Appendix 6C – Vegetation Baseline Report	Completed in 2016
Literature review of re-vegetation at disturbed areas in northern climates	EDI 2019	Completed in 2019
Determine/classify the composition of soil substrate on Site (if/where present) to identify constraints and limitations to the colonization and early establishment of plants	N/A	Scheduled for 2019
Establishment of representative test plots for Project candidate sites for re-vegetation: gravel roads, gravel pads, waste rock, stockpiles, and waste dumps	N/A	Scheduled for 2020
Engage Inuit to incorporate and align with traditional knowledge and land use objectives	N/A	Scheduled for 2019
Soil sampling and vegetation assessment	N/A	Scheduled for 2019-2024
Interpretation and documentation of monitoring results assess confidence in developing re-vegetation procedure (Reclamation Research Summary Report issued)	N/A	Scheduled for 2025
Identify any additional research that may be required and long-term monitoring	N/A	Scheduled for 2025
Continued monitoring and analysis of re-vegetation research plots (if necessary)	N/A	2025-Life of Project (as necessary)
Determine monitoring results applicability to closure and reclamation strategies and criteria	N/A	Scheduled for 2026

Findings of Research Completed

In 2019, a literature review was completed on reclamation practices for Northern mines. Based on the findings of the review, the research tasks and timelines above have been updated with a more focused approach.

Linkages to Other Research/Studies

Findings of natural re-vegetation reclamation research will be considered related to colonization of cover material for waste rock stockpile. Updates on natural re-vegetation reclamation research will be provided in future updates of the ICRP.

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Costs

TBD

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Appendix E

Record of Engagement

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As the Project advances, Baffinland is committed to engagement with stakeholders regarding closure and reclamation issues. These issues include, but are not limited to:

- Appropriate closure and reclamation strategies and criteria based on desired end use of Project areas.
- Additional or modified reclamation research activities (Appendix D).
- Requirements to address identified uncertainties and determine the appropriateness of existing action levels (Appendix D and Appendix G).
- Whether there will be any interest in maintaining the bulk fuel storage facilities and/or sealift landing areas for use by the local community assuming responsibility for the operation and maintenance of the facilities would be transferred to the local interested party.
- Transfer of responsibility of the Tote Road water crossings to the local community and if the Tote Road will be left completely intact assuming road operation and maintenance responsibility would then be transferred to another party.
- Transfer of responsibility of airstrip (including airstrip lighting) to the local community assuming the airstrip is left intact and operation and maintenance responsibility would then be transferred to another party.
- Whether there will be any interest in transfer of salvageable materials and buildings for local community use assuming responsibility would be transferred to another party.

Baffinland anticipates to rely on the MCWG (Section 2.4) in order to best facilitate stakeholder engagement related to the Mary River Project and incorporate considerations for post-closure land use of the Project site. A mandate or Terms of Reference for the MCWG will be developed in consultation with the QIA prior to the initial first meeting of the MCWG. Baffinland expects an early priority for the MCWG will be to determine additional or modified reclamation research activities applicable to the Project to help address identified uncertainties and determine the appropriateness of existing action levels.

Baffinland is currently in the process of integrating ‘StakeTracker’ software into project monitoring and reporting initiatives which will facilitate a comprehensive coverage assessment of stakeholder engagement matters related specifically to closure and reclamation issues historically and moving forward over the life of the Project. Table E-3 provides a summary of comments received to date which are specific to mine closure, together with associated responses and cross-references. While mine closure has not been a primary topic of the feedback received during engagement activities, many in-direct discussions on closure have occurred focusing on related issues such as considering land-use in mine design (e.g. route Tote Road and North Railway), proposed environmental mitigation, management and monitoring techniques during mining, and residual effect predictions. TSD 4 of the Phase 2 Proposal presents the Public Consultation Report from activities supporting this Addendum.

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Closure was included as a topic during the Community Risk Assessment Workshops held February 12-14, 2019. Although a participant suggested it was too early to provide comments on closure, the other issues brought up were generally consistent with the issues listed above. Table E-1 will be updated as 'StakeTracker' is updated with ongoing engagement.

Table E-3: Record of Engagement

Stakeholder Comment	Project team comment	Date and Event
This is not really concerning Baffinland, but refers to caribou. The infrastructure from the Nanisivik Mine was left behind. We tried to get the mine to clean it up but they didn't. There were fuel and diesel spills left behind. No one has cleaned it up. Seals have bad livers now because of what they were eating. Pond Inlet will need to worry about fuel and fuel clean up. The marine mammals can be affected because of this; we've seen the impacts in Arctic Bay from this. Just beware of all these promises the company makes.	None.	2015-11-20 - Pond Inlet - Workshop No. 4
You mention that the mine is going to operate for 100 years, can things start being cleaned up at the mine right now?	It is a very insightful question, when we talk about long term mine life, we are not talking about adding and adding and adding for 100 years. We will clean up deposit one after we are finished and so on. I understand that dust is a major concern, we are hoping that the rail will mitigate dust concern, and help BIM survive. We are constantly monitoring it, and so far we have seen no effect on wildlife. The deposit we have been mining right now, has been eroded for a long time so the animals and plants are used to it, however we are learning as we go and addressing it. This year they want to make a proposal, phase 2 and right now the current certificate to use the tote road, in the event than Baffinland was approved, and they would want to hear about your concerns they will follow your concerns and recommendations. NIRB is the one who issues certificates.	2017-05-30 - Pond Inlet - Community Meeting
On page 11, drums were used in the early stage of exploration. Later on, they were using containers. The drums of fuel that were used are stockpiled at the dump now, corroding away. When I was a young man, these were used as fuel drums. Is that going to be the same practice for you guys? Are you going to leave the drums there when you switch to containers?	Jon: No, we will send the empty drums south afterward. Tom: Things are different now; we need to put up reclamation funds ahead of time. Also, our practice now is to remove the drums by backhauling empty drums as well as any other waste we can't incinerate.	2018-04-05 - Hall Beach Hamlet and HTA re: Ege Bay Exploration Program
Three topics. I myself want the environment protected. Although the job opportunities are important, I also want the environment protected. While they are exploring, once they have done their exploration, we know they won't be making any money and they have to clean up the area. They have to close it and try to put it back the way it was before. Will they go back to Baffinland, or will they be surplus and given to QIA? If that were to happen, if they make money they would probably stay there. If they are going to drill deep down, what will they use to close them up (the drillholes)?	We are required to put up money to guarantee that we will clean the site up if we don't move forward to development, and restore the site to it was before. Regarding the camp and equipment, that would be a decision that upper management would make, whether it was sold off to the community or brought to another project. For reclamation of drillholes, drilling has small disturbance impacts. The site is cleaned up and the hole is backfilled with sand or cement – something just to plug it up.	2018-04-06 - Igloolik Municipal Council, Igloolik HTA and QIA Re: Ege Bay Exploration Program
None.	30Mtpa will be mined out of Deposit 1, the first iron ore deposit. There are other deposits in the area that Baffinland has claims to. We will have to go through this process again to mine on a different deposit. We believe this is a multigenerational project. Once deposit 1 is done we would go into closure or pick another deposit to mine.	2018-06-11 - Clyde River - Workshop

Stakeholder Comment	Project team comment	Date and Event
I want to make a comment, we were told that we could not drink water from the lakes or the river anymore by the docks, because the river is flowing. How are the waters, we have fish in those lakes, I would like you to check on lakes and check on the river, there are 4 big lakes, they have lots of fish, when we see them, the fish are very healthy stock, and there's lots of fish, maybe too many, in one summer, because of the fish in those lakes, because we were told not to drink from those lakes anymore. I wonder how it is affecting the fish, if there is damage done there would be compensation or assistance. It is important that you monitor and check those lakes that are important to us. They are very close to Milne Inlet, I don't know how they are affected, if they have not done any studies, it is important that you do it soon, if you damage all the fish in that area that we depend on for our livelihood, I am looking for compensation, that's the only way we can deal with it if the water is damaged in that area. We saw something different this year, the birthing place of narwhals, that area had no whales whatsoever. When our research vessel checked the situation, they reported that nothing had been happening in the birthing place for a month. I can't say why, nobody knows with certainty. Why is it that you are not monitoring and researching the lakes and rivers? I need to say that you may end up compensating us. One goal is you want to build a railroad, people have lived there, I don't support Steensby Inlet expansion, they also have fish in that area, thank you.	Megan: Thank you for your comments and questions. We are aware that there was information circulating on site this summer that someone was told not to drink the water, I'm not sure exactly what happened and what was said, but I can say that the people who are qualified on site to speak to the quality of the water in the area did not say anything like that. We have environmental monitors on site, they are accessible, you can ask security on site if you want to speak to them directly and they can provide information, so that team that does the environmental monitoring did not say anything like that. We do in fact monitor the freshwater and marine environment, we do monitor the lakes, water and fish around the mine site, and I wanted to say that we have a water compensation agreement with the QIA, so if impacts were to occur or the quality of water were to be harmed, we have a compensation agreement set up with the QIA, where compensation would occur if there were any impacts. Richard: As Megan has indicated, there is what is called an environmental effects monitoring program, at the mine site looking at the lakes right next to the mine, Camp Lake and Sheardown Lake, right now monitoring has shown slight changes in the lakes but nothing harmful to fish. Fish need much cleaner water than humans do, so the environmental limits for fish are very low compared to those for drinking water. At Milne port there is a similar aquatic effects program at the dock area to detect changes around the dock, and no meaningful changes at the dock have been seen. So if there is no meaningful change right by the mine or the port, the project would not be affecting the waters further out. These monitoring programs are comprehensive, look at water quality 3x per year, sediment quality, changes in invertebrate communities (little bugs), and studying fish, so they look at all components of the aquatic environment. So they look if there are any technical changes to those components.	2019-01-10 - Pond Inlet - Phase II Community Consultation
We were asking about tents and upgrading accommodations. Maybe you can give the tents to the communities.	There is a policy that the QIA has priority if they want to take decommissioned equipment. We have to consult with them first.	2018-06-15 - Hall Beach - Workshop

Stakeholder Comment	Project team comment	Date and Event
Thank you, I want you to know, I'll introduce myself, I am a QIA representative now, (Charlie Inuarak), I want to make a few comments. There are issues being raised. When the mine was being initiated, Qikiqtani, NTI and all the new players were not with us. We had to deal with the mining company on our own, they made some wonderful offers, if we see a ship leaving with ore, it means money going to Inuit, and they made wonderful promises, each ship is going to provide that much revenue to the community. They also said if they extract the land and the open mine they will pay royalties to QIA. Workers at the mine also said this, and they sold it very effectively. There will be many Inuit contracts, the offer was very good, jobs were offered, I was the mayor at the time, and I wanted employment for people in the community, I lobbied the federal government, I supported Baffinland because they were going to produce jobs for Inuit. We had hope, I was happy to hear somebody said you made wonderful offers, money, employment, we know that there would be other financial benefits going on, but the community here that I represent, I decided to run for QIA because Phase 2, the railroad to Steensby Inlet, is a current issue. Once they proposed that the hunters and trappers and hamlet met, I heard them talking, saw them, I was a participant, all the things that we had planned, we had hopes, we had raised concerns, and we are not seeing the results we had hoped to see, we are not seeing the promises. Are you using the people of Pond Inlet, are you buying us off? When the hunters and trappers and the hamlet did not support Phase 2, the environment, NIRB, planning commission and other regulatory bodies heard the response from the community. Once we had made a stand, we see a letter that Qikiqtani wrote, NTI president and QIA president wrote a letter and supported expansion too, and they sent those to NIRB. You have breached our trust, Qikiqtani should have said representing the community, they should have come to Pond Inlet to see how the people of Pond Inlet felt about it, and spoken with the elders, nobody consulted us from the Inuit bodies, I decided I was going to run for the QIA representative because they are going past the community, and making those decisions ignoring our input, QIA and NTI president both wrote a letter of support, they said you have been approved by the Crown, does that mean I reiterate that Pond Inlet does not support Phase 2, we are weary about many ships coming and going, and the damage to our life. I know you are in a rush to get going, its a very short time but you are asking us for input. I will be reporting that to Qikiqtani that we are not getting enough time to respond, and I also expect the railroad will affect us, we have not even discussed it as a community, or even reviewed it, we have not yet discusses it as a collective, so I will be reporting to QIA, to the president that we have not had enough time for consultation. It is good that you are here, but you rush, come and go, we need more time, more information, more understanding, I will say again, you do not own the money or the company, you are employees, we don't see the owners of the company, you employees like us Inuit are being used by the company to sell this idea. I would like to deal with the owners of the company. I would like to be able to come up with more concrete ideas and more time to discuss our opposition, you who are present here in the front are doing the job for the company. There's times that you talked about closure, if you don't get this, if your not approved that, so QIA hears that and they believe you, so they look for ways to keep you here, because we need to be better organized as a team, a collective, there are many players in this.	Thank you Charlie, we won't respond to it, we are happy you were elected as a QIA representative.	2019-01-10 - Pond Inlet - Phase II Community Consultation
In the event of having an additional dock, who would have to approve it, would DFO have to approve it?	You would have to approve it in two different ways. Fish cannot be disturbed, and fish use that area and would be using the area in future. DFO would have to approve changes to the area. If the fish were to stop using the area, we would have to have a plan to help the fish could go somewhere instead of the Inlet if the dock affected the fish. No habitat loss with the new dock due to the rehabilitation of fish.	2017-05-29 - Clyde River - Community Meeting

Stakeholder Comment	Project team comment	Date and Event
The past couple years of GN’s composition surveys aren’t designed to determine population levels. John can’t say the population is different than when the last population survey occurred, but when the population is low, the likelihood of detecting an animal is low so you should have increased efforts when populations are low. The traditional knowledge from elders is based on pre-development knowledge—the project may impact the animals coming back, current literature suggests it will. Even if there are no caribou, it’s worth modifying the survey method to increase the confidence there really are none.	Baffinland: Does the GN have any information to suggest that population levels are not low right now? Baffinland isn’t refusing to put more effort into surveys but would need a reason to increase efforts. Baffinland: As an example, we could not run our energetics model (used in FEIS and revised post-FEIS based on QIA comments) unless there are 700 caribou. If anyone knew how many caribou there were, it would be the GN from their regional aerial surveys. Is it correct that most caribou are south of the project? Baffinland comments that we are not saying there are no caribou, just very low abundance, and we are not seeing in our surveys.	2018-08-03 - Teleconference with Gov of Nunavut and Baffinland
People in Pond Inlet would be worried, about a potential sealift in the winter. It will really impact the seals. It would frighten and scare away seals and narwhals. How can we get benefits for the seals?	A lot of planning needs to be done before we do a winter sealift. Including pre- and post-seal den surveys. If wildlife are impacted, then there is a compensation fund if it effects hunters. If there is a big issue, they all cannot get compensation, but an individual can.	2017-06-02 - Hall Beach - HTO and Hamlet Meeting
When they dig down the whole mountain what are we going to call it?	Former Mary River	<u>2016-11-25 - Hall Beach - Public Forum/Meeting</u>
It appears there should be more training programs in the north, there are lots of training opportunities down south in Ontario. There should be more training of heavy equipment operators in the north. We should have more BCLO's than one in each communities and if they have to go on medical travel they should be replaced temporarily. The frequency of ships will impact pond inlet. A fox which was painted red by a white person, a lot of people were against that, they could not determine who painted the fox red and that was unfortunate. Last year, a lot of sculpins died out. We do not hear about these negative impacts on wildlife but a lot of us are being impacted. In the future, we want to hear all of the concerns not just what Baffinland wants us to hear. Can a report be made by Baffinland when such impacts are found?	Part of my job is to help Inuit to apply for benefits and insurance, and QIA is developing a grievance database for employees. A database of Inuit employees that are ready to work is a great idea. Whether a fox or a rabbit is killed by a vehicle QIA always informs the HTO's but they do not necessarily pass it on to the communities. Through the wildlife compensation program, QIA has set away some funds for wildlife compensation purposes. I want to know roadkill there were, we should give it some careful consideration, and we need better communication with community and QIA. HTO should voice their concerns more. We do have environmental working groups set up that have many associations in attendance, in terms of getting info back to communities, we are trying to provide reports that are more accessible to people in communities. Our reports are publically posted on the BIM website document portal. We are open to more ideas on how to serve the communities. We will have future community visits. QIA and many organizations are working on the working group we had a meeting in May and we have returned to summarize this info. I was supposed to go on radio and I got tied up, once this tour is concluded I will go on radio to discuss these issues. I would like to respond, to the comment, it is difficult to anticipate when BCLO's will have to go out on medical leave. I was glad to hear this comment we did not have a BCLO for a lengthy time.	2017-05-30 - Pond Inlet - Community Meeting
Comment Form submitted with the following information: Did the open house provided sufficient information? Response: No. "Quarrying stones, as an Inuit would I be able to have access to the quarry site? Would Baffinland be able to assist me quarrying the stone? No pamphlets, no info available in topics of how Inuit can quarry to harvest stones" Were your questions Answered? Response: No "See left column for info" Any other comments? Response: "What options there are for or available for quarrying carving stones and what sources are available to be assisted quarrying stones for livelihood purposes. Please provide more info at meetings"	Public meeting provided insufficient information	2016-11-22 - Pond Inlet - Public Forum/Meeting

Stakeholder Comment	Project team comment	Date and Event
I probably won't get very good response but hunters, they hunt above all else, I think the people of Pond Inlet are hunters one way or another. Before Phase 2 was being prepared, people of Pond Inlet were informed by Baffinland that the Tote Road from Mary River to Milne Port was going to be a public road, but it turned out once they started hauling ore they would restrict hunters from travelling on the tote road, and under the IIBA it stated that 25% Inuit would be employed by the mine and we have not reached that. Thirdly the ship route, Pond Inlet hunters were shown the route of the ship but it turned out there would be a lot of ships outside the track, right now when they are planning to design the railway line the hunters, our traditional trail was totally blocked by the potential railway line. From 2005 to 2017 they gathered information on how much wildlife had been impacted and marine mammals have been impacted greatly, even though Baffinland says there has been minimal impact, but since the iron ore ships have been loaded and the noise they emit, form 2005 to 2015 condition, how can we review Phase 2 because I want to see a factual agreement, and have an agreement become a law. At this time Inuit people working at Mary River, people have worked lots for Baffinland and they are not put in a senior position because they are not Caucasian, many of them have stopped working because there is bias still, I imagine under the Phase 2 new employees, we were informed by QIA and Baffinland that people from all over Nunavut would be hired and not just those from affected communities.	Thank you for your comments and questions, the first comment that I heard was that the communities were told that the Tote Road would be a public access road, and that hunters have felt there are restrictions to this now. It continues to be a public access road and in the IIBA it outlines the uses of the road and project area. There are no restrictions on the use of the road, but we do ask that hunters for safety reasons check in with security to let them know they are in the area for safety reasons, hunters are welcome to come into the project site and the facilities as well, there are no restrictions on the use of the area. Based on the IIBA, that goes to hire the number of Inuit in the following years, 25% was established by QIA, Baffinland could not achieve that goal. How can we improve this to have more Inuit work at the mine. They have been trying to resolve that issue, but haven't gotten there yet. In the future if QIA negotiates the IIBA and they know the 25% Inuit labour force will not be reached, they will try to resolve the issue by QIA and Baffinland. Once they make changes to the present format communities will be informed. You mentioned about the ships not following their assigned route. Sometimes the ships try to avoid travelling through ice and we have been informed by HTO in Pond Inlet that the ships were waiting out in the open water, and they were supposed to be parked at Ragged Island. Sometimes they have to go out into the open water for safety reasons, they might get stuck or dragged and run aground. Last week we had a meeting with HTO board members and there were some personnel from Baffinland that deal with shipping issues and they were there to talk about shipping routes and they informed the HTO here at this meeting that if the ships do not follow what they are required to do there is a toll free line where HTO board members can contact their shipping people, and the person responsible for shipping from Baffinland will make themselves available to receive information in regards to some ship's contact. You could contact those people in the event that you don't have a toll free line, HTO has a toll free number they can provide to you. Last spring there was an accident involving a caterpillar, people were informed about the Nunavut Quest and I believe the tractor was trying to level the ground because we had limited time to construct that trail that we were informed that the dog teams were going to be travelling through that area, so that was an unfortunate event and we should have been informed way in advance so we could have been prepared well in advance. Inuit when they are put in senior positions they are put down by their supervisors, we can try to deter people, the senior managers from putting people down. I am not a counselor personally but we can try to rectify the situation if such a situation occurs. We want to be informed, know that this person has been letting other employees down, once we hear about it we can try to rectify the situation. You also mentioned someone went on CBC radio stating we hire employees from other Baffin communities, so other people from communities can be hired that's what we heard on CBC radio.	2018-06-12 - Pond Inlet - Workshop

Stakeholder Comment	Project team comment	Date and Event
Continued from comment above.	The IIBA is an agreement by QIA and BIM signed in 2013. The five impacted communities can have employees and if other communities want to have employees Baffinland can't pay for their room and meals. For example if you were to hire a person from Pangnirtung they would have to go through Iqaluit. And based on the IIBA if a person from Pangnirtung came on their airfare would be paid for by Baffinland and they would be picked up in Iqaluit, and we would pay their room and board in Iqaluit. If there are people that are outside of the 5 impacted communities Baffinland would pay for their room, board and flights. So since 2013 people from other communities could be hired, but we want to give priority to the five impacted communities. For example if a person from Pangnirtung and Pond Inlet apply for the same job their chances will have to be treated as equal. That is based on my understanding. Megan you may want to respond to the question about seals and narwhals being impacted by the project. The next area is we are changing the mode of transportation, on the Tote Road we will see an increase in the number of trucks during construction which will be reduced following construction. The road will still be used to transport people and equipment, and access to the road will not change for community members. If we look at the figure showing the northern railway, the red dashed line shows the proposed alignment of the railway, the rail line itself will be within 100m of the road for the most part except for one part where it will be 7km away to avoid a large hill. Line will be about 100km long, with a railway bed of approximately 1.5m height. Railway crossings will be built for humans and wildlife and there will be signalling equipment along the line. Moving to the rail line produces less emissions to the air and reduced fuel comparison to trucks. There will also be fewer transits compared to trucks, 2 trains approx. 1km in length during 3-4 trips per day. Some of the effects that we are looking at are potential habitat loss and restriction of movement for caribou, potential impacts to hunter travel, or effects to fish and fish habitat. Mitigation measures we are proposing to mitigate those impacts are crossings for hunters so the rail does not impact travel routes. They will be designed for passage safely by snow machines and will have signs for the crossings. There will be speed limits on the train and temporary stoppages when animals in the area. Crossings will be a very gentle slope for most of the rail bed there will be large angular boulders used to build up the rail bed, that will be covered by a fine gravel and wood will be placed between steel lines to reduce friction on the rails and prevent animals from getting caught.	2018-06-14 - Iglookik - Workshop
In the event of having an additional dock, who would have to approve it, would DFO have to approve it?	You would have to approve it in two different ways. Fish cannot be disturbed and fish use that area and would be using the area in future. DFO would have to approve changes to the area. If the fish were to stop using the area, we would have to have a plan to help the fish could go somewhere instead of the Inlet if the dock affected the fish. No habitat loss with the new dock due to the rehabilitation of fish.	2017-05-29 - Clyde River - Community Meeting

Stakeholder Comment	Project team comment	Date and Event
Good evening, regarding Baffinland Phase 2 proposal, we were involved in Phase 1, in phase 2 there are many things that you are proposing, some of them having been completed, if you increase your trucks to haul, what traffic is going to increase, regarding dust, if you expand your operations how are you going to manage the dust, secondly, our land is our livelihood, this is our land that you are exploiting, people get away with a lot these days, if this is not your land you are visitors, you did not have a personal claim to it like us, how are you going to care for the land, reclaim it, how will you be the steward of the environment. That is very important. There are 5 communities affected, they need to have better information, exactly what changes you are proposing, it is confusing when changes happen and we arent told, also while youre working on this we who live in our communities we live in this land, you will be working with the world, prices will rise and fall, we know that. Many people are unable to work due to low levels of education, I dont see how you plan to increase your inuit employment, for instance if you have a train its called the Baffinland via rail, you have I think it would be good if you could say Baffinland which includes Igloolik, Pond Inlet, Arctic Bay, all the communities, not just Baffinland.	Regarding increased truck traffic and dust, through Phase 2 the intention is to move from trucking operation to rail operation, which means a decrease in truck traffic, so ore will be transported by rail with 5-8 trips along the rail line as opposed to hundreds of trucks along the tote road. So that is one measure we are putting in. We know the trucks on the road are causing dust along the tote road, so to clarify going from trucking to rail. Your concerns are valid and I appreciate you mentioning us being stewards and taking care of the environment. We have large environment monitoring programs we run earth year to understand how we are impacting fish, soil veg marine terrestrial wildlife, NRIB, DFO, etc. all look at our monitoring programs and provide insight into if changes need o be made. We take env stewardship very seriously and in terms of reclamation and how we intend the land to go back to habitat after its gone, we work with QIA and have developed closure and reclamation plans which dictate how we are going to clean up after we are done Include reveg studies, how we remove infrastructure, we have plans in place that are approved by the landowners through the QIA, but we have those in place already .You also mentioned how we increase Inuit employment, we have put into place additional training programs, QSTEP joint BIM QIA program, increased training, reinitiated work ready programs which are preemployment programs, committed to different funding, running apprenticeship at the mine site, lower people can shadow other people and move up on the job. Have seen a 70% increase in our employment numbers, are produ of that and want to ensure that Inuit who want to work will continue to work with us, so we work with partners, communities, to ensure that Inuit are continuing to be meploed. To our last point to include the communities, we very much appreciate the communities which we work with, we don't forget them, we want to ensure we come back and share info as it does or not does change, want an open forum and open dialogue, so I appreciate everyone's comments and for coming tonight.	2018-01-08 - Igloolik - Phase II Community Consultation
During the discussion of preliminary closure planning, participants provided the following comments: - It is too early to provide comments on closure. When the time comes, it will be different, and we may get the wrong idea now. Need to obtain community input when the plans are developed. - Consider potential for other mine projects to be developed and use the rail and other infrastructure. - If the rail line is developed from the south to the north port, consider giving it to an Inuit organization to operate. This could be used to transport commercial goods, or potentially used for tourism. This is a decision that should be made by Inuit at that time. - Is there the potential to extend the road to Pond Inlet? - There have been issues in the past with projects leaving equipment behind on the land. All equipment should be removed (do not treat the land as a dumpsite). - Rename the area of Mary River to the Inuktitut name (Old Mary River)	None.	2019-02-12 to 2019-02-14 – Trois Riviere, QC – Community Risk Assessment Workshop

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Appendix F

Lessons Learned from Other Projects

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Mine and port decommissioning, closure, and rehabilitation have been conducted at sites in the Canadian North for several decades. This time period has allowed the planning, permitting, closure, and post-closure performance to be evaluated. These include: Colomac Mine, Giant Mine, Diavik Mine, Ekati Mine, Faro Mine, Nanisivik Mine/Port. As part of its reclamation researched initiatives, Baffinland is committed to establishing the primary lessons learned from these examples and others, to help evaluate options related to, but not limited to: re-vegetation strategies; post closure property control and land use; stakeholder relationships and commitments; residual waste material management; post-closure maintenance (if required); water management (before, during, and after closure), and managing socio-economic impacts. An initial summary of lessons learned from some of these projects is compiled below. Understanding the relevant lessons learned at comparable sites will be an ongoing process as part of the closure planning process, future updates will be added as applicable.

Table F-1: Lessons Learned from Other Projects

Development	Activity Leading to Lesson	Lesson Learned	Management Result
Ekati Diamond Mine, Diavik Mine - NWT	Placement and covering of mine rock piles and waste.	Permafrost develops rapidly within mine rock piles with an active freeze/thaw layer, additional run-off and infiltration of water without proper cover.	The use of mine rock piles will limit the quantity of impacted seepage due to exposure to freezing surface temperatures and permafrost aggradation. Placement of an engineered cover over storage areas will promote surface runoff and further limit infiltration and water contact. Waste rock deposition sequencing in winter (max lift thickness).
Ekati Diamond Mine, Diavik Mine - NWT	Revegetation research studies.	Revegetation and planting in northern regions has generally been across long time lines, or often with uncertain success.	Site re-contouring has also improved natural recovery at the Ekati and Diavik Mines.
Ekati Diamond Mine, Diavik Mine, Snap Lake Mine - NWT, Jericho Project - Nunavut	Caribou concerns and mine site infrastructure	Caribou are known to use artificial habitats created by mine structures (e.g., roads, mine waste piles). Caribou travel through and around the mine site during migration. There is a potential for caribou passage to be impeded or for caribou to be hurt or killed by mining operations. Structures and	Road and rail crossings designed for the northern transportation corridor at expected caribou travel routes.

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Development	Activity Leading to Lesson	Lesson Learned	Management Result
		rock piles may also provide a means of shelter avoiding insects. Fencing can lead to caribou mortality from entanglement. Fences can be used by predators to limit escape options of their prey.	
Con Mine - NWT	Site surface and infrastructure.	Certain infrastructure discussed in ongoing engagement may provide value to the local community, or third parties.	Opportunities for beneficial ongoing use of primary infrastructure including airstrip, road, rail embankments, and docks have been considered in engagement discussions to date.
Ekati Diamond Mine - NWT	Operational monitoring programs.	Monitoring programs in place at site are effective in detecting changes.	The operational monitoring programs can be used to design effective post-closure monitoring programs.
Ekati Diamond Mine - NWT	Progressive reclamation of older infrastructure.	The importance of treating closure and reclamation activities as projects is integrated into mining operations.	This learning is incorporated into approach taken for planning, resourcing, and execution of future progressive reclamation, and final reclamation efforts.
Minto Mine-Yukon	Progressive reclamation measures linked to operational development plans for waste rock storage, overburden dumps and tailings management areas	Reduced financial liability for closure costing and bonding.	Review operational plans and procedures to incorporate rigorous assessment and implementation of progressive closure measures. Baffinland's progressive rehabilitation measures proposed as part of the ICRP are expected to be technically and economically feasible and reflect Project closure principles
Giant Mine - NWT	Baker Creek Reach 4 Re-alignment	Frozen material exposed during excavation melted and caused settlement of excavated areas.	Characterization of frozen materials is needed for sensitive excavations. This includes road and rail construction areas.
Ekati, Diavik, Snap Lake Mines - NWT	Underestimated groundwater inflows in initial site water quantity and quality predictions.	All three mines were developed where zones of enhanced permeability persisted, which led to underestimation of groundwater inflows, and in some cases the volume of high TDS water requiring management at surface.	Assessing the water-balance for the proposed Open Pit and timelines for it's enhanced flooding is a priority of closure planning (see Appendix D)

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Development	Activity Leading to Lesson	Lesson Learned	Management Result
Faro Mine-YK, Colomac -NWT, Gahcho Kue - NWT	Flooding of open pits, and establishment of meromictic conditions to isolate poor quality water generated during mining.	Poor water quality (e.g. acidic water, high TDS water) can be isolated at the bottom of the pit when meromictic conditions are present in the flooded pit lake.	Considerations for poor quality water, density differences, high TDS mine water at the bottom of the pit and low TDS overlying freshwater cap, as well as the pit geometry may affect homogenization of pit water following closure.
Cartier Mining, ArcelorMittal, Alaskan Railway, Churchill-Manitoba, Scandinavia and Tibet railway systems	Railway operations in northern regions that are affected by permafrost conditions.	Cold climate conditions and extremities vary across different regions when considering design and implementation of rail systems.	Baffinland will draw from experience of previous railway operators in northern conditions. Baffin Island extreme cold lasts 5 to 6 months. One consideration is strategic management of operation and maintenance crews including rapid rotations at project site during extreme cold conditions.
Ekati Diamond Mine, Diavik Diamond Mine, Gahcho kue-NWT	Remediation hydrocarbon-contaminated material during operations and immediately after contamination occurs	Hydrocarbon-contaminated soil material is expected during operations. Establishing a land treatment area for hydrocarbon contaminated soils during operations ensures prompt cleanup, remediation of material, and reduced closure liability.	The Milne Port landfarm package includes the landfarm containment area and the contaminated snow containment area constructed south of the accommodation camp, near the Milne Inlet Quarry (Q1). The landfarm containment area was constructed to store/remediate the petroleum hydrocarbon (PHC) contaminated sand/gravel materials Remedial efforts for these impacted materials will be a priority for Baffinland..

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Appendix G

Residual Effects

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G.1 Predicted Residual Effects

Residual effects refer to the remaining environmental effects identified for the Project, post-mitigation, at the expected closure period of the Project. Based on the information presented in the Mary River Project FEIS, the Mary River Project as approved will have no significant adverse residual effects for the VECs identified within the biophysical environment. The Project is not expected to compromise the ecosystematic integrity of the Nunavut Settlement Area. In addition, no significant adverse residual effects are predicated to occur to VSECs identified within the socio-economic environment, and the Project is expected to have significant positive effects for most of the VSECs. This position is supported by comprehensive site-specific studies (baseline and modeling studies), IQ, extensive public consultation, and expert opinions. The Phase 2 Proposal assessed proposed additions to the scope of the Project, and also concluded no significant adverse residual effects.

An overview of the assessment methodology used to develop this residual effect position, as detailed in Volume 2 of the Mary River Project FEIS, and carried forward in the ERP and Phase 2 Proposal Addendums, is provided in Section G.2. A summary of the non-significant residual effects identified for each VEC and VSEC as part of the Mary River Project FEIS is provided in Section G.3. Section G.4 includes an overview for Baffinland's approach to ongoing assessment of the predicted residual effects.

Further detail of the Project residual effects is presented in relevant TSDs within the Phase 2 Proposal.

G.2 Residual Effects Assessment Methodology

G.2.1 *Determining Significance of Residual Effects*

One of the underlying purposes of the EIS is the assessment and determination of significance of the residual effects and their acceptability to Inuit communities and the Project stakeholders. As directed by the Guidelines (NIRB 2015), determination of significance considers the following criteria.

- Direction or nature of an effect (i.e., positive/beneficial versus negative/adverse);
- Magnitude and complexity of an effect;
- Extent of the effect, including the geographical area that will be affected, the size of the affected human populations, and/ or the size of the affected wildlife populations and habitat;
- Frequency and/or duration of an effect;
- Reversibility or irreversibility of an effect;
- Probability or likelihood of occurrence of the effect; and
- The level of confidence in the effects prediction.

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These criteria were carried forward in the Phase 2 Proposal assessment, as specified in the Guidelines. Additional attributes are considered, if and as applicable, in the assessment of the VECs/VSECs. The residual effect (i.e., after mitigation is applied) is described within the detailed assessments of the residual effects from the Project are presented in the various TSDs. The findings of these assessments are summarized in Table G.4 below. Section 90 of NuPPA lists factors to be considered in determining the significance of impacts. Certain factors, listed below, are the same for all VECs and are unchanged from the Approved Project:

- The ecosystematic sensitivity of the area;
- The historical, cultural, and archaeological significance of the area; and
- The size of the human and the animal populations likely to be affected by the effects.

The remaining factors are included in Table G.4.

Definitions and assessment criteria for each are identified in Table G-1, which lists the complete set of attributes (criteria and qualifiers), provides a definition and rationale as well as a summary of their relevance or context to the Mary River Project, and describes how the attribute was incorporated into the assessment.

Table G-1: Attributes Used to Evaluate Significance of Residual Effects

Attribute	Definition and Rationale	Role in Significance Determination²
Direction and Nature ¹	The ultimate long-term trend of an environmental effect - positive, neutral, or negative.	Qualifier Only negative effects are assessed for significance
Magnitude ¹	The amount or degree of change in a measurable parameter or variable relative to existing conditions (the exposed population) ³ . This attribute can also consider complexity - the number of interactions (Project phases and activities) contributing to a specific effect.	Primary Criterion High magnitude = high significance Secondary Criterion If magnitude and geographic extent are related, the higher the potential significance
Extent ¹	The geographic area over which the interaction will occur.	Secondary Criterion The larger the zone of influence, the higher the potential significance
Frequency ¹	The number of times during a project or a project phase that an interaction or environmental effect can be expected to occur.	Secondary Criterion Greater the frequency of occurrence, the higher the potential significance

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Attribute	Definition and Rationale	Role in Significance Determination ²
Timing	The Project Phase within which the environmental effect will occur.	Qualifier Provides context
Duration ¹	The period over which the environmental effect will occur.	Secondary Criterion The longer the duration of an interaction the higher the potential significance
Reversibility ¹	The likelihood that a VEC/VSEC or Indicator will recover from an environmental effect, including consideration of active management techniques. Reversibility is considered for biological VECs at the population level. Therefore, although an effect like mortality is irreversible, the effect at the population level might be reversible.	Primary Criterion The greater the potential to reverse an effect, the lower its potential significance
Probability ¹	The likelihood that an interaction and a consequent effect will, in fact occur.	Qualifier (considered only for potentially significant effects) The higher the probability of occurrence, the greater the significance
Certainty ¹	The level of confidence in the knowledge or analysis that supports the prediction, in particular with respect to limitations in overall understanding of the ecosystem, and limitations in the ability to foresee future events or conditions.	Qualifier (considered only for potentially significant effects) The lower the certainty of occurrence, the more conservative the approach to prediction of significance
Ecological/Socio-economic context/value ¹	The general characteristics of the area in which the Project is located, as indicated by existing levels of human activity and associated types of disturbance. Interpreted to mean the basis for assigning "value" to the particular VEC.	Qualifier VECs/ VSECs and Indicators have been identified as "valued"
Environmental Sensitivity ¹	Environmental sensitivity of the area likely to be potentially affected. Refers to areas of heightened sensitivity that will be identified where applicable in relation to the	Qualifier The Magnitude of an effect within an area of environmental sensitivity will be greater; therefore environmental sensitivity

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Attribute	Definition and Rationale	Role in Significance Determination ²
	Project (i.e., areas sensitive to spills; caribou calving areas).	is considered in the discussion and rating of the Magnitude attribute.
Historical, cultural, archaeological significance ¹	To be considered within the geographic area to be potentially affected	Qualifier (Extent - above) Historic, cultural and archaeological significance is evaluated within the archaeology effects assessment (Volume 4)
Human and wildlife populations, and the size of the affected wildlife populations and related habitat ¹	The size of the potentially affected human populations; and the size of the potentially affected wildlife populations and related habitat.	Qualifier (Extent - above)
The extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit harvesting activities ¹	The Project might have the potential to affect other human and wildlife population, if there are residual effects to marine wildlife or socio-economic benefits that extend outside Nunavut.	Qualifier Consider within the Transboundary Effects Assessment (FEIS Volume 9, Section 4; Phase 2 Proposal, TSD-27)
The potential for cumulative adverse effects given past, present and future relevant events ¹	The Project might have the potential for cumulative effects where residual effects from the Project are expected to occur.	Qualifier Consider in the Cumulative Effects Assessment (FEIS Volume 9, Section 1; Phase 2 Proposal, TSD-27)
Ecosystem function and integrity ¹	Ecosystem function and integrity is important to identified VECs and humans.	Qualifier Outcome of the significance determination
The effect on the capacity of resources to meet present and future needs (sustainability) ¹	The sustainability of this Project, and any major industrial project, is an important element to assess.	Qualifier Outcome of the significance determination
Value ¹	The value attached to the affected VEC or VSEC by those who identified them. An environmental or socio-economic component was identified as “valued” and was addressed in the EIS if it was found to have a high value to communities.	Qualifier Addressed as part of Issues Scoping where the “value” of each component is considered. The value attached to a VEC or VSEC is more or less equivalent to “Sensitivity” described above.

NOTES:

1. Specifically required by NIRB guidelines.
2. Criterion – directly contributes to the determination of significance. Primary criteria are given greater weight than secondary criteria. Qualifier – acts as a modifier to be considered when assigning values/rankings to assessment criteria.
3. In the majority of cases there is either a poor or no estimate available of the total population. However, for the purpose of undertaking an environmental assessment, an effects prediction can be made by making reasonable assumptions. The most common approach is to take an area that is less than the full range of a population and, often on the basis of density estimates (or by using habitat as an indicator), a conservative prediction is possible, i.e. If the effect is calculated for a portion

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of the population and it results in a magnitude of effect that is beneath a defined threshold, then it is reasonable to predict the effect on the entire population, even in the absence of a total population estimate. This approach is not greatly different from that used by resource managers that have the mandate to manage wildlife populations, who are challenged to develop harvest quotas, even where they do not have an accurate or complete population estimate available to support these decisions.

G.2.2 Rating Criteria of Residual Biophysical Impacts

For the categories for criteria and qualifiers applied directly to the determination of significance for residual biophysical effects, with due consideration to the NIRB requirements cited above, see Table G-2.

Table G-2: Ratings for Evaluating Residual Biophysical Effects

Criteria	Classification	
Magnitude (Specific to the VEC and the impact)	Level I	An effect on the exposed indicator/VEC that results in a change that is not distinguishable from natural variation and is within regulated values
	Level II	An effect that results in some exceedance of regulated values and/or results in a change that is measurable but allows recovery within one to two generations
	Level III	An effect predicted to exceed regulated values and/or results in a reduced population size or other long-lasting effect on the subject of assessment
Extent The physical extent of the effect, relative to study area boundaries	Level I	Confined to the LSA
	Level II	Beyond the LSA and within the RSA
	Level III	Beyond the RSA
Frequency How often the effect occurs	Level I	Infrequent
	Level II	Intermittent
	Level III	Frequent or continuous
Duration The length of time over which a Project effect will occur	Level I	Short-term (effect lasts up to four years)
	Level II	Medium-term (up to 25 years, for the life of the Project)
	Level III	Long-term (beyond the life of the Project) or permanent
Reversibility The likelihood of the VEC to recover from the effect	Level I	Fully reversible
	Level II	Reversible with cost/effort
	Level III	Irreversible
Qualifiers		
Certainty Limitations in the overall understanding of the ecosystem and ability to predict future conditions	High	Baseline data are comprehensive; predictions are based on quantitative data; effect relationship is well understood
	Medium	Intermediate degree of confidence between high and low
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is not well understood
Probability The likelihood that the predicted impact/residual effect will occur	Unlikely	Less than 20% likelihood of occurrence
	Moderate	Between 20 and 60% likelihood of occurrence
	Likely	Over 60% likelihood of occurrence

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Each of the five criteria contributes to the determination of significance. Criteria are categorized in three levels (Levels I, II, and III), where Level I is indicative of a negligible or limited potential to contribute to an overall significant environmental effect, and Level III is indicative of a high potential. Level II represents the intermediate condition.

G.2.3 Rating Criteria for Residual Socio-Economic Impacts

Similar criteria were applied to the socio-economic effects assessment with some modification and additional criteria in consideration of the nature, complexity, and multiple perspectives associated with socio-economic issues. For the attributes (criteria and qualifiers) identified as the determinants of significance of socio-economic effects, see Table G-3.

Table G-3: Rating Criteria for Evaluating Residual Socio-Economic Impacts

Criteria	Classification
Direction	Positive
	Variable
	Negative
Geographic Extent	Description of the area and communities most affected
Social Extent	Demographic groups or social units identified as most affected
Magnitude Intensity of the effect	Low
	Moderate
	High
Frequency How often the effect occurs	Infrequent
	Intermittent
	Continuous
Duration Length of time over which a Project effect will occur	Short-term (less than four years)
	Medium-term (up to 25 years, life of the Project)
	Long-term (beyond the life of the Project)
Reversibility Likelihood of recovery from effect	Reversible
	Partly reversible with cost/effort
	Irreversible

G.3 Residual Effects Predicted at Planned Closure

Using the methodology presented in Section G.2, the predicted residual impacts were assessed and the associated consequences were evaluated for each impact to a VEC or VSEC. Although no significant adverse residual effects were predicted for the Project at planned closure, this section provides a summary of all predicted residual impacts that were expected to exist during closure and beyond the closure of the Project site for both VECs and VSECs. Table G-4 provides a tabular summary of residual effects.

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Residual impact criteria (e.g., direction, magnitude, reversibility, etc.) noted in the following sub-sections are defined in Section G.2. Complete details including the environment consequence calculations, residual impact criteria classification, probability of occurrence and level of confidence all VECs and VSECs are presented in the Mary River Project FEIS, FEIS Addendum and the Phase 2 Proposal. Updates to the residual impacts assessment (referred to as “residual effects” within the Phase 2 Proposal) were completed as part of the Phase 2 Proposal EIS; however, no changes to residual effects during closure and post-closure were identified as part of this addendum. The evaluation of closure and post-closure residual effects associated with the Phase 2 update was primarily qualitative, and results are summarized in criteria (i.e. duration of effect, reversibility) which are presented in Table G-4. Additional detail can be found in the relevant TSDs associated with each of the VEC/VSECs.

The limited change in results for predicted post-closure effects reflects the minimal changes expected during operations from the Phase 2 Proposal activities relative to the approved project, or in some cases changes to that are positive in direction (e.g. air quality improvements associated with the change to rail operations from trucking, water quality improvements at the Mine Site due to changes in secondary ore processing). At the Waste Rock Stockpile and Open Pit areas, which have identified uncertainty with respect to post-closure residual effects, no substantial changes in project activities are associated with the Phase 2 Proposal and updated predictions for closure were not undertaken.

G.3.1 *Project Effects on VECs*

The Phase 2 Proposal design sought to minimize the interactions of the Project with the natural environment and to implement measures to minimize the potential negative effects of interactions. With these measures in place, the effects of the Phase 2 Proposal on the natural environment overall was assessed as not significant. The following sections summarize key project interactions and mitigation measures that will be implemented.

G.3.2 *Atmospheric Environment - Climate change; Air quality; Noise and vibration*

Climate change is predicted to have little effect on the very cold and deep permafrost conditions in the area over the planned life of the Approved Project. The Phase 2 Proposal facilities will also be designed to account for any changes in site conditions induced by climate change. The Phase 2 Proposal activities will produce Greenhouse gases. Releases of Greenhouse gases from the Project are anticipated to be small in comparison to Nunavut and Canadian totals and the Phase 2 Proposal will reduce current emissions by use of rail over road ore transport. Greenhouse gas releases will not have a measurable effect on global climate change.

Ore handling, as well as driving on access roads, and emissions from power plants, trucks, and camp incinerators will affect air quality through the generation of particulates and other gaseous emissions. The use of low-sulphur arctic diesel fuels and ensuring modern emission controls on equipment will reduce these emissions. As well, air pollution controls such as dust suppressants will prevent significant effects

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on air quality. Once the railroad is constructed and operating, it will replace trucking as the method of transporting the ore from the mine to the port, and dust emissions from ore transportation will be reduced. With the Phase 2 Proposal, secondary crushing will be moved from the Mine Site to Milne Port, where it will be enclosed, reducing dust emissions.

Phase 2 Proposal activities will increase noise levels but these will be limited to areas close to the activities. As well, the use of mufflers and regular maintenance of engines and equipment will prevent significant noise levels.

G.3.3 *Land Environment: Landforms, soil and permafrost; Vegetation; Terrestrial wildlife and habitat; Birds*

Sensitive landforms in the Project area include frozen soils that contain ice lenses or areas that could shift under pressure. Sensitive landforms will be avoided or appropriate engineering designs will be used to protect the sensitive areas. During site preparation adequate drainage to prevent water pooling during thaw periods will be used.

The design of all Phase 2 Proposal facilities minimizes the amount of land that the Project needs to disturb. Thus the amount of vegetation that is affected is minimal compared to the amount of vegetation cover in the North Baffin. Numerical modelling was done to predict the amount of dust that could settle on the vegetation in the area and these studies concluded that the dust suppression actions would prevent impacts on plants.

Caribou are the main indicator species used to assess potential effects on terrestrial animals. The main project interaction with caribou would be when caribou cross the road or rail lines. Although it is possible that individual caribou could be involved in collisions with trains or trucks, these numbers are expected to be limited and will not be significant compared with total numbers in the region. Several measures are in place to avoid collisions with caribou. Strict speed limits will be in place for trucks and trains, thus decreasing the probability of collision. Trucks will be required to stop if wildlife is observed on or next to the road. No sightings have been made at the Project sites.

There are many birds through the region and a small amount of habitat loss for migratory birds is expected to result from Phase 2 Proposal activities. These are not expected to lead to effects on populations of key species such as peregrine falcons, snow geese, eiders, and loons. Prior to initiating Phase 2 Proposal activities, nests and nesting areas will be identified and mitigation will be implemented to avoid direct effects to birds and bird habitat.

G.3.4 *Freshwater Environment – Surface water and sediment quality; Water quantity; Freshwater fish, fish habitats and other aquatic organisms*

A number of proven mitigation measures have been included in the Phase 2 Proposal to reduce potential effects on water quality, freshwater fish, fish habitat, and other aquatic organisms. Specific Management Plans detail the many ways that water will be protected.

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Water use will be reduced to the minimum necessary and all used water will be tested and if required treated before it is released back to the environment. Sewage treatment facilities will ensure that all discharged water satisfies established standards. Run-off water from fuel storage and maintenance facility areas will be contained and wastewater from truck and rail maintenance facilities and explosives equipment-washing facilities will meet established standards before being discharged to the natural environment. An Emergency and Spill Response Plan will be in place and will ensure that there is prompt and appropriate clean-up of any spills should they occur.

In response to the non-compliant discharges from the Waste Rock Facility (WRF) in 2017, Baffinland has taken multiple corrective actions to prevent additional non-compliant discharges from the WRF and retained Golder Associates (Golder) to determine the appropriate corrective actions required to address the seepage observed at the WRF in 2017 and investigate the potential for ARD and develop mitigation measures, as required. Actions completed in 2018 include installation of a water treatment system to manage captured runoff at the WRF pond and installation of thermistors and oxygen sensors to monitor the thermal profile, freezeback rates and oxidation of the WRF. In 2019 Baffinland will continue work at the WRF, including upgrading the WRF pond to address seepage and expand capacity and updating the Interim Waste Rock Management Plan. The revised plan will outline the management of waste rock and surface water at the WRF for the next five years and will incorporate geochemistry data collected during field programs in 2018 and 2019, updated water quality modelling results and lessons learned from the 2017 events.

The Tote Road and North Railway crosses a large number of watercourses and a portion of these contain fish habitat. New bridges will be constructed, and many culverts will be replaced and will be designed to limit barriers to fish movement. A habitat compensation plan is included as part of the assessment.

G.3.5 Marine Environment – Sea ice; Marine water and sediment quality; Marine habitat and biota; Marine mammals

At Milne Port, near-shore, including port activities, will be carefully managed to protect the marine environment. All sewage and wastewater from maintenance facilities and explosive residues will be treated before discharge and runoff from port site areas will be contained and monitored for water quality before discharge. Ship to shore fuel transfers will take place following the Canada Shipping Act regulations.

Pile driving during construction at the Milne Port has the potential to create an acoustic disturbance, which could affect the marine environment. Mitigation will be used to dampen sound transmission and marine mammal monitoring to avoid pile driving when marine mammals are present. Auditory disturbances are not expected to affect marine biota and mammals at the population level.

Shipping from Milne Port will be mainly during a nominal shipping window from July 1 to November 15, with a caveat that Baffinland will not break through landfast ice. Ore carriers will carry ballast water during

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their inbound trips to Milne Port. This water is required in order to keep the vessels stable and at an even draft. Ballast water will be managed in accordance with the Canada Shipping Act and its regulations which require mid-ocean exchange of ballast water. The water is pumped overboard as the vessels approach Milne Port. Ballast water will only be slightly different (in temperature and salinity) from the water in the Inlet. Modeling has shown that discharge will not alter the quality of water in Milne Inlet. There is a concern that ballast water could result in the unintended introduction of invasive species. Adherence to strict protocols developed by regulatory agencies will mitigate this concern.

The key marine mammal species include narwhals, beluga whales, and bowhead whales. Effects of Phase 2 Proposal activities were assessed for these species as well as ringed seals, bearded seals and walruses.

There is potential for acoustic disturbance from ship noise along the Northern shipping route as well as vessel strikes on marine mammals which can cause serious injury or mortality through physical harm. With respect to the Northern shipping route, ringed seals, narwhal, beluga whales and bowhead whales may all be expected to encounter ship traffic in low to high frequencies. There have been no vessel strikes to date with marine mammals. Polar bears and walruses are infrequent along the Northern shipping route in the open water season and are, therefore, not expected to experience acoustic disturbances from ship noise or vessel strikes. Given the relatively low likelihood and short duration of encounters between marine mammals and vessel traffic, acoustic disturbances are not expected to affect marine mammals at the population level. To mitigate potential vessel strikes, the Phase 2 Proposal includes mandatory nautical instructions including reduced speed limits when transiting within Milne Port or along the Northern shipping corridor, and the maintenance of a constant course and speed when in transit. Given the planned mitigation, and low likelihood for marine mammal vessel strikes, vessel strikes are not expected to affect marine mammals at the population level.

Ringed seals are present year-round along the northern shipping route, including the Milne Port site. Shipping and most construction activities at the Milne Port site will occur during the open-water period, which avoids pupping, nursing, mating, and moulting. Ringed seals are generally tolerant of industrial activity and shipping. The effects of Phase 2 Proposal activities on ringed seals are considered minor and are expected to occur in a localized area.

Bearded seals are expected to occur in small numbers along the northern shipping route during the open-water periods given that they predominately occur in areas of pack ice. Shipping during the Phase 2 Proposal does not overlap with bearded seal pupping and nursing. If bearded seals do occur along the northern shipping route or near the Milne Port, they may exhibit localized avoidance of shipping and construction activities. Given the small numbers of bearded seals expected to occur in Eclipse Sound and Milne Inlet, and the planned mitigation measures, predicted impacts are not significant.

Walruses may occur in small numbers along the northern shipping route during the open-water period. If walruses do occur along the northern shipping route or near the Milne Port, they may exhibit localized

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avoidance of shipping and construction activities. Given the small numbers of walrus expected to occur in Eclipse Sound and Milne Inlet, and the planned mitigation measures, predicted impacts are not significant.

Narwhals are present along the northern shipping route primarily during the open-water period when about 20,000 animals summer in the Eclipse Sound and Milne Inlet area. Narwhals are thought to calve and perhaps feed in this summering area. While there is little information on how narwhals respond to vessel traffic—there are relevant observations in the Milne Inlet area that indicated that narwhals exhibited variable responses to vessels (including the passage of an ore carrier, fuel tanker and sea lifts). Observations, including through the Bruce Head shore-based monitoring program, which involves local Inuit as observers, suggest that some narwhals may have left certain areas after a ship's passage but that others did not. It is predicted that narwhals will exhibit localized avoidance of ore carriers along the northern shipping route and vessel traffic in the Milne Port area. Potential effects are expected to be reduced by decreasing ship speed and hence, minimizing sound levels. Narwhals are predicted to habituate to repeat passages of ore carriers along the northern shipping route. Ongoing monitoring will be conducted to detect unexpected effects on narwhals and to identify any additional mitigation measures.

Beluga whales occur in relatively small numbers in Eclipse Sound and Milne Inlet during the open-water period. Beluga responses to vessels during periods of open water are variable, ranging from tolerance to avoidance, and likely depend on the type of vessel and its speed and course, and the whales' activity and previous exposure to industrial activity. It is likely that belugas will exhibit localized avoidance of ore carriers along the northern shipping route. Effects are expected to be reduced by decreasing ship speed. It is predicted that belugas will habituate to repeat passages of ore carriers along the northern shipping route. To address the uncertainty with this prediction ongoing monitoring will be conducted to detect unexpected effects on belugas and to identify any additional mitigation measures.

Bowhead whales regularly occur along the northern shipping route, and it is thought that this summering area is used for feeding. Behavioural responses to shipping activity by bowhead whales are variable and appear to depend on the whale's activity and the type of vessel. Based on previous studies, bowheads will likely avoid at least the immediate area around ore carriers and that effects can be minimized by reducing ship speed and by vessels maintaining a constant course and speed. It is predicted that bowheads will exhibit localized avoidance of ore carriers along the northern shipping route. It is predicted that bowheads will habituate to repeat passages of ore carriers along the northern shipping route. To address the uncertainty with this prediction ongoing monitoring will be conducted to detect unexpected effects on belugas and to identify any additional mitigation measures.

Polar bears occur along the northern shipping route throughout the year in relatively small numbers. Phase 2 Proposal activities will primarily occur during the open-water period and as such will not overlap with polar bear denning and mating. Bylot Island and coastal Baffin Island are used as summer retreats by

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polar bears. Polar bears are expected to avoid ships and the port site; however, they may also approach these areas. Project personnel will be educated about bear safety and the strict management of waste will reduce the chances of human bear interactions. Polar bear monitors will be hired to ensure worker safety.

G.3.6 *Project Effects on VECs*

The Phase 2 Proposal will provide many potential social and economic benefits to the residents of North Baffin. These will arise from employment and training opportunities as well as from opportunities for businesses and from payments made to government and Inuit organizations. Careful planning is needed in order to improve the ability of people to attain these opportunities. Individuals and families will also require support as they cope with the challenges associated with the fly-in/fly-out style of life and with the wealth and financial responsibilities that come with this lifestyle. The assessment of valued socio-economic components is an important way to identify issues and develop appropriate mitigation measures. Overall the Phase 2 Proposal represents important and significant socio-economic benefits to Nunavut.

G.3.7 *People: Population demographics; Education and training; Human health and well-being*

The potential for the Phase 2 Proposal to cause non-Inuit migration into communities, as well as the potential for Inuit to move out of the communities as a result of the Phase 2 Proposal was assessed. Neither of these possibilities is identified as significantly affecting the composition and numbers of the North Baffin populations or the community social fabric.

Baffinland's education and training commitments will help upgrade the skills of North Baffin residents. Baffinland is committed to supporting training programs that will enable residents of nearby communities to develop the skills needed to qualify and perform jobs at every level of the Phase 2 Proposal operation. Baffinland has been actively pursuing education and training partnership initiatives. Baffinland and the QIA recently developed the Q-STEP training program, a four-year initiative that will be undertaken by QIA in close partnership with Baffinland to provide Inuit with skills and qualifications to meet the employment needs of the Mary River Project as well as other employment opportunities in the region.

The Approved Project was predicted to deliver positive effects related to education and training through access to industrial work supported by pre-employment preparation and on-the-job training for young adults, incentives related to school attendance and success, and opportunities to gain skills. Monitoring supports that these predictions are being realized by individuals employed by the Project and their families (TSD-27). While the development of an adequately trained and skilled Inuit workforce will take time to achieve, Baffinland expects that training programs will eventually contribute to the development of a stronger local workforce and economy. Monitoring supports that these predictions are being realized by individuals employed by the Project and their families.

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The rotation schedule is two weeks in two weeks outs. The challenges associated with fly-in/fly-out operation are recognized. Steps will continue to be taken to help workers and families to succeed in this type of work environment. Orientation and training will continue to be provided to help workers and families adapt to the work rotations and improve money management practices.

Concerns are sometimes raised about the potential effects of the Phase 2 Proposal or the Approved Project on the transport of illegal substances through Project sites and on the affordability of such substances. To counter the possibility of increased substance abuse the company has a strict no drug–no alcohol policy. Addiction counselling will also be available.

G.3.8 Community: Community infrastructure and public service; Cultural Resources; Resources and land use; Governance and leadership: Livelihood and employment; Cultural Well-being

The Project is expected to create competition for skilled workers. Hamlets have expressed concern that they may face difficulty in hiring the people they need to deliver local services. However, employment experience and ongoing training will significantly improve labour force capacity helping to equip local residents with the qualifications and experience. As a result, increased competition for workers will be balanced by increased capacity.

The Phase 2 Proposal will be making use of the public airstrips at Iqaluit and at the five nearest communities for transporting workers to and from worksites. The Phase 2 Proposal's transportation plans will be designed to avoid placing demands on the airport's facilities beyond its capacity. Some increased demand for infrastructure is also expected to arise indirectly due to the Phase 2 Proposal. For example, increased wealth might lead to more vehicles and a need for road improvements.

Education and training as well as on-the-job work experience and counseling will develop leadership skills that will significantly improve local governance. The participation of community residents and leaders in agreement negotiations with Baffinland and in initiatives to identify key indicators for regional monitoring programs has already contributed to local community leadership development.

Measures will continue to be taken to respect and preserve the culture of Inuit employees while they are working. Policies that encourage respect of other cultures and diversity are in place. Baffinland supports the use of Inuktitut onsite, for signage and in work units. Traditional country foods will be provided in the Project cafeterias. Policies encouraging safety, employment equity, and, preventing harassment will be strictly enforced.

Archaeological sites have been identified in Phase 2 Proposal areas that contain features and artifacts representing substantial degrees of area use throughout the human past to the present. A number of important archaeological sites will be avoided by relocating Phase 2 Proposal infrastructure, and others will require protection through excavation, mapping, and artifact retrieval by a licensed archaeologist.

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The Phase 2 Proposal will interact with existing land uses by Inuit. Measures to support these activities include check-in procedures at Phase 2 Proposal sites and a focus on public safety for the Milne Inlet Tote Road.

G.3.9 Economy: Economic development and self-reliance; Contracting and business opportunities; Benefits, taxes and royalties

Direct and indirect economic growth generated by the Phase 2 Proposal will create new opportunities for employment and business. The Phase 2 Proposal will enhance labour force capacity and may increase Inuit business capacity. Businesses may gain opportunities to expand through the supply of business services to the Phase 2 Proposal as well as indirectly through an expanded market for consumer goods and services. Baffinland will help Inuit firms, and in particular smaller Inuit firms located in communities in the Baffin Region to develop capacity to bid on and carry out contracts for the Phase 2 Proposal.

The Phase 2 Proposal will provide substantial cash payments to Inuit organizations and to government. These will arise through the Inuit Impact and Benefits Agreement with QIA as well as through royalty payments for the iron ore made to NTI. Payments to the Government of Nunavut will arise from fuel taxes, property taxes, and taxes on the profits earned by Baffinland. Some of these payments will start as early as the construction phase, while other payments will not kick in until later in the operations phase.

Through its contribution to human skills, to household wealth and to economic growth, the Phase 2 Proposal will support achievement of overall economic development goals, including progress toward improved self-reliance of individuals, communities, and the territory.

G.3.10 Cumulative and Transboundary Effects

Consideration was given to potential cumulative effects from reasonably foreseeable projects. For the Approved Project, the main potential cumulative effects are thought to arise if development of the Mary River Project would lead to further iron ore production up to twice the currently proposed production rate. Other projects in the area will have only minor cumulative effects. A doubled production rate of one or more other deposits would increase effects to a number of valued ecosystem and socio-economic components, but not to the extent that any of the cumulative effects are expected to be significant. In relation to the Approved Project, the Phase 2 Proposal presents no significant cumulative effects.

Transboundary effects to marine mammals would occur as a result of shipping, however, because the effects to marine mammals within the study area are not significant, the transboundary effects are similarly not significant. Socio-economic effects will occur in other jurisdictions of Canada as a result of employment of the Phase 2 Proposal by people living outside of Nunavut. However, these effects are not deemed significant.

Table G-4: Summary of Residual Effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
Atmospheric Environment VECs							
Meteorology and Climate (including Climate Change)	Greenhouse gases (GHGs): - Carbon dioxide (CO₂) - Methane (CH₄) - Nitrous oxide (N₂O)	Increase in GHG emissions	Review, update, and implement the Climate Change Strategy as necessary to incorporate GHG reduction, climate change adaptation, and monitoring and collaborative research initiatives specific to the Phase 2 Proposal.	Releases of GHGs from the Project are small in comparison to Nunavut and Canadian totals and will partially mitigate current emissions by use of rail over road transport of ore. GHG releases will not have a measurable effect on global climate change. Overall, the residual effect of the Project on climate change is predicted to be: - Adverse in direction (the Project will result in GHG emissions); - Low in magnitude (not expected to contribute notably to Canadian or global GHG totals or global climate change); - Geographically widespread (GHGs cause a global effect); - Continuous in frequency; and - Irreversible (following cessation of Project GHG releasing activities the GHGs will remain in the atmosphere for 20 years or more). There is a high probability of the residual effect occurring.	Not significant	Not significant	Not significant
Air Quality	Criteria air contaminants (CACs): - Total suspended particulate (TSP) - Sulphur dioxide (SO₂) - Nitrogen dioxide (NO₂) - Carbon monoxide (CO) - Sulphur and nitrogen deposition and potential acid input (PAI) - Particulate matter <2.5 µm (PM_{2.5}) - Particulate matter <10 µm (PM₁₀) - Fugitive dust and metal concentrations and deposition	Increase in CACs	- Review, update and implement the following plans, targeting dust suppression along the Northern Transportation Corridor: - Environmental Protection Plan; - Air Quality and Noise Abatement Management Plan; - Dust Management Protocol in the Roads Management Plan; and - the dust fall monitoring program outlined in the Terrestrial Environment Mitigation and Monitoring Plan.	Concentrations of SO ₂ , NO ₂ , and CO are not predicted to exceed thresholds outside of the PDAs. Exceedances of TSP are predicted under certain conditions. However, no exceedances are predicted at the HTO cabin near Milne Port, and at the HTO cabin on the west bank of Camp Lake. Once the new rail road is operational and ore is transported by rail instead of truck, dust emissions along the Northern Transportation Corridor will be reduced from current levels associated with ERP operations. Overall, the residual effect of the Project on air quality are predicted to be: - Adverse in direction, though positive along the transportation corridor once rail is operational; - Of a magnitude that exceeds thresholds for certain worst-case modeled scenarios, but with additional mitigation exceedances are not anticipated at sensitive receptors; - Geographically confined to the LSA; - Infrequent; and - Reversible with the cessation of Project activities. There is a high probability of the residual effect occurring. In consideration of the information available and the results of ongoing monitoring activities related to air quality, there is a moderate level of confidence in the residual effects predictions for air quality.	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
Noise and Vibration	Noise and vibration levels	• Increase in noise levels • The potential effects of increased vibration levels were assessed for the Approved Project (Baffinland, 2012), and were determined to be not significant. Vibration from the Phase 2 Proposal is expected to be very similar to that of the Approved Project. Therefore, vibration was treated as a subject of note for the Phase 2 Proposal.	• Review, update, and implement the Environmental Protection Plan and the Air Quality and Noise Abatement Management Plan. • Implement key mitigation measures outlined under the AER Directive 038 (AEUB 2007), such as: ◦ Fitting internal combustion engines with appropriate muffler systems; ◦ Using acoustical screening from existing on-site buildings, where appropriate, to shield dwellings from construction equipment noise; ◦ Taking advantage of local topography to screen noise emissions, where possible; and ◦ Enclosing Milne Port crushing/screening plant in a building.	Overall, the residual effect of the Project on noise and vibration is predicted to be: • Adverse in direction; • Of a magnitude that exceeds thresholds for certain worst-case modelled scenarios outside of the Mine Site and Milne Port PDAs and at times at the HTO Cabin east of Milne Port; • Geographically confined to the LSA; • Of a duration that extends throughout the life of the Project • Infrequent; and • Reversible with the cessation of Project activities. There is a high probability of the residual effect occurring. In consideration of the information available and the results of ongoing monitoring activities related to noise, there is a high level of confidence in the residual effects predictions for noise and vibration.	Not significant	Not significant	No transboundary effects
Terrestrial Environment VECs							
Landforms, Soils, and Permafrost	• Landforms: ◦ Glaciofluvial deposits ◦ Eskers ◦ Drumlins ◦ Bedrock outcrops (cliffs) • Geochemistry • Paleontology	• Effects on unique or valuable landforms • Increase in geohazard risks • Increase in geochemical risks • Effects on paleontological resources	• Review, update and implement the following plans: ◦ Environmental Protection Plan; ◦ Borrow Pit and Quarry Management Plan; ◦ Railway Management Plan; ◦ Railway Emergency Plan; and ◦ Spill Contingency and Emergency Response Plan. • Thermal insulation may be used for the proposed Milne Port buildings, and adfreeze piles may be used for deep foundations.	The railway embankment will cross glaciofluvial deposits and a large esker. However, these landforms are not ecologically unique given the abundance of other similar glaciofluvial deposits (including eskers) in the RSA. The rail construction will also remove existing bedrock outcrop. However, bedrock outcrops that will be affected are not currently used by cliff-nesting raptors. The potential for ML/ARD occurring from quarrying and rock cuts is considered unlikely as most of the affected rock is sedimentary. Granitic rocks present in the area are predicted to be low potential for ML/ARD. Overall, the residual effects of the Project on landforms, soils, and permafrost are predicted to be: • Adverse in direction; • Low in magnitude; • Geographically confined to the LSA; • Permanent in duration; • Infrequent; and • Irreversible. The probability of the residual effect occurring is high for: • A residual change in the abundance and distribution of unique or valuable landforms; and • A residual ground disturbance of paleontological resources. The probability of the residual effect occurring is low for: • Residual effects related to geohazard risks (i.e., thaw settlement at Milne Port second ore dock, Milne Port infrastructure on land, and along the proposed North Railway); and • A residual increase in geochemical risks (i.e., exposure of potentially ML/ARD rock surfaces to the elements [along the North Railway]) have a low probability of occurring.	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				In consideration of the information available and the results of ongoing monitoring related to landforms, soils, and permafrost, there is: • A moderate level of confidence in the residual effects predictions related to thaw settlement along the proposed North Railway and exposure of potentially ML/ARD rock surfaces to the elements; and • A high level of confidence in the residual effects predictions for all other residual effects on landforms, soils, and permafrost.			
Vegetation	• Vegetation abundance and diversity • Vegetation health • Culturally valued vegetation	• Change in vegetation abundance and diversity • Change in vegetation health • Any Project-related effects to culturally valued vegetation will be negligible since blueberry abundance within the RSA is very low and was previously assessed for the Approved Project as being not significant at the RSA scale with a high confidence. No effect assessment for culturally valued vegetation was completed for the Phase 2 Proposal.	• Review, update and implement the Environmental Protection Plan and the Terrestrial Environment Mitigation and Monitoring Plan. • Take measures to keep equipment brought to the site clean of soils that could contain plant seeds that do not currently occur within the RSA. • Allow natural regeneration of disturbed areas.	The Phase 2 Proposal has the potential to affect vegetation abundance and diversity in the PDA, as construction of the Northern Transportation Corridor and expansion at the Milne Inlet Port will remove approximately 14 km² of terrestrial habitat. Changes in vegetation health resulting from TSP deposition and atmospheric emissions outside the PDA were predicted to be negligible from natural variation. Vegetated habitat has the potential to be exposed to some level of dust deposition generated at Milne Inlet, Tote Road, the Mine Site, and along the North Railway. Although all vegetation classes considered sensitive to dust deposition and may be affected by annual TSP deposition, most of the habitats will remain intact within the RSA. Overall, the residual effects of the Project on vegetation are predicted to be: • Adverse in direction; • Of a magnitude that exceeds thresholds for certain dust deposition parameters within the PDA; • Geographically confined primarily to the PDA (as well as adjacent to the PDA for dust deposition); • Infrequent; • Of a duration that lasts for the life of the Project; and • Reversible with the cessation of Project activities and with reclamation. A residual change in vegetation abundance and diversity has a high probability of occurring. The probability of the residual effect occurring is low for a residual change in vegetation health due to TSP and a residual change in vegetation health due to atmospheric emissions. In consideration of the information available and the results of ongoing monitoring activities related to vegetation, there is: • A high level of confidence in the residual effects predictions related to a change in vegetation abundance and diversity; and • A moderate level of confidence in the residual effects predictions related to changes in vegetation health due to TSP and to atmospheric emissions.	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
Birds and Bird Habitat	• Red-throated loon • Snow goose • Common eider • King eider • Thick-billed murre • Lapland longspur • Harlequin duck • Peregrine falcon • Red knot • Buff-breasted sandpiper • Red-necked phalarope • Ivory gull • Ross’s gull • Short-eared owl	• Effects on habitat • Effects on risk of mortality • Effects on health	• Review, update, and implement the Environmental Protection Plan and the Terrestrial Environment Mitigation and Monitoring Plan. • Make raptor nest sites temporarily inaccessible to breeding birds during the nesting seasons potentially affected by construction.	Overall, the residual effect of the Project on birds and bird habitat are predicted to be: • Adverse in direction; • Low in magnitude; • Geographically confined to the PDA in general, but extending to the LSA for indirect effects on habitat quality or availability; • In a range from infrequent (for occurrences of bird injury and mortality), to frequent (for sensory disturbance), to continuous (for habitat loss); • Of a duration that last for the life of the Project; and • Reversible with the cessation of Project activities. The probability of the residual effects occurring is considered low for residual effects on bird health and moderate for all other residual effects on birds and bird habitat. In consideration of the information available and the results of ongoing monitoring activities related to birds and bird habitat, there is a high level of confidence in the residual effects predictions for birds and bird habitat.	Not significant	Not significant	Not significant
Terrestrial Wildlife and Wildlife Habitat	• Caribou • Wolf	• Effects on habitat • Effects on movement • Effects on risk of mortality • Effects on health	• Review, update and implement the following plans: ○ Environmental Protection Plan; ○ Terrestrial Environment Mitigation and Monitoring Plan; ○ Roads Management Plan; ○ Railway Management Plan; and ○ Railway Emergency Plan. • Implement the Caribou Protection Measures developed collaboratively with the QIA. • Continue engagement with stakeholders and the Terrestrial Environment Working Group.	Phase 2 Proposal components and activities at the Mine Site, the Tote Road and North Railway, and Milne Port have the potential to interact with terrestrial wildlife and habitat through collisions; increased harvesting; direct loss or alteration of terrestrial wildlife habitat; barriers to wildlife movement within or between habitats; and sensory disturbances. Overall, the residual effects of the Project on terrestrial wildlife and wildlife habitat are predicted to be: • Adverse in direction; • Generally low in magnitude given planned mitigation, but moderate in magnitude with respect to potentially reduced caribou habitat effectiveness during the winter season; • Generally geographically confined to the PDA, but extending outside of the PDA (within a 14 km ZOI) for potential residual effects on caribou habitat; • In a range from infrequent (for occurrences of wildlife injury and mortality), to frequent (for sensory disturbance), to continuous (for habitat loss and barriers to movement) for the life of the Project; • Of a duration that lasts for the life of the Project; and • Reversible with additional mitigation and the cessation of Project activities, except in the case of the residual change in risk of caribou mortality associated with improved harvester access and/or knowledge of the area, which may persist indefinitely. There is a high probability that the Project will result in residual changes in caribou movement and caribou mortality risk. The probability of the residual effects occurring is moderate for residual changes in caribou and	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				wolf habitat and is low for residual changes in caribou health. In consideration of the information available and the results of ongoing monitoring related to terrestrial wildlife and wildlife habitat, there is: • A moderate level of confidence in the residual effects predictions related to caribou habitat, caribou movement, caribou health, and wolf habitat; and • A high level of confidence in the residual effects predictions related to caribou mortality risk.			
Freshwater Aquatic Environment VECs							
Freshwater Quantity and Quality	Freshwater quantity and quality	• Effects on water quantity • Effects on water quality	• Review, update and implement the following plans: ○ Environmental Protection Plan; ○ Surface Water, Aquatic Ecosystems, and Fish and Fish Habitat Management Plan; ○ Fresh Water Supply, Sewage, and Wastewater Management Plan; and ○ Plans required under the Type A Water Licence, which will be submitted to the NWB for review and approval, including: ▪ Aquatic Effects Monitoring Plan; ▪ Surface Water Sampling Program – Quality Assurance and Quality Control Plan; ▪ Blasting Management Plan; and ▪ Quarry Management Plans.	As a result of the Phase 2 Proposal, freshwater quantity and quality may change due to changes in sedimentation rates, hydrology, metal concentrations; and water flows via withdrawals and diversions. Overall, the residual effect of the Project on freshwater quantity and quality is predicted to be: • Adverse in direction, with the exception of a positive direction on water quality at the Mine Site due to changes associated with secondary ore processing; • Low in magnitude given planned mitigation and the small footprint affected relative to the watershed scale in the region; • Geographically confined to the LSA; • Infrequent effects are associated with the water withdrawals and continuous effects are associated with the stream diversions and water/sediment quantity and quality alterations; • Of a duration that will occur throughout the life of the Project; and • Reversible with additional mitigation and the cessation of Project activities. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to freshwater quantity and quality, there is a high level of confidence in the residual effects predictions for freshwater quantity and quality.	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
Freshwater Biota and Habitat	Arctic char	• Effects on health and condition of Arctic char • Effects on habitat of Arctic char • Effects on risk of mortality of Arctic char	• Adhere to applicable DFO authorization and offsetting requirements (DFO, 2013b, 2016). • Obtain Project-specific <i>Fisheries Act</i> Authorization(s) from DFO, where required for water crossings and other in-water works, and comply with associated terms and conditions. • Develop an Offsetting Plan which will be submitted to DFO for review and approval as part of the application for <i>Fisheries Act</i> Authorization, to offset the serious harm to fish associated with construction of the North Rail and construction of the second ore dock at Milne Port.	As a result of the Phase 2 Proposal, Arctic char habitat loss/alteration due to construction of North Railway is expected. In-water infrastructures (i.e., bridge footings, culverts, diversion activities) may negatively affect fish passage. Water withdrawals for dust suppression may reduce shoreline habitat, and cause stranding or impingement on the water intakes. The water and sediment quality and quantity at the Mine Site and along the Northern Transportation Corridor may be negatively affected by sediment inputs from ore production, transport, and related activities. Overall, the residual effects of the Project on freshwater biota and habitat are predicted to be: • Adverse in direction; • Low in magnitude given planned mitigation and the small footprint effected relative to available habitat in the region; • Geographically confined to the LSA; • Infrequent effects are associated with the water withdrawals and continuous effects are associated with the habitat and water/sediment quantity and quality alterations; • Of a duration that will occur throughout the life of the Project; and • Reversible with mitigation and the cessation of Project activities. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to freshwater biota and habitat, there is a high level of confidence in the residual effects predictions.	Not significant	Not significant	No transboundary effects
Marine Environment VECs							
Marine Ice, Water, and Sediment Quality	• Marine ice • Marine water quality • Marine sediment quality	• Effects on marine ice • Effects on marine water quality • Effects on marine sediment quality	• Review and update the following plans: ○ Environmental Protection Plan; ○ Marine Environmental Effects Monitoring Plan; ○ Shipping and Marine Wildlife Management Plan; ○ Surface Water, Aquatic Ecosystems, and Fish and Fish Habitat Management Plan; ○ Fresh Water Supply, Sewage, and Wastewater Management Plan; ○ Emergency Response Plan; ○ Spill Contingency Plan; ○ Oil Pollution Emergency Plan; ○ Spill at Sea Response Plan; and ○ Plans required under the Type A Water Licence, which will be submitted to the NWB for review and approval, including: ▪ Aquatic Effects Monitoring Plan; and	Phase 2 Proposal components and activities at Milne Port and the Northern shipping route have the potential to interact with marine ice, water, and sediment quality through the construction and removal of the ore dock and other marine facilities; vessel traffic; ballast water discharge; wastewater and site water discharge and; ore dust from the stockpiles and ship loading. Overall, the residual effects of the Project on marine ice, water, and sediment quality are predicted to be: • Adverse in direction; • Low in magnitude that is low given planned mitigation; • Geographically confined to the LSA but extending to the RSA for a residual increase in TSS and metals in water as well as a residual increase in metals and change in physical composition in sediments due to dispersion and deposition of dust; • Frequent; • Of a duration that lasts for the life of the Project; and	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
			▪ Surface Water Sampling Program – Quality Assurance and Quality Control Plan. • Manage runoff, sewage, and wastewater discharges to comply with the effluent quality discharge limits specified in Type A Water Licence.	• Reversible with additional mitigation and the cessation of Project activities. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to marine ice, water, and sediment quality, there is a high level of confidence in the residual effects predictions.			
Marine Habitat and Biota	• Marine fish habitat • Arctic char	• Effects on marine fish habitat • Effects on Arctic char health and condition	• Implement the commitments listed above for the Marine Ice, Water, and Sediment Quality VEC. • Adhere to applicable DFO authorization and offsetting requirements (DFO, 2013b, 2016). • Obtain Project-specific <i>Fisheries Act</i> Authorization(s) from DFO, where required for in-water works, and comply with associated terms and conditions. • Develop an Offsetting Plan, which will be submitted to DFO for review and approval as part of the application for <i>Fisheries Act</i> Authorization, to offset the serious harm to fish associated with construction of the second ore dock at Milne Port. TSD 23 outlines a conceptual Marine Offsetting Plan. • Continue to implement existing plan for Aquatic Invasive Species Monitoring of Milne Inlet Marine Ecosystem.	• Phase 2 Proposal components and activities at Milne Port and Marine Shipping along the Northern shipping route have the potential to interact with marine biota and habitat through habitat loss/alteration, acoustic disturbances, and invasive species introduction. • Overall, the residual effect of the Project on marine habitat and biota is predicted to be: • Adverse in direction; • Low in magnitude given planned mitigation; • Of a duration that ranges from during construction (e.g., sediment resuspension) to extending beyond the life of the Project (e.g., introduction of aquatic invasive species); • Geographically confined to the LSA, apart from aquatic invasive species introduction; • Continuous, apart from sediment resuspension concerns during construction; and • Reversible with additional mitigation and the cessation of Project activities, apart from aquatic invasive species introduction. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to marine habitat and biota, there is a high level of confidence in the residual effects predictions.	Not significant	Not significant	Not significant
Marine Mammals	• Ringed seal • Walrus • Beluga whale • Narwhal • Bowhead whale • Polar bear	• Change in habitat • Acoustic disturbance effects • Hearing impairment effects • Auditory masking effects • Effects on risk of mortality	• Implement the commitments listed above for the Marine Ice, Water, and Sediment Quality VEC. • Review and update the following additional plans: ◦ Shipping and Marine Wildlife Management Plan; ◦ Polar Bear Safety Plan; and ◦ Biophysical Environmental Effects Monitoring Framework, Appendix 4 (Candidate Environmental Effects Monitoring Studies Marine Mammal). • Implement a ramp-up procedure for pile driving activities during construction and install a bubble curtain around the wetted pile to dampen sound transmission through water during active pile driving. • Engage a qualified and experienced Marine Mammal Observer (MMO) to undertake marine mammal monitoring, and	Phase 2 Proposal components and activities at Milne Port and the Northern shipping route have the potential to interact with marine mammal populations through ship strikes, acoustic disturbances, contaminant loading, and habitat loss. Overall, the residual effects of the Project on marine mammals are predicted to be: • Adverse in direction; • Low in magnitude given planned mitigation; • Geographically confined to the LSA; • Infrequent; • Of a duration that extends throughout the life of the Project; and • Reversible with additional mitigation and the cessation of Project activities. In consideration of the information available and the results of ongoing monitoring related to marine mammals, there is:	Not significant	Not significant	Not significant

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
			communicate all marine mammal sightings to the piling contractor, during all pile driving activities. • Reduce vessel speeds when transiting along the established shipping corridor and operating in Milne Port.	• A moderate to high level of confidence in the residual effects predictions related to a change in habitat; and • A moderate level of confidence in the residual effects predictions for all other residual effects on marine mammals. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to marine mammals, there is a high level of confidence in the residual effects predictions.			
Human Environment VSECs							
Population Demographics	• Demographic stability	• Change in in-migration of non-Inuit Project employees into the North Baffin LSA • Change in out-migration of Inuit residents from the North Baffin LSA	• Direct hire from within and outside the LSA.	While Inuit employment levels have the potential to increase over time, the overall magnitude of Inuit out-migration is not expected to change. Assessment outcomes for population demographics therefore remain the same as for the Approved Project. Potential residual effects arising from in-migration and out-migration are not expected to be sufficient to cause adverse effects on demographic stability of the affected communities. Overall, the residual effects of the Project on population demographics are predicted to be: • Adverse in direction; • Low to moderate in magnitude; • Occurring within point-of-hire communities; • Intermittent in frequency; • Long-term in duration; and • Reversible. There is a high probability of the residual effects occurring. In consideration of the information available and the results of ongoing monitoring related to community population demographics, there is: • A moderate level of confidence in the residual effects predictions related to the out-migration of Inuit residents from the North Baffin LSA; and • A high level of confidence in the residual effects predictions related to the in-migration of non-Inuit Project employees into the North Baffin LSA.	Not significant	Not significant	• No transboundary effects
Education and Training	• Life skills • Education and skills	• Improvement of life skills among LSA residents • Change in incentives related to school attendance and success • Change in opportunities to gain skills	• Review, update and implement Human Resources Plan. • Implement IIBA initiatives, and the Q-STEP training program	In general, the Phase 2 Proposal is expected to result in positive effects on education and training. These positive effects are anticipated to arise from access to industrial work supported by pre-employment preparation and on-the-job training. Overall, the residual effects of the Project on education and training are predicted to be: • Positive to mostly positive in direction; • Moderate to high in magnitude; • Occurring within point-of-hire communities; • Continuous in frequency;	Significant (positive)	Positive cumulative effects	• Positive transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				• Of a duration that extends throughout the life of the Project to long-term in duration; and • Non-reversible or spontaneous. The probability of the residual effects occurring is high. In consideration of the information available and the results of ongoing monitoring related to education and training, there is: • A moderate level of confidence in the residual effects predictions related to improved life skills among LSA residents; and • A high level of confidence in the residual effects predictions related to incentives for school attendance and success and opportunities to gain skills.			
Livelihood and Employment	• Wage employment • Job progression and career advancement	• Creation of jobs in the LSA • Change in employment of LSA residents • New career paths	• Review, update and implement Human Resources Plan. • Implement IIBA initiatives, and the Q-STEP training program. • Designate all LSA communities as points-of-hire.	In general, the Phase 2 Proposal is expected to result in positive effects on livelihood and employment. These positive effects are anticipated to arise from new employment opportunities, local hiring commitments, and career progression opportunities provided by the Project. Overall, the residual effects of the Project on livelihood and employment are predicted to be: • Positive in direction; • Moderate to high in magnitude; • Occurring within point-of-hire communities; • Continuous in frequency; • Medium-term to long-term in duration; and • Spontaneous. The probability of the residual effects occurring is high. In consideration of the information available and the results of ongoing monitoring related to livelihood and employment, there is: • A moderate level of confidence in the residual effects predictions related to employment of LSA residents and new career paths; and • A high level of confidence in the residual effects predictions related to creation of jobs in the LSA.	Significant (positive)	Positive cumulative effects	Positive transboundary effects
Economic Development and Self-reliance	• Land • People • Community economies • Territorial economy	Specific residual effects were not identified or assessed for this VSEC. Rather, overall assessments of the key indicators ‘land’, ‘people’, ‘community economy’, and ‘territorial economy’ were conducted and conclusions were drawn based on this integrated analysis.	• Review, update and implement Human Resources Plan. • Implement IIBA initiatives, and the Q-STEP training program. • Designate all LSA communities as points-of-hire.	No new residual effects will result from the Phase 2 Proposal, as no new impact pathways for economic development and self-reliance will be created. The Phase 2 Proposal will not introduce any new activities that change the previously assessed effects to economic development and self-reliance, although positive effects in some areas may be enhanced. Similar to previous assessments of the Approved Project, direct and indirect economic expansion associated with the Project will create new opportunities for employment and business across the RSA, and particularly within the LSA. The Project will also enhance labour force capacity and increase Inuit business capacity. Residual effects were not characterized for this VSEC because the assessment was integrative in nature, relying primarily on the conclusions of other VEC and VSEC	Significant (positive)	Positive cumulative effects	Positive transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				residual effect assessments to understand the Phase 2 Proposal’s interactions on economic development and self-reliance. The overall direction of the Phase 2 Proposal’s effects on the economic development and self-reliance VSEC has been assessed, with a high level of confidence, to be positive.			
Human Health and Well-being	- Well-being of children - Substance abuse - Community social stability	- Changes in parenting - Change in household income and food security - Change in transport of substances through Project sites - Change in affordability of substances - Change in attitudes toward substances and addictions - Effects of absence from the community during work rotation	- Continue to implement a no drugs/no alcohol policy on site with baggage searches for all employees and contractors arriving at site, access to an EFAP for workers and their family members, and contributions to the INPK community wellness fund. - Implement IIBA initiatives.	The nature of the activities associated with the Phase 2 Proposal are such that positive effects associated with the Approved Project will continue to be realized, and possibly enhanced. The Phase 2 Proposal is predicted to have a positive effect on parents gaining employment at the Project and an overall benefit by most children from the improved well-being their parents gain from having a good job, reduced financial stresses in the family, and improved food security. For a minority of children, challenges related to parental absence, the transition between parental comings and goings, changing parental expectations, and the response of parents to the stresses and concerns brought about by fly-in/fly-out employment are expected to lead to some adverse residual effects. The adverse residual effects of the Project on human health and well-being are predicted to be: - Low to moderate in magnitude; - Occurring within point-of-hire communities; - Intermittent to continuous in frequency; - Medium-term to long-term in duration; and - Spontaneous. The probability of the adverse residual effects occurring is high for: - Residual changes in parenting; and - Residual effects of absence from the community during work rotations The probability of the adverse residual effect occurring is moderate for a residual change in the transport of substances through Project sites. In consideration of the information available and the results of ongoing monitoring related to human health and well-being, there is: - A moderate level of confidence in the adverse residual effects predictions related to changes in parenting; and - A high level of confidence in the adverse residual effects predictions related to the transport of substances through Project sites and absence from the community during work rotations.	Not significant	Not significant	Not significant
Community Infrastructure and Public Services	Hamlet staff recruitment and retention in the North Baffin LSA	- Effects on competition for skilled workers - Change in labour force capacity	Monitor employee-specific information (e.g., through surveys, and employment and training records), Project-related community infrastructure use, and government statistics (e.g., on health centre usage).	The nature of the activities associated with the Phase 2 Proposal are such that positive effects associated with the Approved Project will continue to be realized, and possibly enhanced. The Phase 2 Proposal is predicted to have a positive effect on labour force capacity. However, an adverse residual effect on competition for skilled workers	Not significant (adverse); significant (positive)	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				is also predicted from the creation of competition with local employers. This adverse residual effect of the Project on community infrastructure and public services is predicted to be: • Moderate in magnitude; • Occurring within point-of-hire communities; • Intermittent in frequency; • Short-term in duration; and • Reversible. The probability of the residual effects occurring is high. In consideration of the information available and the results of ongoing monitoring related to community infrastructure and public services, there is a high level of confidence in the residual effects predictions.			
Contracting and Business Opportunities	• Business opportunities	• Expansion of market for business services to the Project • Expansion of market for consumer goods and services	• Monitor the value of procurement with Inuit-owned businesses and joint ventures, LSA employee payroll amounts, and the number of registered Inuit firms in the LSA.	The nature of the activities associated with the Phase 2 Proposal are such that positive effects associated with the Approved Project will continue to be realized, and possibly enhanced as Baffinland looks to expand its operations (e.g., through additional capital expenditure and contracting opportunities associated with the Phase 2 Proposal) and boost its local contracting efforts. Overall, the residual effects of the Project on contracting and business opportunities are predicted to be: • Positive in direction; • Moderate to high in magnitude; • Occurring within the LSA, RSA, and point-of-hire communities; • Continuous in frequency; • Medium-term in duration; and • Spontaneous. The probability of the residual effects occurring is high. In consideration of the information available and the results of ongoing monitoring related to contracting and business opportunities, there is a high level of confidence in the residual effects predictions.	Significant (positive)	Positive cumulative effects	Positive transboundary effects
Culture, Resources, and Land Use	• Cultural resources • Harvesting • Travel and camps	• Effects related to ground disturbance • Effects on caribou harvesting • Effects on marine mammal harvesting • Effects on safe travel within Pond Inlet, Eclipse Sound, Milne Inlet during open water • Sensory disturbance at camps • Effects on safe travel inland through Milne Port • Sensory disturbance and effects on safety along the Milne Inlet Tote Road • Effects on difficulty and safety relating to railway crossing	• Review, update, and implement Cultural Heritage Resource Protection Plan.	In general, the nature and magnitude of the effects to culture, resources and land use are consistent with the conclusions presented in the Approved Project. The Phase 2 Proposal will result in adverse effects associated with the culture, resource and land use VSEC related to the loss of cultural resources, change in access to or availability of harvesting resources, and change in access to travel corridors and camps. Overall, the residual effects of the Project on culture, resources, and land use are predicted to be: • Adverse in direction; • Low to moderate in magnitude; • Occurring generally within PDA and extending to areas that may experience additional noise and dust; • Infrequent, though in some cases continuous for effects related to access, throughout the life of the Project; and	Not significant	Not significant	No transboundary effects

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
				• Reversible in nature with the exception of potential ground disturbance effects on cultural resources. There is generally a high probability of the residual effects occurring, except for: • residual effects on marine mammal harvesting, which have a moderate probability of occurring; and • residual effects on caribou harvesting, which have a low probability of occurring. In consideration of the information available and the results of ongoing monitoring related to culture, resources, and land use, there is: • A high level of confidence in the residual effects predictions related to increased ground disturbance, sensory disturbance at camps, and difficulty and safety relating to railway crossing; and • A moderate level of confidence in the residual effects predictions for all other residual effects on culture, resources, and land use.			
Benefits, Royalty, and Taxation	• Benefits, royalties, and taxation	• Change in benefits, royalties, and taxation	• Implemen IIBA initiatives.	The Approved Project provides significant positive effects with respect to the benefits generated in Nunavut. The Phase 2 Proposal will provide an incremental increase to these already significant effects.	Significant (positive)	Positive cumulative effects	Positive transboundary effects
Governance and Leadership	• Governance and leadership	• Not applicable (assessed as subject of note)	• Implement IIBA initiatives.	In the FEIS, Governance and Leadership was addressed as a subject of note. The Phase 2 Proposal does not change the effects of the Project on Governance and Leadership. Since the FEIS, Baffinland and the QIA have negotiated an IIBA, a number of initiatives have been launched, and socio-economic monitoring has been ongoing. In line with the FEIS, the Project is considered to have a positive and significant effect on Governance and Leadership.	Significant (positive)	Positive cumulative effects	No transboundary effects
Assessment of Effects of the Environment on the Project and Accidents, Malfunctions, and Unplanned Events							
Effects of the Environment on the Project	• Geo-hazards • Extreme Weather Events • Global Climate Change	• Ground Stability • Slope Stability • Seismic Events • Extreme Temperatures • Extreme Precipitation and Flooding • High Winds and Waves • Storm Surges • Severe Fog or White-Outs • Increasing Temperatures • Reduced Sea Ice • Sea Level Changes • Increasing Precipitation • Increasing Active Layer Thickness	• Appropriate engineering design	Potential concerns are mitigated through the adoption of appropriate engineering design.	Not significant	Not applicable	Not applicable
Accidents, Malfunctions, and Unplanned Events	Accidents and malfunctions were assessed as part of the Approved Project, and a risk register was developed to identify the potential risks, the likelihood of the accidental event occurring, level of consequence associated with each accidental event, and applicable emergency response plans. The Phase 2 Proposal has not altered the risk register for the Project, apart from one accident scenario related to shipping					Not applicable	Not applicable

VEC/VSEC	Key Indicator	Potential Effect(s)	Mitigation, Monitoring, Environmental Management, and Follow-up	Characterization of Residual Effect(s)	Significance Rating	Cumulative Effects	Transboundary Effects
	during periods of ice break-up and ice formation. Overall, consequence and likelihood ratings have not changed from the Approved Project and the environmental effects of a spill in ice conditions would be no greater than, and often less than, those described in the Approved Project, and therefore the conclusions presented in the Approved Project remain unchanged for Phase 2 Proposal.						

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G.4 Ongoing Assessment of Predicted Residual Impacts

The Phase 2 Proposal presents up to date predictions for residual effects of the Project. Collection of information and data occurs on an annual basis under Baffinland's environmental monitoring programs and is used to assess current site conditions for comparison to initial predictions and assumptions from the Mary River EIS and Addendums. Results are reported annually to the NIRB and other relevant stakeholders (Section 2.5.2).

Revisions to existing predictions of residual impact assessments will be completed where significant variances are identified. Identification of significant variances includes the QA/QC; comparisons to the respective benchmark and to reference and/or baseline; and review of the data using various tools such as Exploratory Data Analysis (EDA) and Statistical Data Analysis (SDA), to determine if change is occurring. A change may be detected statistically or qualitatively, relative to benchmarks, baseline values and/or spatial or temporal trends. A change may be statistically significant, but professional judgement will also be applied using the various evaluation tools to detect a change qualitatively. If this analysis does not detect change, then no action is required. If a change is observed, then further evaluation of the data for that/those indicator(s) will be carried out to determine whether the observed change is Project-related. If the evaluation has indicated with some certainty that the measured change is Project-related, a determination of the action level associated with the observed monitoring results through comparisons to indicators or benchmarks will be conducted. As appropriate to the VEC in question, a determination of the action level associated with the observed monitoring results, and the appropriate response will align with any relevant management and monitoring programs.

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Appendix H

FEIS Freshwater Quality Predictions

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Effects to freshwater and sediment quality have been identified as an area of interest by QIA during its review of Baffinland's ICRP since 2015. This Appendix presents a summary of findings specifically for this VEC. Effects on the surface water and sediment quality VEC were assessed in accordance with the methodology outlined in FEIS Volume 2, Section 3.0. VEC-specific modifications were made to the general methodology, which are highlighted below. As part of the effects assessment completed for the Phase 2 Proposal, a review of existing effluent quality predictions was completed. The conclusion of this review was that the previous modelling was substantially representative of the effluent quality monitoring conducted at site to date (TSD 13, Phase 2 Proposal). It is worth noting that modelling efforts to assess seepage and runoff quality at the Waste Rock Facility are ongoing as part of an updated 1-5 Year Waste Rock Management Plan which will be submitted in December 2019.

Water and Sediment Quality

Assessment Methods and Criteria

The following basic EA steps were undertaken during the assessment:

- Regional and local study areas were determined.
- VECs, Key Indicators and Thresholds were identified.
- Project activities that could affect surface water and sediment quality were identified.
- Project interactions with, and effects on, the surface water and sediment quality VEC were identified.
- Linkage evaluations were performed outlining potential effects related to various phases of the Project (Construction, Operation, and Closure) and Project LSAs (Milne Port, Milne Inlet Tote Road, Mine Site, Railway Alignment, and Steensby Port).
- Mitigation measures were identified to avoid or reduce the potential effects during the various phases of the Project.
- Residual effects and their relative significance were identified for the surface water and sediment quality VECs.
- Long-term monitoring programs were identified to distinguish Project-related impacts from natural variability, in order to verify impact assessment predictions and to meet compliance/conformance criteria.

Key Indicators and Thresholds

For the assessment of potential effects on the surface water and sediment quality VEC a list of key indicators that were considered to be the most relevant and important elements of the VEC was assembled. The key indicators fall into four categories:

1) General Parameters

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- 2) Metals
- 3) Nutrients
- 4) Petroleum Hydrocarbons

Thresholds were identified representing a level of change where adverse effects may be expected to occur. In the case of water and sediment quality, it is important to note that the thresholds do not relate to water or sediment quality in itself, but rather to known effects on aquatic receptors that rely on water and sediment to exist.

The thresholds used in this assessment were derived from the following sources, which are relevant in the context of this environmental effects assessment:

- Schedule 4 of the Metal and Diamond Mining Effluent Regulation under the Federal *Fisheries Act*.
- CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (PAL) (2003).
- Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) identified in the CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (2003).

The CCME PAL thresholds are typically the most stringent; hence these values were generally selected for application.

Local waters around the Project sites have not historically been used for drinking, although the Project uses and will use local waters for potable water supply, and it is conceivable that Inuit travelling over the land could also drink any of the local water. Therefore, Health Canada's Canadian Drinking Water Guidelines (2004) have been used for comparison purposes.

To fill gaps for those key indicators that have no thresholds identified in the sources listed above, two secondary sources were adopted:

- BC Ministry of Environment (MOE) Approved and Working Water Quality Guidelines and Alert Levels.
- Criteria Continuous Concentration (Chronic) National Recommended Water Quality Criteria, USEPA (2006).

The relationships between potential surface water and sediment quality effects, key indicators and thresholds are summarized in Table H.1.

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Table H.1: Key Indicators and Thresholds for Water and Sediment Quality

Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		MMER ¹	CWQG (PAL) ²	CDWQG ³	NWB ⁴
Water Quality from Mine Contact Water and Site Runoff	TSS (mg/L)	15	+5		35
	pH (pH unit)	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5 ¹¹	6.0 - 9.5
	Hardness CaCO ₃ (mg/L)				
	Alkalinity CaCO ₃ (mg/L)				
	Chloride (mg/L)		640 (Short-term) 120 (Long-term)	250 ¹²	
	Sulphate SO ₄ (mg/L)			500 ¹²	
	Ammonia N (total) (mg/L)		Varies ⁵		
	Ammonia N (un-ionized) (mg/L)		0.019		
	Nitrate N (mg/L)		13	10	
	Nitrite N (mg/L)		0.06	3.2	
	Total P (mg/L)		see Table 7-3.4 (FEIS Volume 7)		
	Total Aluminum (mg/L)		0.005 - 0.1 ⁶ (0.94) ⁷	0.1	
	Total Antimony (mg/L)			0.006	
	Total Arsenic (mg/L)	0.5	0.005	0.01	
	Total Barium (mg/L)			1	
	Total Beryllium (mg/L)		0.0053 ⁸		
	Total Boron (mg/L)		29 (Short-term) 1.50 (Long-term)		
	Total Cadmium (mg/L)		0.000029 ⁸	0.005	
	Total Chromium (mg/L)		0.0047 ⁷	0.05	
	Trivalent Chromium (mg/L)		0.001		
	Hexavalent Chromium (mg/L)		0.0089		
	Total Cobalt (mg/L)				
	Total Copper (mg/L)	0.3	0.00467 ⁷	1.0 ¹²	
	Total Cyanide (mg/L)	1.0	0.005 (as free CN)	0.2	
	Total Iron (mg/L)		1.2 ⁷	0.3 ¹²	
	Total Lead (mg/L)	0.2	0.001 ⁹	0.01	
	Total Manganese (mg/L)			0.05 ¹²	
	Total Mercury (mg/L)		0.000026	0.001	
	Total Molybdenum (mg/L)		0.073		
	Total Nickel (mg/L)	0.5	0.083 ¹⁰		
	Total Selenium (mg/L)		0.001	0.01	
	Total Silver (mg/L)		0.0001		
	Total Thallium (mg/L)		0.0008		
	Total Uranium (mg/L)		0.015	0.02	
	Total Vanadium (mg/L)		0.006 ¹¹		
	Total Zinc (mg/L)	0.5	0.03	5.0	
	1-2 Propylene Glycol		500 (interim)		
	Benzene (µg/L)		370		

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Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		MMER ¹	CWQG (PAL) ²	CDWQG ³	NWB ⁴
Water Quality from Fuel Contact	Toluene (µg/L)		2		
	Ethyl benzene (µg/L)		90		
	Lead (µg/L)		1		
	Oil and Grease (µg/L)		15,000		
Water Quality from Discharge of Sewage	BOD ₅ (mg/L)				30
	Fecal Coliform (CFU/100mL)				1,000
Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		ISQG ¹⁴	PEL ¹⁴		
Sediment Quality	Arsenic (mg/kg)	5.9	17		
	Cadmium (mg/kg)	0.6	3.5		
	Chromium (mg/kg)	37.3	90		
	Copper (mg/kg)	35.7	197		
	Lead (mg/kg)	35.0	91.3		
	Mercury (mg/kg)	1.7	4.86		
	Zinc (mg/kg)	123	315		

NOTE(S):

1. MEAN MONTHLY MAXIMUM AVERAGES IN SCHEDULE 4 OF THE METAL AND DIAMOND MINING EFFLUENT REGULATION UNDER THE FEDERAL *FISHERIES ACT*.
2. CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (PAL) (2011).
3. HEALTH CANADA GUIDELINES FOR CANADIAN DRINKING WATER QUALITY SUMMARY TABLE (2010).
4. NUNAVUT WATER BOARD WASTEWATER CRITERIA.
5. VARIES WITH TEMPERATURE AND PH.
6. VARIES WITH PH; AT PH <6.5 CRITERION IS 0.005 MG/L; AT PH >6.5 CRITERION IS 0.1 MG/L.
7. SITE SPECIFIC CRITERION DEVELOPED FOR THE MARY RIVER MINE SITE AREA (KNIGHT PIÉSOLD, 2011)
8. VARIES WITH HARDNESS $[Cd] = 10^{0.86[\log_{10}(\text{hardness})] - 3.2} \mu\text{g/L}$. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE CADMIUM CRITERION WOULD BE 0.000029 MG/L.
9. VARIES WITH HARDNESS. $[Pb] = e^{1.273[\ln(\text{hardness})] - 4.705} \mu\text{g/L}$. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE LEAD CRITERION WOULD BE 0.00255 MG/L.
10. VARIES WITH HARDNESS. $[Ni] = e^{1.273[\ln(\text{hardness})] - 4.705} \mu\text{g/L}$. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE NICKEL CRITERION WOULD BE 0.083 MG/L.
11. BC MOE APPROVED AND WORKING WATER QUALITY GUIDELINES.
12. AESTHETIC OBJECTIVE.
13. PROPOSED GUIDELINE.
14. INTERIM SEDIMENT QUALITY GUIDELINES (ISQG) AND PROBABLE EFFECTS LEVEL (PEL) IDENTIFIED IN THE CCME CANADIAN SEDIMENT QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (2003).

The thresholds identified in Table H.1 were applied in the effects assessment in the following manner:

- MDMER Schedule 4 thresholds were applied as ‘end of pipe’ criteria for mine contact water discharge.
- CCME PAL (or site-specific water quality objectives) were applied as receiving environment criteria for all sources.

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- NWB were applied as 'end of pipe' criteria for wastewater (sewage effluent) discharge.

A number of key parameters are naturally elevated in surface waters around the Mine Site, and as such, site specific water quality objectives (SSWQOs) were developed for the following parameters using CCME (1993) background concentration procedure (Knight Piésold, 2011):

- Aluminum
- Chromium
- Copper
- Iron

The developed SSWQOs are summarized in Table H.1 above. It was not appropriate to develop site specific criteria for Uranium or Selenium as explained in FEIS Appendix 7B-2.

Key Issues and Pathways

Key issues which were assessed for the surface water and sediment quality VEC included:

- Pit water quality from the Mine Site LSA
- Surface runoff from Project roads in the five freshwater LSAs
- Discharges from Project WWTFs from the five freshwater LSAs
- Acid Rock Drainage (ARD) and Metal Leaching (ML) resulting from waste rock piles, ore stockpiles, open pit dewatering, construction fills, embankment of roads and railway, and open quarries in the five freshwater LSAs
- Nutrient input from blasting activities and chemical leaching from rail sleeper coatings in the five freshwater LSAs
- Suspended sediment due to construction of mine facilities, Milne Inlet Tote Road, the railway and associated water crossings
- Runoff at fuel storage facilities, including fuel spills and malfunctions from the five freshwater LSAs
- Effects from waste management activities including storage, handling and landfilling of waste, landfarming of contaminated ice/snow/soil, the management of historically contaminated material, and sewage effluent discharges in the five freshwater LSAs
- Effects from construction and operation of camps in the five freshwater LSAs
- Effects from erosion and sediment transport due to vegetation removal, cuts/fills and other disturbances in the five freshwater LSAs
- Effects from dust deposition in the five freshwater LSAs

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- Effects from drilling water withdrawals and returns in the Mine Site LSA

An account of key issues, indicators, and Project locations and phases that were incorporated in the effects assessment is provided in Table H.2.

Table H.2: Key Issues for Water and Sediment Quality

Key Issue	Indicators	Project Location (LSA)	Project Phase
Ground Preparation, Earthworks, Road and Railway construction	pH, TSS, Metals and Nutrients	All	Construction and Closure
Site Water Management	pH, TSS, Metals, Nutrients and Petroleum Hydrocarbons	Milne Inlet LSA Northern Transportation Corridor LSA Mine Site LSA Rail Alignment LSA	Construction, Operation and Closure
Laydown Areas	pH, TSS, and Metals	All	Construction and Closure
Airstrips and Airstrip Use	TSS and Petroleum Hydrocarbons	All	Construction, Operation, Closure
Mine Contact Water - Waste Rock Stockpile	pH, TSS, Metals and Nutrients	Mine Site LSA	Operation, Closure and Post Closure
Mine Contact Water - Open Pit and Run of Mine Stockpile	pH, TSS, Metals and Nutrients	Mine Site LSA	Operation, Closure and Post Closure

Residual Effects Rating Criteria

Residual effects are those effects that persist after mitigation has been applied to potential effects. Each Project-related residual effect was rated using the standard criteria described in FEIS Volume 2.0 and the VEC-specific criteria identified in Table H.3.

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Table H.3: Significance Ratings for Evaluating Residual Water and Sediment Quality Effects

Criteria	Classification	
<u>Magnitude</u>	Negligible	Concentrations of indicator(s) predicted to be less than threshold value(s)
	Level I	Concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s) (1 to 10x the threshold)
	Level II	Concentrations of Indicators predicted to be exceed threshold value(s) by an order of magnitude or greater (10 to 100x the threshold)
	Level III	Concentrations of Indicators predicted to be exceed threshold value(s) by more than two orders of magnitude (greater than 100x the threshold)
<u>Extent</u> The physical extent of the effect, relative to study area boundaries	Level I	Confined to the LSA
	Level II	Beyond the LSA and within the RSA
	Level III	Beyond the RSA
<u>Duration</u> The length of time over which a Project effect will occur	Level I	Short-term (effect lasts for up to 4 years)
	Level II	Medium-term (up to 25 years, for the life of the Project)
	Level III	Long-term (beyond the life of the Project) or permanent
<u>Frequency</u> How often the effect occurs	Level I	Infrequent – rarely occurring
	Level II	Intermittent – occasionally occurring
	Level III	Continuous
<u>Reversibility</u> The likelihood of the VEC to recover from the effect	Level I	Fully reversible after activity is complete
	Level II	Partially reversible after activity is complete
	Level III	Non-reversible after activity is complete

Of the five rating criteria used in rating residual effects, magnitude is heavily weighted when determining the significance of the residual effect and is also the criterion that requires the most interpretation. Since the main receptor affected by changes in water quality is aquatic life, magnitude ratings were established based on aquatics-related thresholds, as summarized in Table H.1.

Receiving water quality objectives (WQOs) have been established for the Protection of Freshwater Aquatic Life (CCME PAL). If receiving waters meet the selected Water Quality Objectives (CCME PAL or SSWQOs) with a discharge, this is deemed a Negligible effect to freshwater biota and hence to water and sediment quality. Level I, II and III magnitude effects are related to the relative level of exceedance of any WQOs.

The potential effects associated with discharge of mine contact water into the natural environment are well understood and have led to the enactment of the MDMER under the *Fisheries Act*. The following parameters, identified in Schedule 4 of the MDMER, are regulated by point-of-discharge concentrations:

- Arsenic
- Copper

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- Cyanide
- Lead
- Nickel
- Zinc
- TSS
- Radium

These parameters have been regulated due to potential deleterious effects on fish and other biota in the receiving environment. Mine contact waters may be authorized for discharge under the MDMER of the *Fisheries Act*, provided the effluents at the point of discharge meet the MDMER Schedule 4 criteria and pass regular testing for acute lethality and chronic toxicity.

Baseline Characterization

Using the baseline data as a frame of reference, the following methods were applied to aqueous non-point source emissions, aqueous point source emissions and airborne emissions.

Aqueous Non-Point Source Emissions

Infrastructure and activities that were widespread or had non-point source emissions, were assessed in a qualitative manner on a Project-wide basis rather than assessing residual effects for each individual water body. To identify potential sensitivity to the particular indicators and to add context to the rating, general water quality parameters determined for the Sample Group and/or the LSA were considered. The description of the general water quality characteristics for Sample Groups (rivers/streams and lakes) is provided in FEIS, Volume 7, Tables 7-3.5 and 7-3.7.

Given the uncertainty regarding the potential contaminant source, distribution, and location that would be required to complete a quantitative assessment, a qualitative assessment was undertaken applying conservative assumptions. Examples of residual effects associated with aqueous non-point source emissions included increased TSS due to erosion and sediment transport, ML/ARD from various earth materials, nutrient additions from blasting, and petroleum hydrocarbon constituents from accidental spills.

The majority of meltwater and precipitation in the Project area occurs between June and September, the open-water period for streams and rivers. Consequently, erosion and sediment transport, nutrient and metals transport, and petroleum hydrocarbon mobilization are likely to occur in this period, when receiving waterbodies are at their maximum flows and have increased capacity to buffer these inputs.

Where residual effects were considered likely and there was a lack of reliable data available to quantify the contaminant source, a conservative approach was employed by assuming that the concentration of

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the key indicator(s) for that particular effect would exceed the respective threshold(s) (Table 7-3.8, FEIS, Volume 7), resulting in a Level II magnitude effect. For these cases, it was further assumed that the magnitude could be maintained below a Level III effect (i.e., less than an order of magnitude greater than the threshold) by identifying the occurrence of the effect through environmental monitoring and responding appropriately under an adaptive management framework.

A conservative approach was also applied to assumptions regarding the effectiveness of mitigation measures, in recognition that there may be limitations associated with implementation and effectiveness, given the extreme climatic conditions in the Project area. Following that logic, where qualitative assessment was employed, a magnitude of Level I was only attributed to a residual effect when there was a high Level of Certainty that mitigation would be fully implemented and effective. All instances where the effectiveness of the mitigation was in question resulted in a magnitude rating of Level II.

Aqueous Point Source Emissions

For Project infrastructure and activities that generate point-source emissions with the potential to affect a specific receiving waterbody, the residual effects assessment focused on those particular locations, where adequate baseline data were available.

For point source mine contact water discharges, source terms of runoff water quality were obtained from geochemical testing (AMEC, 2012b) to compare effluent water quality to MDMER criteria, and to evaluate the resultant water quality in receiving waters compared to CCME PAL Guidelines. As a mitigation measure to maximize mixing, and to minimize changes in the natural flow regimes, discharges of mine contact waters will be carried out following the natural hydrograph. The Camp Lake tributary at MR-12 and the Mary River are gauged during the open water season, which will allow for real-time monitoring of flows and regulation of releases.

A mass balance approach was used, mixing annualized discharge flows with the annualized receiving flow at the nearest downstream location inhabited by fish. The mass balance model is shown below:

$$C_{Res} = \frac{(C_D \times Q_D) + (C_R \times Q_R)}{Q_{Res}}$$

Where:

C_D = indicator concentration in discharge (mg/L)

Q_D = volume of effluent discharged annually (m³/year)

C_R = indicator concentration in receiving waterbody (mg/L)

Q_R = volume of water in the receiving waterbody annually (m³/year)

C_{Res} = resulting (mixed) indicator concentration (mg/L)

Q_{Res} = volume of resulting (mixed) waterbody annually (m³/year)

The model assumes near-instantaneous mixing in riverine environments due to the discharge to receiving flow ratio, and no modification of indicators due to precipitation, speciation, attenuation or degradation.

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Modelling was carried out using both mean and 90th percentile baseline concentrations, and under both mean and low flow (7Q10) conditions.

Mixing Assumptions

While the water quality model used above assumes instantaneous mixing, in reality Initial Dilution Zones (IDZs) will exist at each discharge. The specifics for each discharge location are discussed below.

- West Waste Rock Stormwater Pond – Stormwater will be discharged to a natural drainage (L1) that is fishless until about 100 m before the drainage discharges into a main tributary of Camp Lake (tributary L0). The receiving water is the lower reach of L0 below the falls that provide the fish barrier. Stormwater will be mixed with the natural waters in the drainage L1, and although discharge flows are greater than natural flows, it is expected that this mixing will effectively occur over the approximate 1.5 km length to where the water flows over the falls and subsequently into tributary L0, receiving further dilution.
- East Waste Rock Stormwater Pond – Stormwater will be discharged to a natural drainage (F0) that is fishless until the F0 drainage discharges into the Mary River. Stormwater will be mixed with the natural waters in the drainage F0, and although discharge flows are similar to the natural flows, it is expected that this mixing will effectively occur over the approximate 2,500 m section to where the water flows over the falls. F0 then discharges into the Mary River at a point where the flows are highly turbulent, and therefore further mixing is expected to be nearly instantaneous.
- ROM Stockpile Stormwater Pond and Ore Stockpile Stormwater Pond –These discharges will be directly to the Mary River, but at distinct locations separated by approximately 1,500 m of river. IDZs will exist downstream of each discharge. Because of the volume and turbulent nature of flows in the Mary River, the IDZs will be confined to 20 to 30 m in length.

Source Terms – Waste Rock

Mine contact water from the Waste Rock Stockpiles at the Mine Site will be collected in stormwater ponds prior to discharge. Stormwater runoff water quality (source terms) from Waste Rock Stockpiles were derived by preparing a mass loading model using laboratory derived reaction data and the anticipated site conditions. The ponds will be designed with holding capacities that act to moderate water quality. During mining, when the waste rock pile is under development, stormwater will require retention to settle out solids. The water quality modelling by AMEC (2012a) suggests that if suspended solids are properly managed, the quality of discharge will meet MDMER requirements. While water treatment is not expected to be required, treatment options will be available as a contingency measure. As a conservative measure, maximum waste rock runoff quality estimates were used in the assessment.

For a number of parameters sampled in the humidity cell tests, metals were measured at or below the analytical method detection limit (MDL) for a large proportion of samples. Generally the MDLs are high

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relative to the selected water quality objectives (CCME PAL or SSWQOs). For these parameters, the values assigned were set at one-half the MDL (AMEC, 2012a). The 90th percentile calculated source term was influenced by predicted water quality results based largely on the non-detect results in the humidity cells for the following metals: mercury (Hg), selenium (Se), copper (Cu), arsenic (As), cadmium (Cd), chromium (Cr), silver (Ag) and thallium (Tl). Consequently, the modelled water quality for these parameters is highly conservative.

A similar issue with detection limits was identified in the baseline water quality dataset. The majority of sample results for several metals were reported as non-detect (measured below the MDL). In the baseline dataset, non-detect samples were conservatively set at the MDL. This contributed to overly conservative modelling results; i.e., when the majority of results were reported at the detection limit, the calculated values were close to or even exceeded the Water Quality Objective (WQO).

Two notable parameters, mercury and selenium, were calculated to exceed the respective WQO because of the high proportion of non-detects in both the baseline receiving waters and in the humidity cell testing.

	Mercury	Selenium
WQO (CCME PAL) (mg/L)	0.000026	0.001
90 th Percentile Baseline Concentration (mg/L)	0.0001	0.0001
% of Detects in Baseline (Measured above MDL)	2 %	2 %
Calculated Source Term (mg/L) (west discharge / east discharge)	0.004 / 0.003	0.047 / 0.038
Humidity cell testing MDL (mg/L)	0.001	0.001

As a consequence mercury and selenium are predicted to reach Level II magnitude in the assessments.

During the technical review of the DEIS, the Qikiqtani Inuit Association expressed concern over the potential for nitrates to be elevated in the waste rock stormwater runoff, due to the quantities of ammonium nitrate fuel oil (ANFO) explosives that will be used in mining.

Ammonia releases have been associated with the use of certain explosives at mining and quarrying operations. The use of ammonium nitrate and fuel oil (ANFO) explosive could cause elevated nitrates in waste rock and mine run-off. Ammonia can occur as un-ionized (NH₃) or ionized (NH₄⁺) ammonium ion species. Total ammonia is a measure of both un-ionized and ammonium ion species. The un-ionized is more toxic to aquatic life than the ionized species. Consequently, mining companies have taken a number of initiatives to address this issue. For example, Diavik Diamond Mines Inc has investigated the use, loss and mitigation measures to address nitrate losses, and as a result, has developed and implemented at its site several iterations of an Ammonia Management Plan (Diavik Diamond Mines: Ammonia Management Plan).

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Annual explosive use for blasting waste rock and ore is estimated to range from 15,700 tonnes to 18,200 tonnes per annum depending on the year. FEIS Volume 3, Appendix 3B, Attachment 8, Section 2.6 states that the emulsion:AN ratio used for the Project is 70:30. The use of emulsion improves the bulk strength of the explosive and allows efficient rock breakage. The emulsion product also reduces ANFO solubility. Modeling by other companies concludes that ammonia releases can be reduced if proper controls are not implemented. The Explosives Management Plan (FEIS Volume 3, Appendix 3B, attachment 8) and FEIS Volume 10 Section 4.3.3 outline the mitigation measures that will be taken to control the nitrate concentrations entering the receiving environment.

Commercial ammonia reduction technologies, if required, include biological treatment, air stripping, ion exchange, reverse osmosis and breakpoint chlorination. Non-commercial technologies that may have future applications include aerated lagoons, constructed wetlands, land treatment and natural treatment in ponds. (Table 5, Annex C of the Diavik Diamond Mines Ammonia Management Plans), describes for each technology an ammonia reduction estimate, the environmental effect, an evaluation of technology feasibility, capital cost and operating time frames.

Source Terms –Pit Water Quality

Preliminary estimates of pit water quality were made using a similar mass loading approach to that for the waste rock drainage quality (AMEC 2012b). Equilibrated estimates of pit water quality are presented in Table H.4. It is expected that the effluent quality during mine operations will meet MDMER requirements for metals. It is possible that, during the latter portion of the mine, pH may decrease below the lower limit of the MDMER (pH 6.0). The estimated water quality derived for the pit drainage includes allowance for acidic drainage from exposed potentially acid generating (PAG) rock toward the end of mine life. The quantity of this exposed rock and the data used in deriving this drainage quality is the subject of additional study.

It has therefore been assumed that pH adjustment of the pit water will be required in the second half of mine life and into post-Closure. During Operations, pH adjustment will most likely be carried out inside the pit before the water is pumped to the East Waste Rock Pond. Again, humidity cell testing is expected to over-estimate the runoff quality. These modelling results are very conservative and will be reviewed once data are available from recently initiated neutralizing potential-depleted humidity cell testing. This will improve confidence in drainage water quality and pH.

Although the pit water quality source term for the latter part of mine life is beyond the MDMER range for pH and may require minor pH adjustment, the source terms (assuming no treatment) have been applied in the water quality modelling as a conservative measure.

The EEM program under MDMER is specifically designed for this type of situation and is a well-designed monitoring tool. It is a tiered program, meaning that the results of monitoring are used in the design of

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subsequent monitoring, and results also serve to identify the need for corrective action (Dumaresq *et al.* 2002).

Source Terms – Ore Runoff

Mine contact water from the ROM stockpile and the main ore stockpile at the Mine Site will be collected in stormwater ponds prior to discharge to the Mary River. Source terms were derived by calculating the 90th percentile concentrations from sampling carried out by Baffinland in 2010 from lysimeters installed in an ore stockpile generated at the site during the bulk sampling program in 2008. No runoff has been collected since then due to especially dry conditions during the 2011 field season. The runoff data, while limited, are considered conservative in that they represent runoff collected after the stockpile had been sitting dormant for two years; in reality the turnover in the ore stockpiles will be rapid and therefore the contact time between water and the ore will be limited. It has also been identified that non-representative manganese-rich ore may be a component of the lysimeter samples, since this ore was used in construction of the crusher pads where the lysimeters were located. Therefore, lysimeter results may be influenced by drainage from atypical ore.

Runoff from the ore stockpiles is not expected to require treatment beyond settlement of suspended solids in the stormwater pond. Nevertheless, treatment has been identified as a potential contingency measure that can be implemented if monitoring program results indicate that the water quality does not meet discharge criteria. More detail on contingency treatment options for mine contact water is provided in Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031).

Table H.4: Predicted Pit Water Quality

Parameters	MDMER Limits	Year 6	Year 10	Year 15	Year 21
pH	6 – 9.5	6.5	6.5	5.1	4.2
Sulphate (mg/L)		77	80	88	158
Arsenic (mg/L)	0.5	0.006	0.006	0.006	0.007
Copper (mg/L)	0.3	0.007	0.008	0.016	0.074
Lead (mg/L)	0.2	0.0005	0.0005	0.0007	0.0022
Nickel (mg/L)	0.5	0.004	0.005	0.018	0.11
Zinc (mg/L)	0.5	0.030	0.031	0.035	0.062
Aluminum (mg/L)		0.24	0.24	0.77	4.2
Antimony (mg/L)		0.007	0.007	0.007	0.008
Boron (mg/L)		0.060	0.062	0.067	0.11
Cadmium (mg/L)		0.00005	0.00005	0.00006	0.00016
Chromium (mg/L)		0.007	0.007	0.008	0.019
Cobalt (mg/L)		0.002	0.002	0.008	0.053
Iron (mg/L)		<0.002	<0.002	0.031	0.22

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Parameters	MDMER Limits	Year 6	Year 10	Year 15	Year 21
Manganese (mg/L)		0.0001	0.0001	0.10	0.57
Mercury (mg/L)		0.0013	0.0014	0.0014	0.0016
Molybdenum (mg/L)		0.023	0.024	0.024	0.027
Selenium (mg/L)		0.015	0.016	0.016	0.022
Silver (mg/L)		0.0002	0.0002	0.0002	0.0008
Thallium (mg/L)		0.0007	0.0007	0.0007	0.0009
Vanadium (mg/L)		0.0024	0.0025	0.0025	0.0029
Barium (mg/L)		0.022	0.023	0.024	0.034
Sodium (mg/L)		1.0	1.0	1.1	1.8
Potassium (mg/L)		29.2	30.1	30.2	34.9
Calcium (mg/L)		36.0	37.2	37.4	43.4
Magnesium (mg/L)		20.2	20.8	22.9	40.0
Notes: 1. Equilibrated concentrations, which assume equilibrium with amorphous Al(OH) ₃ , ferrihydrite and manganite where estimated concentrations exceed saturation indices for those phases.					

Significance Determination

The potential to result in significant adverse environmental effects was determined for each residual effect, based on professional judgment of the combination of residual effect ratings for each potential effect and taking into account the environmental context and the Level of Confidence associated with each rating.

Residual Effects Assessment

This Section presents potential effects, mitigation measures and the residual effects assessment for two categories:

- Aqueous Non-Point Source Emissions;
- Aqueous Point Source Emissions.

Aqueous Non-Point Source Emissions

Potential effects on surface water and sediment quality associated with aqueous non-point source emissions (key issues) identified in Table H.2 are described below. These emissions are common where activities take place near water bodies and may affect watercourses throughout the Project area. Locations of infrastructure and activities are described for each LSA.

Table H.5 summarizes the ratings assigned to the significance criteria of residual effects associated with each effect discussed below.

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Prediction Confidence

The significance rating and confidence level assigned to the predictions of significance for aqueous non-point source discharge effects to water and sediment quality are summarized in Table H.5.

Ground Preparation and Earthworks - Impact Statement SWSQ-1

Impact Statement SWSQ-1: Project-related ground preparation and earthworks may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Ground preparation and earthworks are essential prerequisites during the Construction and Closure phase in all five freshwater LSAs. The areas requiring earthworks notably include the following:

- Developing each of the key areas (Milne Port, Mine Site and Steensby Port) including the construction and reclamation of buildings, laydown areas, access roads and other site infrastructure;
- Minor improvements to the roadbed of the Milne Inlet Tote Road; and
- Railway construction, including the construction access road.

Typical ground preparation activities include vegetation removal and stripping, resulting in ground surface conditions that are prone to potential erosion and liberation of potential contaminants of concern; this may have an effect on surface water quality through changes in pH or the introduction of TSS, petroleum hydrocarbons and/or nutrients. Left unmitigated, direct effects may be observed in surface water quality. By implementing standard best management practices (BMPs) during ground preparation activities, water quality effects can be avoided or reduced to the point where only incidental, minor to moderate adverse short-term effects are anticipated. As required, the following mitigation measures will be applied:

- Minimize the footprint of disturbance;
- Schedule ground preparation to maintain adequate ground cover during periods of expected rainfall;
- Install and maintain water management features, designed to segregate and prevent co-mingling of offsite water and onsite water;
- Install and maintain adequately designed erosion control features;
- Install and maintain adequately designed sediment transport control features;
- Capture and treat potentially contaminated site run-off to applicable water quality standards prior to discharging to the receiving environment; and
- Erosion control measures.

Following the ground preparation activities, earthworks (earth moving, excavation, grading, cut/fill and backfilling) are required for development of components during Construction and reclamation of components during Closure.

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The disturbance, exposure, transportation and relocation of earth materials can potentially affect surface water quality in receiving bodies adjacent to these work areas. Left unmitigated, direct effects may be observed in surface water quality including changes in pH, introduction of TSS, petroleum hydrocarbons, and/or nutrients. By implementing standard BMPs described above, water quality impacts can be avoided or reduced to the point where only minor to moderate short-term adverse effects are anticipated.

In the event that existing contamination is suspected or encountered during earthwork activities, the Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011) will be used as a guideline for containment, testing, removal, treatment and disposal of contaminated media.

Soil spoils will be re-used nearby as general fill (if suitable), stored for reclamation purposes and/or disposed of in roadside borrows. Borrows will be contoured to provide stable side slopes and restore natural drainage.

Temporary roads will be decommissioned and restored through scarification as soon as practical to reduce the risk of potential effects of erosion and sediment transport. Culverts and bridges will be removed to restore pre-disturbance drainage patterns.

The Southern railway alignment and train-related infrastructure are described and illustrated in FEIS Volume3. Completion of the rail line will incorporate ground preparation and earthworks, a temporary access road, rail bed construction and rail sleeper installation. The entire rail line consists of new construction through previously unaltered landscape; therefore, potential effects on water and sediment quality are anticipated.

Rail line construction activities with the potential to affect surface water and sediment quality include culvert installation, bridge construction, infilling of right-of-way through watercourses (encroachment), rail bed construction, grading, and water management.

Standard BMPs will be employed to address potential effects during Construction and Closure. The rail bed, rail line and associated features will be designed and installed so as to avoid contamination of surface waters. Specifically, all structures will be designed, constructed and operated in compliance with *Fisheries Act* authorizations designed to protect water quality as an integral component of fish habitat. Adherence to the conditions of the *Fisheries Act* Authorizations and standard BMPs are anticipated to result in minor adverse residual effects.

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Table H.5: Effects Assessment Summary - Aqueous Non-Point Source Emissions

Effect		Residual Effect Evaluation Criteria					Significance
Effect	Direction & Nature of Effect	Magnitude / Complexity	Geographical Extent	Frequency	Duration	Reversibility	Rated Significance of Residual Effect
SWSQ-1 Ground preparation & earthworks	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level II: will occur for the operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-2 Site Water Management	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level I: will occur mainly during the construction phase	Level II: effect is partially reversible with cost/effort	Not Significant
SWSQ-3 Laydown Areas	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level I: will occur mainly during the construction phase	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-4 Explosives	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level II: will occur for the operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-5 Quarries and Borrow Areas	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level I: will occur mainly during the construction phase	Level I: effect is reversible after activity is complete	Not Significant

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Effect		Residual Effect Evaluation Criteria					Significance
Effect	Direction & Nature of Effect	Magnitude / Complexity	Geographical Extent	Frequency	Duration	Reversibility	Rated Significance of Residual Effect
SWSQ-7 Camps and Fuel Management	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level I: Effect is expected to be less than threshold values	Level I: confined to the LSA	Level II: will occur intermittently	Level II: will occur for the operation phase (life of the Project)	Level II: effect is partially reversible with cost/effort	Not Significant
SWSQ-8 Water Use and Management	Negative Water quality (pH, TSS, metals, nutrients and hydrocarbons)	Level I: Effect is expected to be less than threshold values	Level I: confined to the LSA	Level III: continuous	Level II: will occur for the operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-9 Airstrips and Airstrip Use	Negative TSS and Petroleum Hydrocarbons	Level II: Effect is expected to result in a change greater than threshold value(s)	Level I: confined to the LSA	Level I: infrequent	Level III: will occur beyond the life of the Project	Level I: effect is reversible after activity is complete	Not Significant

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Table H.6: Significance of Residual Effects from Non-Point Source Discharges

Key Issue	Significance of Predicted Residual Environmental Effect		Likelihood ⁽¹⁾	
	Significance Rating	Level of Confidence	Probability	Certainty
SWSQ-1: Project-related ground preparation and earthworks, including road and railway construction/closure	N	2	N/A	N/A
SWSQ-2: Project-related site water management	N	2	N/A	N/A
SWSQ-3: Project-related laydown areas	N	1	N/A	N/A
SWSQ-4: Project-related explosives manufacture, storage, and use	N	2	N/A	N/A
SWSQ-5: Quarries and borrow sources	N	2	N/A	N/A
SWSQ-7: Camps, fuel storage and waste management	N	2	N/A	N/A
SWSQ-8: Water use and management	N	2	N/A	N/A
SWSQ-9: Airstrips and airstrip use	N	2	N/A	N/A
KEY: Significance Rating: S= Significant, N = Not Significant, P = Positive Level of Confidence : 1= Low; 2= Medium; 3=High (1) Likelihood - only applicable to significant effects Probability: 1= Unlikely; 2= Moderate; 3=Likely Certainty: : 1= Low; 2= Medium; 3=High				

Materials from borrow sources have undergone representative geochemical testing, which has indicated that non-reactive material is available throughout the alignment for rail bed construction. The use of non-reactive rock avoids the potential for acid generation and metals leaching that could affect surface water and sediment quality. Imported materials used in rail bed construction will be screened for other obvious contaminants that could affect nearby watercourses. In the event that existing contamination is suspected or encountered during earthwork activities, the Project's Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011) will be used as a guideline for containment, testing, removal, treatment and disposal of contaminated media.

The rail sleepers will be hewn from raw wood and will not have any preservatives such as creosote or zinc chloride. One of the factors in the selection of raw wood for rail sleepers was to remove the potential for adverse water quality effects. No negative adverse effects are expected from materials leaching from the raw wood rail sleepers.

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Residual Effects Rating

Magnitude

Based on a qualitative assessment, there is a potential for minor to moderate water quality effects associated with ground preparation and earthworks activities, including road and railway construction and reclamation. Generally, the mitigation measures described above are expected to prevent contact of sediment-laden water with natural surface waterbodies in the LSA. Mitigation measures may, however, have limitations, especially considering the extreme climatic conditions: the effectiveness of the installation and performance of sediment transport mitigation (e.g. silt fences) in frozen ground conditions, challenges in providing adequate ground cover, and challenges in completing earthworks in areas of permafrost.

Given the potential limitations of mitigation measures, it is anticipated that TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These effects are most likely to coincide with freshet conditions, which in themselves result in elevated TSS and have the potential to mitigate the magnitude of the potential effect through added capacity to buffer these inputs. Environmental construction monitoring is expected to be successful in identifying potential effects as they arise, and adaptive management will improve the performance of mitigation measures and thereby avoid exceedance of the CCME PAL guidelines.

In the event that existing (pre-Project) contaminated media are identified on any of the Project sites, appropriate measures will be taken to collect, treat and dispose of the material without increasing the footprint of the contamination and/or creating new pathways for contaminant transport. Currently, there are no known instances of existing contamination located in the Project area. Negligible to minor effects may be anticipated with any existing contaminated media identified during ground preparation and earthworks activities.

Based on the potential for water quality to occasionally exceed the identified thresholds, the effect was rated at Level II.

Environmental monitoring, ongoing water quality monitoring and adaptive management are expected to limit the magnitude of potential TSS related effects.

Extent

The extent of residual water and sediment quality effects associated with ground preparation and earthworks will be limited to the LSA where the infrastructure is located. Environmental construction monitoring will identify effects and where necessary, mitigation will limit the extent of the effect. The extent is rated as Level I.

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Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects will be limited to summer months when construction activities are scheduled and when freshet and the majority of rain events occur. Frequency is rated as Level I.

Duration

While ground disturbance and road and railway construction will be concentrated in the Construction phase, these facilities will require ongoing maintenance throughout the duration of the Project. The duration has been rated as Level II.

Reversibility

The potential effects are anticipated to be fully reversible, once the roads have been decommissioned and rehabilitated and natural drainage has been restored. The effect is rated as Level I.

Significance – SWSQ-1 – Project-related ground preparation and earthworks, including road and railway construction/reclamation

Based on the ratings described above, ground disturbance and earthworks activities are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium due to the combined qualitative and semi-quantitative nature of the assessment (Table H.6).

Site Water Management – Impact Statement SWSQ-2

Impact Statement SWSQ-2: Project-related site water management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Management of storm water, process water and site runoff from engineered surfaces will be required throughout the five freshwater LSAs during all Project phases. The areas requiring site water management are identified in FEIS Table 3.2.1, Major Project Components, Volume 3. The approach to site water management is provided in the Surface Water and Aquatic Ecosystem Management Plan (BAF-PH1-830-P16-0026).

All stormwater sources have the potential to affect surface water quality through the alteration of Ph and/or introduction of TSS, petroleum hydrocarbons, metals and nutrients. By implementing standard BMPs such as the Land Development Guidelines for the Protection of Aquatic Habitat (DFO, 1993), adverse effects can be avoided or reduced. The following mitigation measures will be used to manage the effects of water management on surface water quality:

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- Minimize the footprint of disturbance;
- Install and maintain water management features, designed to segregate and prevent co-mingling of offsite water and onsite water.
- Install and maintain adequately designed erosion control features;
- Install and maintain adequately designed sediment transport control features;
- Where required, locate infrastructure on competent bedrock or provide ground conditions that limit permeability and transport into the active layer; and
- Capture and treat contaminated site run-off prior to discharging to the receiving environment.

Residual Effects Rating

Magnitude

Preliminary site observations coupled with experience gained from existing operations in the Project area indicate that untreated site water can typically be managed in a way that prevents contact with natural surface waterbodies and water contained in the active layer. The underlying bedrock and permafrost conditions will act as a relatively impermeable barrier to migration of potential contaminants into groundwater.

All potentially affected stormwater sources will be collected, contained and treated to applicable water quality criteria prior to discharge. Environmental construction monitoring will focus on receiving waterbodies that have relatively soft water, i.e., sensitive to increased metal toxicity (upstream of the deposits, Mary Lake and tributaries, Camp Lake, Sheardown Lake, Ravn River and Cockburn Lake) and watercourses that are sensitive to nutrient inputs.

Based on the anticipated success of controlling stormwater and treating it to applicable discharge standards, only minor to moderate water effects are anticipated. The magnitude is rated as Level II.

Extent

Based on the scale of the surface areas where site water is being collected, the extent of residual water and sediment quality effects associated with Project-related site water management may extend beyond the LSA where the source is located, but is not anticipated to extend to the RSA scale. Environmental construction monitoring will identify residual water and sediment quality effects and where necessary, mitigation efforts will limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects occur during summer months when construction activities are scheduled. A Level I frequency rating was assigned.

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Duration

Residual water and sediment quality effects associated with site water management are expected during the Construction and Operation phases of the Project and are anticipated to coincide with the timing of freshet, when any potential effect would be expected to be diluted by high flow conditions resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

Residual surface water and sediment quality effects associated with site water management are anticipated to be partially reversible. The majority of Project areas where site water management is required will be returned to the pre-disturbed state during Closure phase. Following rehabilitation, key indicators are generally expected to return to baseline conditions through removal of the contaminant source. A Level II reversibility rating was assigned.

Significance – SWSQ-2 – Project-related Site Water Management

Based on these ratings, site water management infrastructure and site water discharge are not expected to result in significant adverse environmental effects on the water and sediment quality VEC in the five freshwater LSAs. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium (Table H.6). While the assessment is qualitative, there is a high Level of Confidence in the effectiveness of mitigation measures.

Laydown Areas - Impact Statement SWSQ-3

Impact Statement SWSQ-3: Project-related laydown areas may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Laydown areas are temporary sites used for the storage of equipment and construction materials during the Construction and Closure phase. Requirements are dictated by equipment needs, the sequence of construction/closure activities, and the timing of material shipments. These factors will be optimized to reduce the number of anticipated laydown areas, and to minimize their anticipated footprints. The two main considerations are sediment and erosion control, and introduction of hazardous substances, leading to discharge of sediment-laden or contaminated water into the receiving environment.

Left unmitigated, direct effects may be observed through the introduction of TSS and metals. By implementing standard BMPs during development and use, water quality effects can be avoided or minimized to the point where only minor to moderate adverse effects are anticipated. In addition to the mitigation measures described in the ground preparation section, the following mitigation measures will be employed in laydown areas, as required:

- Siting of laydown areas over competent bedrock or impermeable ground layers;

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- Placement and grading of clean, free draining material to promote a workable lay down area environment;
- Installation of adequate storm water management infrastructure to restrict runoff from overland flow or seepage through the active layer into receiving waterbodies; and
- Appropriate handling and storage of hazardous materials.

Residual Effects Rating

Magnitude

Based on a qualitative assessment, that minor to moderate water quality effects may be associated with Project-related laydown areas and activities. The mitigation measures described above, while they are expected to prevent contact of sediment-laden or contaminated water with natural surface waterbodies may have limitations associated with their implementation and effectiveness.

Given these limitations, TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These effects are most likely to coincide with freshet conditions, which have the potential to mitigate the magnitude of the potential effect through added capacity to buffer these inputs. Environmental construction monitoring will identify potential effects as they arise and adaptive management will reduce the risk of exceeding the CCME PAL guidelines.

Potentially hazardous materials will be stored in appropriate containment in designated locations away from water bodies, to reduce the potential for loss of hazardous materials to the aquatic environment.

Based on the potential for changes in water quality occasionally to exceed the identified thresholds, a Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with Project-related laydown areas will be limited to the LSA in which they are located. Environmental construction monitoring will identify effects and, where necessary, mitigation efforts preclude or limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects that these effects would be limited to summer months when construction activities are scheduled and when freshet and the majority of rain events in the Project area occur. A Level I frequency rating was assigned.

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Duration

Residual water and sediment quality effects associated with laydown areas are only expected to occur during Construction and Closure. Potential effects are anticipated to coincide with the timing of freshet, when any potential effect would be expected to be diluted by high flow conditions resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

Residual surface water and sediment quality effects associated with Project-related laydown areas are anticipated to be fully reversible. Following the closure and rehabilitation, key indicators are generally expected to return to baseline conditions through removal of the contaminant source. A Level I reversibility rating was assigned.

Significance – SWSQ-3 – Project-related Laydown Areas

Based on these ratings, laydown areas are not expected to result in significant adverse environmental effects on the water and sediment quality VEC in the five freshwater LSAs. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Low due to the qualitative nature of the assessment and potential limitations related to mitigation measures (Table H.6).

Explosives Manufacture, Explosives Magazine, and Explosives Use - Impact Statement SWSQ-4

Impact Statement SWSQ-4: Project-related explosives manufacture, magazine, and use may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs. Explosives transportation, storage and handling have the potential to affect surface water quality in receiving environments during the Construction, Operation and Closure phases.

Explosives will be used throughout the Project footprint area during Closure to operate quarries, make rock cuts and access aggregate. During early construction and late closure, packaged explosives and ANFO will be delivered to specific areas of use. Packaged explosives will be stored in magazine areas, which will comply with the set-back requirements of NRCan.

Permanent bulk explosives factories will be established at the Mine Site and Steensby Port as early as possible to manufacture explosives from ammonium nitrate. These will be used if possible during early closure.

Explosives (primarily ANFO) manufacture, transportation, storage and handling may result in the introduction of nitrogenous and petroleum hydrocarbon based components into surface water. Certain nitrogenous compounds can be toxic to aquatic life, depending on the form (e.g. nitrate, nitrite, or ammonia) and relative concentration. Elevated nitrogen concentrations can also result in the eutrophication of receiving waters where phosphorus is not limiting.

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The following mitigation will be used to manage potential effects on surface water and sediment quality:

- Explosives will be stored in explosives magazines positioned in accordance with the *Nunavut Mine Health and Safety Act* and Regulations. Detonators and explosives will be stored in separate magazines, and inventory will be strictly controlled by designated supervisors.
- Prefabricated magazines will be positioned and appropriately bermed to store explosives between unloading and distribution.
- If bulk mixing plants are available, ammonia nitrate (AN) will be delivered in bulk and transported by truck to the permanent storage facilities.

By implementing standard BMPs identified for explosives transportation, storage, and handling, water quality effects can be avoided or reduced to the point where only minor adverse effects are anticipated.

The mining pit will be mostly dry throughout the year; consequently ammonia or residual nitrogen is not expected to escape to the aquatic environment. During the freshet and summer months, any residual explosives washed away by precipitation will report to the waste rock pile; runoff will be channelled to a sedimentation pond, and discharge will be monitored for compliance with MDMER water quality limits.

The interaction between explosives use and water quality can be a challenge. The primary forms of mitigation to avoid contamination by nitrogen and petroleum hydrocarbons include use of appropriate weights of explosives to achieve desired blasting results, use of blast guards to prevent 'fly-away', and adequate water management features that will prevent co-mingling of contact and noncontact water. The primary area of use of explosives during Construction and Closure are quarries and borrow sources for aggregate production and are generally sited in competent ground conditions, away from sensitive receiving waterbodies, to minimize the potential for adverse effects. As an additional measure, collection sumps can be constructed to capture and treat potentially contaminated contact water prior to discharge.

Residual Effects Rating

Magnitude

Based on a qualitative assessment, minor to moderate water quality effects may be associated with explosives manufacture, transportation, magazine and use. Due to the potentially serious nature of health and safety effects, mitigation will be tightly controlled and intently managed. The permanent bulk explosives factories, ANFO mixing plants, ammonium nitrate storage facilities, and truck wash facilities will be constructed to contain any solid explosives and contact water for appropriate treatment. It is not anticipated that nitrogenous and petroleum hydrocarbon residues originating from these sources will exceed applicable CCME thresholds. Residual effects on water quality and sediment quality are expected to be negligible to minor.

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The majority of blasting during the Operation phase will be confined to the open pit where water containing elevated levels of nitrogenous and petroleum hydrocarbon residues can be collected and treated prior to discharge (described in Section 3.4.1.6).

During Construction and Closure, nitrogenous and petroleum hydrocarbon residues are likely to be released due to blasting and wastage (minimal with pre-packaged ANFO) at quarry locations and other required sites. For these other scenarios, restricting blasting during freshet, volatilization by sunlight and attenuation by vegetation and soil and containment of contact water (where possible) are expected to limit potential effects. Even with the implementation of mitigation measures, it is possible that ammonia, nitrates, nitrites and petroleum hydrocarbon residues originating from blasting activities in less confined locations may occasionally exceed their respective CCME thresholds. These effects would likely coincide with the snow melt when accumulated nitrogen and petroleum hydrocarbon residues are released during the thaw and freshet conditions. High flow conditions will moderate the magnitude of the potential effect.

Nutrient characteristics of the receiving streams and lakes are summarized in FEIS Tables 7-3.5 and 7-3.7. The findings indicate that all of the freshwater receiving environments are relatively sensitive to nutrient inputs; therefore, environmental monitoring coupled with adaptive management will limit the magnitude of residual effects.

A Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with Project-related explosives manufacture, transportation, magazine and use will be limited to the LSA in which it is located. Environmental monitoring will identify residual water and sediment quality effects and where necessary, mitigation efforts will limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects would occur during summer months when construction activities are scheduled and when freshet and the majority of rain events occur. A Level I frequency rating was assigned.

Duration

Explosives manufacture, transportation, storage and use will be required during the Construction, Operation and Closure phases. Considering that the most likely uncontrolled contribution of nitrogen to the aquatic environment would come from blasting in unconfined areas along the Milne Inlet Tote Road or Railway Alignment, it is likely the source would not persist beyond the Construction phase. Nitrogen introduced in the form of ammonium would likely be assimilated into biomass rapidly, resulting in a relatively short

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duration of effect. Since the nitrogen source will be removed after Construction, and given the anticipated rapid assimilation of ammonium, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible once blasting activities have ceased. This assumes that residual nutrient levels will be attenuated through nitrification/denitrification and that the conclusion of blasting activities will terminate the nitrogen source. A Level I reversibility rating was assigned.

Significance – SWSQ-4 – Explosives Manufacture, Storage and Use

Based on the ratings described above, explosives manufacture, storage and use are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). Despite the qualitative nature of the assessment, there is a High Level of Confidence in the effectiveness of the identified mitigation measures.

Quarries and Borrow Sources - Impact Statement SWSQ-5

Impact Statement SWSQ-5: Project-related quarries and borrow sources may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Quarries and borrow sources required for rock, fill and aggregate during construction and closure are identified on FEIS Figures 3.2.1 through 3.2.9 in Volume 3. The primary concern is the potential for ML/ARD and sediment generated at these locations to affect water quality when released into the natural environment.

As a mitigation measure, materials from identified quarries and borrow sources have undergone representative geochemical testing, which has indicated that the material is non-reactive (FEIS Volume 6). Additional testing will be completed to ensure that sources used during Construction and Closure consist of non-reactive material.

Quarries and borrow sources are generally sited in competent ground conditions away from sensitive receiving waterbodies to avoid the potential for adverse effects. As an additional measure, collection sumps will capture and treat affected contact water to applicable water quality standards prior to discharge. As stated in the Borrow Pit and Quarry Management Plan (BAF-PH1-830-P16-0004) Baffinland will strive to avoid quarry site that have the potential for ML/ARD. A detailed ML/ARD testing protocol for potential quarry sites is presented in the Borrow Pit and Quarry Management Plan. Based on the results of the representative geochemical testing, it is not anticipated that treatment will be required to address ML/ARD issues.

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Residual Effects Rating

Magnitude

A semi-quantitative assessment of magnitude was based on representative geochemical testing of materials from quarries and borrows sources, which indicated that the sampled materials are non-reactive (FEIS, Volume 6). The use of non-reactive materials makes it likely that run-off from quarries and borrow sources will meet the CCME thresholds for pH and metals (ML/ARD). FEIS Tables 7-3.5 and 7-3.7, which summarize acid sensitivity of the receiving streams and lakes, indicate that none of the streams or lakes is particularly sensitive to acidic inputs.

Nitrogenous and petroleum hydrocarbon residues originating from blasting activities, as well as sediment-laden water, will be confined to the water management infrastructure within each quarry and borrow site. While mitigation measures will prevent contact of storm water with natural surface waterbodies, they may have limitations associated with their implementation and effectiveness. Given these limitations, it is anticipated that uncontrolled discharges of water from quarries and borrow sources may occasionally exceed applicable CCME thresholds. These exceedances would likely coincide with freshet conditions during snow melt; this will mitigate the potential effect through dilution.

Environmental construction monitoring will be comprehensive, with an emphasis on those receiving bodies that have relatively soft water quality, a condition that can result in increased susceptibility to metals uptake.

A Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with quarry or borrow sources will be limited to the LSA in which they are located. The relative insensitivity of watercourses to acidic inputs suggests a relatively high potential to buffer through elevated levels of calcium carbonates that are present. Environmental monitoring will identify effects and, where necessary, mitigation efforts will limit their extent. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, these effects will be limited to summer months when construction/closure activities are scheduled and when freshet and the majority of rain events occur. A Level I frequency rating was assigned.

Duration

Quarries and borrow sources will be required during the Construction and Closure phase. Potential effects are anticipated to coincide with the timing of freshet, when any potential effect will be diluted by high flow

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conditions, resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

The potential effects associated with quarry or borrow sources are anticipated to be fully reversible once blasting is completed and these locations have been closed and rehabilitated. A Level I reversibility rating was assigned.

Significance – SWSQ-5 – Quarries and Borrow Sources

Based on the ratings described above, the residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium due to the semi-quantitative nature of the assessment (Table H.6).

Camps, Fuel Storage and Waste Management – Impact Statement SWSQ-7

Impact Statement SWSQ-7: Project-related camps, fuel storage and waste management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Temporary and permanent camps will be located throughout the Project area as described and illustrated in FEIS Volume 3. The potential effects include changes in water and sediment quality due to withdrawal, waste management, fuel storage, and discharge of sewage.

In order to protect water quality, the following management actions have been adopted at waste management facilities:

- Incineration of non-hazardous combustible wastes;
- Landfilling of inert non-combustible wastes;
- Temporary storage and off-site shipping of hazardous and recyclable waste materials; and
- On-site treatment for hydrocarbon-impacted materials (soil, water, ice, and snow).

Diesel, gasoline and aviation fuel will be delivered to temporary camp locations via tanker trucks and will be stored in double-walled fuel tanks located on foundations equipped with impermeable bermed liners and bedding materials. The storage site will be far enough removed from receiving watercourses to reduce the potential for water quality effects.

Fuel will be delivered to the camps at Milne Port, the Mine Site and Steensby Port via marine vessels and tanker trucks and will be stored in large volume double-walled tanks located on foundations equipped with impermeable bermed liners and bedding materials. Within the bermed fuel storage areas, any fuel-contact water will be collected in engineered drainage and sumps, treated to applicable water quality standards, and then discharged if it does not exceed the CCME thresholds for TSS, oil and grease, or petroleum hydrocarbons.

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Residual Effects Rating

Magnitude

Effects associated with fuel storage and use and waste management were all assessed qualitatively. Mitigation measures described above will prevent the discharge of fuel contact water that exceeds CCME thresholds for TSS, oil and grease, or petroleum hydrocarbons.

Waste management mitigation as described above will limit any potentially adverse effects to a negligible to minor magnitude.

A Level I magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to watercourses located in the LSA in which a camp is situated. A Level I extent rating was assigned.

Frequency

The frequency of potential effects will be periodic and limited to summer months when the majority of precipitation falls in the Project Area. A Level II frequency rating was assigned.

Duration

Camps, fuel storage and waste management will be required during Construction and Operation; therefore, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be partially reversible once this infrastructure is decommissioned and rehabilitated. A Level II reversibility rating was assigned.

Significance – SWSQ-7 – Camps, Fuel Storage and Waste Management

Based on these ratings, construction and operation of camps, fuel storage and waste management are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While the assessment is qualitative in nature, there is a High Level of Confidence in the effectiveness of mitigation measures.

Water Use and Management - Impact Statement SWSQ-8

Impact Statement SWSQ-8: Project-related water use and management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

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Water withdrawal will support a number of Project-related activities (FEIS Tables 7-2.5, 7-2.6, 7-2.9 and 7-2.10). Withdrawal from these sources has the potential for indirect effects on surface water quality by reducing the total volume of water in the system at that location.

Various Project-related water uses have the potential to affect water and sediment quality when process water is released back into the freshwater environment, including:

- Aggregate washing;
- Concrete manufacture;
- Concrete curing;
- Truck wash; and
- Equipment/floor wash-down.

Water for aggregate washing will be pumped from the potable water source and stored in a designated washing area. The main consideration with aggregate wash water is the potential for it to contain a high TSS concentration. Wash water will be reused and recycled to the extent possible, and solids will be settled out prior to discharge.

Water used for concrete manufacture and curing will be pumped from the potable water source and stored at the batch plant. Volumetric trucks will be used for remote concrete pours, and standard BMPs will be put in place to ensure that untreated contact water is not discharged. The main consideration with concrete contact water is the potential to contain elevated TSS and pH, which may affect water quality in the environment. Concrete contact water will be treated through settlement and with pH adjustment (e.g. carbon dioxide sparging) prior to discharge.

Truck wash facilities will be constructed with water management features designed to segregate and prevent co-mingling of offsite and onsite water. A drain system and sump will capture and treat potentially contaminated water to applicable quality standards prior to discharge.

Snow, ice, soil or water that has been contaminated by petroleum hydrocarbons has the potential to impair water quality. Any such materials will be transported to lined, bermed treatment landfarm facilities, and materials that have been in contact with oil will be transported to the same locations for treatment in oil/water treatment facilities in the maintenance shops. Contaminated snow will be placed into cells in the landfarms; after thawing it will be treated and discharged. Discharges will not be directed into the freshwater environment; therefore, only minor adverse effects are anticipated from incidental occurrences.

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Residual Effects Rating

Magnitude

Negligible to minor magnitude residual water quality effects may be associated with water abstraction (FEIS Tables 7-2.5, 7-2.6, 7-2.9 and 7-2.10). Water used for other activities (e.g., aggregate washing, concrete manufacture, concrete curing, and dust suppression for the quarry crusher) will be managed to ensure the discharges meet applicable CCME water quality guidelines. Negligible to minor water and sediment quality effects are anticipated.

Potential effects of contaminated by petroleum hydrocarbons were assessed qualitatively. Based on the mitigation described above, it is anticipated that treated contact water discharges will meet applicable CCME water quality guidelines and only negligible to minor adverse effects are expected.

A Level I magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to watercourses from which the abstraction or water use is occurring. A Level I extent rating was assigned.

Frequency

The frequency of the potential effect will be year round, while seasonal discharge of treated contact water will occur during freshet. A Level III frequency rating was assigned.

Duration

Effects are anticipated to last through the Construction, Operation and Closure phases; therefore, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible, once water withdrawal and treated contact water discharge are discontinued. A Level I reversibility rating was assigned.

Significance – SWSQ-8 – Water Use and Management

Based on these ratings, water use and management are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While aspects of the assessment are qualitative, there is a High Level of Confidence in the effectiveness of mitigation measures.

Airstrips and Airstrip Use - Impact Statement SWSQ-9

Impact Statement SWSQ-9: Project-related airstrips and airstrip use may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

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The airstrip and related infrastructure are described in FEIS Volume 3. Its construction, operation and closure have the potential to affect surface water quality in adjacent water bodies. The primary concern during Closure stems from erosion and sediment transport during ground preparation and earthworks. Mitigation measures are summarized in the sections above.

The primary concern stems from the possibility of contaminating nearby water bodies with runoff from the surface of the airstrip, including de-icing agents such as propylene glycol. De-icing by a portable discharge unit will be carried out in a defined area to the side of the runway using propylene glycol. A synthetic organic polymer (EK 35) will be used as a dust suppressant on the airstrips as needed.

Water management features will be installed and maintained to prevent co-mingling of offsite water with potentially affected onsite water. Any potentially contaminated water will be treated to applicable quality standards prior their discharge.

Residual Effects Rating

Magnitude

As a result of the crowned configuration of the airstrip, surface run-off will be directed to drainage collection structures around the perimeter. Mitigation measures will prevent contact of sediment-laden water with natural surface waterbodies; however, mitigation measures may have limitations associated with their implementation and effectiveness. Given these limitations, it is anticipated that TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These exceedances would likely coincide with freshet conditions during snow melt, which is likely to dilute and mitigate any potential effects.

Use of propylene glycol is anticipated to result in negligible to minor water quality effects as collection and treatment will to ensure that the CCME interim guideline is not exceeded.

The synthetic organic polymer EK 35 is not an identified substance under CCME PAL; therefore, it is recommended that potential effects be assessed through routine water quality monitoring.

Based on the potential for infrequent exceedances of applicable CCME thresholds, a Level II magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to waterbodies adjacent to the airstrips. A Level I extent rating was assigned.

Frequency

The frequency of potential effects will be limited to summer months, when the majority of precipitation falls in the Project Area. A Level I frequency rating was assigned.

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Duration

Airstrips and airstrip use will be required during Construction, Operations and Closure. Potential effects are anticipated to coincide with the timing of freshet, when high flows will act to reduce concentrations and render them indistinguishable from baseline. A Level III duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible once the infrastructure is decommissioned and rehabilitated and de-icing and dust suppression ceases. A Level I reversibility rating was assigned.

Significance – SWSQ-9 – Airstrips and Airstrip Use

Based on these ratings, airstrips and airstrip use are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While the assessment is qualitative, there is a high Level of Confidence in the effectiveness of the identified mitigation measures.

Aqueous Point Source Emissions

Potential effects on surface water and sediment quality associated with aqueous point source emissions (key issues) identified in Table H.2 are described below. These emissions are from a single, identifiable, localized source and affect a specific receiving waterbody. Locations of infrastructure and activities involving each aqueous point source emission are presented by LSA.

Table H.7 summarizes the ratings assigned to the significance criteria of residual effects associated with each effect discussed below.

Prediction Confidence

The confidence level assigned to the predictions of significance for aqueous non-point source discharge effects to water and sediment quality are summarized in Table H.8.

Milne Port LSA

All aqueous point source emissions from the Milne Port LSA are directed into Milne Inlet (marine environment) via surface release through a combination of constructed/natural drainage to areas that have no identified sensitive receptors (i.e., fish and/or fish habitat). Due to the absence of sensitive secondary receptors, an assessment of freshwater effects was not completed. The assessment of residual effects associated with emissions into the marine environment, where secondary receptors are located, is addressed in FEIS Volume 8.

Milne Inlet Tote Road LSA

No aqueous point source emissions into the freshwater receiving environment are located in the Milne Inlet Tote Road LSA.

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Table H.7: Effects Assessment Summary - Aqueous Point-Source Discharges

Effect		Residual Effect Evaluation Criteria					Significance
Effect	Direction & Nature of Effect	Magnitude / Complexity	Geographical Extent	Frequency	Duration	Reversibility	Rated Significance of Residual Effect
SWSQ-10 West Waste Rock Stormwater Discharge to Camp Lake and Tributaries	Negative Water quality (pH, TSS, metals, ammonia, nitrite)	Level II: Concentrations of indicator(s) predicted to exceed threshold value(s) by an order of magnitude or greater	Level I: confined to the LSA	Level II: will occur frequently	Level III: long-term/permanent	Level II: effect is partially reversible (water treatment, if required)	Not Significant
SWSQ-11 Waste Rock and Ore Stormwater Discharge to Mary River	Negative Water quality (pH, TSS, metals, ammonia, nitrite)	Level I: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	Level I: confined to the LSA	Level II: will occur frequently	Level II: will occur for the Operation phase (life of the Project)	Level II: effect is partially reversible (water treatment, if required)	Not Significant
SWSQ-12 Exploration Drilling Runoff to Mary River	Negative Water quality (pH, TSS, chlorides)	Level I: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	Level I: confined to the LSA	Level II: will occur frequently	Level II: will occur for the Operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-13 Pit Lake and Waste Rock Discharges to Mary River in Post-closure	Negative Water quality (pH, TSS, metals)	Level I: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	Level I: confined to the LSA	Level II: will occur frequently	Level III: long-term/permanent	Level II: effect is partially reversible (water treatment, if required)	Not Significant

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Effect		Residual Effect Evaluation Criteria					Significance
Effect	Direction & Nature of Effect	Magnitude / Complexity	Geographical Extent	Frequency	Duration	Reversibility	Rated Significance of Residual Effect
SWSQ-14 Exploration Camp WWTF Effluent Discharge to Sheardown Lake	Negative Water quality (pH, TSS, BOD, nutrients, ammonia)	Level I: Effect is expected to be less than threshold values	Level I: confined to the LSA	Level II: will occur frequently	Level II: will occur for the Operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant
SWSQ-15 Mine Site WWTF Effluent Discharge to Mary River	Negative Water quality (pH, TSS, BOD, nutrients, ammonia)	Level I: Effect is expected to be less than threshold values	Level I: confined to the LSA	Level II: will occur frequently	Level II: will occur for the Operation phase (life of the Project)	Level I: effect is reversible after activity is complete	Not Significant

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Table H.8 Significance of Residual Effects from Point Source Discharges

Key Issue	Significance of Predicted Residual Environmental Effect		Likelihood ⁽¹⁾	
	Significance Rating	Level of Confidence	Probability	Certainty
SWSQ-10 West Waste Rock Stormwater Discharge to Camp Lake and Tributaries	N	3	N/A	N/A
SWSQ-11 Waste Rock and Ore Stormwater Discharge to Mary River	N	3	N/A	N/A
SWSQ-12 Exploration Drilling Runoff to Mary River	N	2	N/A	N/A
SWSQ-13 Pit Lake and Waste Rock Discharges to Mary River in Post-closure	N	2	N/A	N/A
SWSQ-14 Exploration Camp WWTF Effluent Discharge to Sheardown Lake	N	2	N/A	N/A
SWSQ-15 Mine Site Camp WWTF Effluent Discharge to Mary River	N	2	N/A	N/A
KEY: Significance Rating: S= Significant, N = Not Significant, P = Positive Level of Confidence : 1= Low; 2= Medium; 3=High (1) Likelihood - only applicable to significant effects Probability: 1= Unlikely; 2= Moderate; 3=Likely Certainty: : 1= Low; 2= Medium; 3=High				

Mine Site LSA

Impact Statements SWSQ-10 to SWSQ-13: Project-related discharges of mine contact water may result in impaired surface water and sediment quality in the Mine Site LSA.

Management of storm water and process water that has been in contact with the iron ore (mine contact water) is required at the Mine Site. Plans and drawings illustrating proposed site water management infrastructure for mine contact water are provided in the Surface Water and Aquatic Ecosystem Management Plan (BAF-PH1-830-P16-0026). The following sources have been identified for inclusion in the aqueous point source emissions assessment because they involve mine contact water that will be discharged into the freshwater environment:

- Waste Rock Stockpile runoff to Camp Lake and Tributaries (SWSQ-10);
- Waste rock and ore stockpile runoff to Mary River (SWSQ-11);
- Exploration drilling runoff (SWSQ-12); and

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- Pit lake water and waste rock discharges to Mary River in post-closure (SWSQ-13).

The development of source terms (runoff water quality estimates) for waste rock, ore and pit water is described above.

Given the variability in runoff flows, the ponds were sized to accommodate the two-year extreme event. Discharge is anticipated to be distributed evenly with the natural flows from approximately mid-June until September.

Details regarding theoretical treatment options are provided in the Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031). The main findings suggest that, with sufficient storage and upstream control, any water quality issues that arise can be managed. If the only challenge with the water quality is TSS concentration, this will often be solved using retention time alone. With a buffer pond that has a sufficiently large retention time it is possible to allow particles to settle while discharging - either by gravity or pumping - in a continuous system.

All mine contact water (including that from the ore stockpiles) in the Milne Port and Steensby Port LSAs is discharged to the ocean; their potential effects are assessed in FEIS Volume 8.

Residual effects ratings for the various mine contact water discharges are provided below.

Waste Rock Stormwater Discharge to Camp Lake and Tributaries - Impact Statement SWSQ-10

Runoff discharged from the West Waste Rock Stockpile Pond (Pond 1) has the potential to adversely affect water quality in the tributary of Camp Lake to which stormwater will be discharged, and downstream into Camp Lake.

Contact water (runoff) from the Waste Rock Stockpile will be settled in the west pond (Pond 1) prior to discharge to tributary L1, which in turn reports to tributary L0 and subsequently to Camp Lake. The arrangement of the stockpile, the sedimentation pond and the receiving environment are illustrated in Life-of-Mine Waste Rock Management Plan. It is predicted, based on waste rock seepage modelling, that runoff from the stockpile will meet MDMER requirements (Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031)).

Background water quality was measured in the open-water seasons (June to September) of 2006, 2007, 2008 and 2011. Open-water season means were calculated for key water quality parameters at sampling locations L0-01, L1-02 and L1-08. Water quality sampling included analysis of routine water quality parameters identified in the Baseline Water and Sediment Quality Report in FEIS Appendix 7B-1. Background mean and 90th percentile baseline concentrations were applied to the modelling.

Mean and low flow rates (or annual volumes) were obtained from hydrological surveys conducted over five years (2006, 2007, 2008, 2010 and 2011).

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A mass balance approach was applied using the methodology described above to estimate water quality in the receiving waters under mean flow conditions and by discharging runoff following the natural hydrograph. Resultant water quality in Camp Lake tributary L1 (at the location of falls which prevent the upstream passage of fish), downstream where L1 reports to tributary L0 and then at Camp Lake is presented in Table H.9. The same analysis during the 10-year dry year is presented in Table H.10.

Residual Effects Rating

Magnitude

The mass balance modelling indicates that several parameters will have Level II magnitude effects to water quality under both mean and low flow conditions at the nearest downstream location inhabited by fish at L0, and in Camp Lake (Hazard Quotient - HQ of >1 and <10). An HQ >10 and <100 was applied for mercury using 90th percentile baseline concentrations. All other parameters are at Level I or lower.

As mentioned above, each of the metals showing an HQ >1 (a Level I effect) or HQ >10 (a Level II effect) is identified in the humidity cell testing as having >50 % non-detects, and half the detection limits were assumed for non-detect results. Consequently, the derived source terms for these metals are substantially based on the MDLs. Most of these same parameters (including arsenic, cadmium, chromium, mercury, selenium and silver, as well as other metals that do not trigger a Level I effect) have measured baseline concentrations that are mostly non-detect, and therefore the calculated mean or 90th percentile concentrations are substantially based on MDLs. On this basis, the assignment of a Level II magnitude rating for water and sediment quality effects arising from discharge of stormwater from the west waste rock pond to the Camp Lake tributaries and Camp Lake is considered to be highly conservative. Baffinland is exploring options for re-testing or additional testing to obtain a dataset of more precise measurements for these parameters.

Aquatic Effects Monitoring, Environmental Effects Monitoring and routine water quality monitoring are expected to identify potential effects as they arise, and adaptive management will reduce the risk of exceeding the predicted effects level.

Duration

Discharge of mine contact water from the West Waste Rock Pond into the lower reach of Camp Lake tributary L1 will be required during the Operation, Closure and post-closure phases of the Project; a Level III duration rating was assigned.

Frequency

The frequency of the potential effect will be annual, limited to the period between June and September. A Level II frequency rating was assigned.

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Extent

The extent of the potential effect is expected to be limited to the Mine Site freshwater LSA and to reach negligible levels where Camp Lake discharges into Mary Lake. A Level I extent rating was assigned.

Reversibility

The potential effects are anticipated to be partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-10 – West Waste Rock Stormwater Discharge to Camp Lake and Tributaries

Based on these ratings, discharge of mine contact water from the West Waste Rock Sedimentation Pond into the tributary of Camp Lake is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence (Table H.8) is High due to the quantitative nature and conservative assumptions of the assessment. Additionally the EEM requirements of MDMER provide assurance that effects will be detected and necessary corrective actions implemented.

Table H.9: Predicted Water Quality in Camp Lake Tributaries and Camp Lake Under Mean Flow Conditions

									WATER QUALITY IN THE RECEIVING WATERS									
Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to Mean Summer Flow Discharge Volume = 843,000 m³/yr Mean Baseline Flows in L1 = 790,807 m³/yr				Discharge Equalized to Summer Flow - Additional Dilution in L0 Discharge Flows = 1,633,807 m³/yr Mean Baseline Flows in L0 (MR-10) at outlet to lake = 976,453 m³/yr				Assume Instantaneous Mixing within lake = 27,511,100 m³ Discharge Flows into Camp Lake (MR- 10 Outlet Flows + Discharge Volume) = 2,610,260 m³/yr	
		Baseline Concentrations		Mean	HQ													
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		MDMER	West Waste Rock Pile Source Terms										
pH		7.84	8.38		7.61	6.5 - 9.0	-	6.9	7.35	-	7.62	-	7.54	-	7.90	-	7.64	-
Hardness	mg/L CaCO ₃	74.11	121.00		57.69	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.0190	0.0390	82%	0.0095	0.94	-	0.12	0.071	0.1	0.081	0.1	0.052	0.05	0.065	0.07	0.0143	0.02
Antimony	mg/L	-	0.0004	0%	0.00010	-	-	0.0031	-	-	0.0018	-	-	-	0.0013	-	0.00020	-
Arsenic	mg/L	-	0.0050	6%	0.00018	0.005	0.50	0.0025	-	-	0.0037	0.7	-	-	0.0042	0.8	0.00053	0.1
Barium	mg/L	0.0093	0.0119	59%	0.00565	-	-	0.064	0.038	-	0.039	-	0.027	-	0.029	-	0.0076	-
Beryllium	mg/L	-	0.0050	0%	0.00050	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.0320	10%	0.01000	1.5	-	0.025	-	-	0.028	0.02	-	-	0.030	0.02	0.012	0.01
Cadmium	mg/L	-	0.00010	10%	0.000023	0.000029	-	0.000020	-	-	0.00006	2.0	-	-	0.00007	2.6	0.00003	0.9
Chromium	mg/L	-	0.0010	10%	0.00055	0.0047	-	0.0029	-	-	0.0020	0.4	-	-	0.0016	0.3	0.00064	0.1
Cobalt	mg/L	-	0.0003	4%	0.00011	-	-	0.00079	-	-	0.00055	-	-	-	0.00046	-	0.00014	-
Copper	mg/L	0.0015	0.0020	94%	0.00207	0.0047	0.30	0.0031	0.0023	0.5	0.0026	0.5	0.0020	0.4	0.0024	0.5	0.0021	0.4
Iron	mg/L	0.0471	0.0610	67%	0.03152	1.2	-	<0.002	0.023	0.02	0.030	0.03	0.032	0.03	0.042	0.03	0.032	0.03
Lead	mg/L	0.0002	0.0007	18%	0.000171	0.001	0.20	0.00020	0.0002	0.2	0.00044	0.4	0.0002	0.2	0.001	0.5	0.0002	0.2
Manganese	mg/L	0.0063	0.0100	51%	0.002289	-	-	0.00004	0.0031	-	0.0049	-	0.004	-	0.0068	-	0.002678	-
Mercury	mg/L	-	0.00010	2%	0.000040	0.000026	-	0.00057	-	-	0.00034	13	-	-	0.00025	9.7	0.000058	2.2
Molybdenum	mg/L	0.0027	0.0050	46%	0.000620	0.073	-	0.010	0.0065	0.1	0.0076	0.1	0.0051	0.07	0.0066	0.09	0.0011	0.02
Nickel	mg/L	0.0030	0.0050	32%	0.00109	0.083	0.50	0.0019	0.0024	0.03	0.0034	0.04	0.0026	0.03	0.0040	0.05	0.0013	0.02
Selenium	mg/L	-	0.0050	2%	0.00100	0.001	-	0.0077	-	-	0.0064	6	-	-	0.0059	5.87	0.0014	1.4
Silver	mg/L	-	0.0001	4%	0.000017	0.0001	-	0.000064	-	-	0.00008	0.8	-	-	0.00009	0.9	0.000023	0.2
Thallium	mg/L	-	0.0002	0%	0.00010	0.0008	-	0.00029	-	-	0.00025	0.3	-	-	0.00023	0.3	0.00011	0.1
Uranium	mg/L	0.0016	0.0027	100%	0.000402	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.0010	2%	0.00100	0.006	-	0.0010	-	-	0.0010	0.2	-	-	0.0010	0.2	0.0010	0.2
Zinc	mg/L	0.0020	0.0030	25%	0.00247	0.03	0.50	0.013	0.008	0.3	0.008	0.3	0.006	0.2	0.006	0.2	0.00280	0.1
NOTES: 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE. 7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.																		

Table H.10: Predicted Water Quality in Camp Lake Tributaries and Camp Lake In A Dry Year

									WATER QUALITY IN THE RECEIVING WATERS									
Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to 10-Year Low Flow Discharge Volume = 354,060 m³/yr 10-Year Low Baseline Flows in L1 = 332,139 m³/yr				Discharge Equalized to 10-Year Low Flow - Additional Dilution in L0 Discharge Flows = 686,199 m³/yr 10-Year Low Baseline Flows in L0 (MR-10) at outlet to lake = 410,110 m³/yr				Assume Instantaneous Mixing within lake = 27,511,100 m³ Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 1,096,309 m³/yr	
		Baseline Concentrations		Mean	HQ													
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		MDMER	West Waste Rock Pile Source Terms										
pH		7.84	8.38		7.61	6.5 - 9.0	-	6.9	7.35	-	7.62	-	7.54	-	7.90	-	7.62	-
Hardness	mg/L CaCO ₃	74.11	121.00		57.69	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.0190	0.0390	82%	0.0095	0.94	-	0.286	0.157	0.2	0.166	0.2	0.105	0.11	0.119	0.13	0.0137	0.01
Antimony	mg/L	-	0.0004	0%	0.00010	-	-	0.007	-	-	0.004	-	-	-	0.003	-	0.0002	-
Arsenic	mg/L	-	0.0050	6%	0.00018	0.005	0.50	0.006	-	-	0.0055	1.1	-	-	0.0053	1.06	0.00038	0.08
Barium	mg/L	0.0093	0.0119	59%	0.00565	-	-	0.152	0.083	-	0.084	-	0.056	-	0.057	-	0.0076	-
Beryllium	mg/L	-	0.0050	0%	0.00050	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.0320	10%	0.01000	1.5	-	0.060	-	-	0.046	0.03	-	-	0.041	0.03	0.0112	0.01
Cadmium	mg/L	-	0.00010	10%	0.000023	0.000029	-	0.00005	-	-	0.00007	2.5	-	-	0.00008	2.9	0.00003	0.87
Chromium	mg/L	-	0.0010	10%	0.00055	0.0047	-	0.007	-	-	0.0040	0.9	-	-	0.0029	0.62	0.00064	0.14
Cobalt	mg/L	-	0.0003	4%	0.00011	-	-	0.0019	-	-	0.0011	-	-	-	0.0008	-	0.00014	-
Copper	mg/L	0.0015	0.0020	94%	0.00207	0.0047	0.30	0.007	0.0045	1.0	0.0048	1.0	0.0034	0.7	0.0037	0.8	0.00213	0.5
Iron	mg/L	0.0471	0.0610	67%	0.03152	1.2	-	0.002	0.024	0.02	0.031	0.03	0.033	0.03	0.042	0.0351	0.032	0.03
Lead	mg/L	0.0002	0.0007	18%	0.000171	0.001	0.20	0.0005	0.0003	0.3	0.0006	0.6	0.0003	0.3	0.0006	0.6	0.00019	0.2
Manganese	mg/L	0.0063	0.0100	51%	0.002289	-	-	0.00010	0.0031	-	0.0049	-	0.0043	-	0.0068	-	0.0025	-
Mercury	mg/L	-	0.00010	2%	0.000040	0.000026	-	0.001	-	-	0.00075	29	-	-	0.00051	19.46	0.000058	2.23
Molybdenum	mg/L	0.0027	0.0050	46%	0.000620	0.073	-	0.024	0.014	0.2	0.015	0.2	0.010	0.13	0.011	0.15	0.0010	0.01
Nickel	mg/L	0.0030	0.0050	32%	0.00109	0.083	0.50	0.005	0.004	0.05	0.005	0.06	0.003	0.04	0.005	0.06	0.00123	0.01
Selenium	mg/L	-	0.0050	2%	0.00100	0.001	-	0.018	-	-	0.0119	12	-	-	0.0093	9.31	0.0013	1.32
Silver	mg/L	-	0.0001	4%	0.000017	0.0001	-	0.0002	-	-	0.00013	1.3	-	-	0.00012	1.2	0.00002	0.21
Thallium	mg/L	-	0.0002	0%	0.00010	0.0008	-	0.001	-	-	0.00045	0.6	-	-	0.00036	0.448	0.00011	0.14
Uranium	mg/L	0.0016	0.0027	100%	0.000402	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.0010	2%	0.00100	0.006	-	0.002	-	-	0.0017	0.3	-	-	0.0014	0.24	0.0010	0.17
Zinc	mg/L	0.0020	0.0030	25%	0.00247	0.03	0.50	0.031	0.017	0.6	0.017	0.6	0.011	0.4	0.012	0.4	0.0028	0.1
NOTES: 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT. 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON. 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.																		

							WATER QUALITY IN THE RECEIVING WATERS											
Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to 10-Year Low Flow Discharge Volume = 354,060 m³/yr 10-Year Low Baseline Flows in L1 = 332,139 m³/yr				Discharge Equalized to 10-Year Low Flow - Additional Dilution in L0 Discharge Flows = 686,199 m³/yr 10-Year Low Baseline Flows in L0 (MR-10) at outlet to lake = 410,110 m³/yr				Assume Instantaneous Mixing within lake = 27,511,100 m³ Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 1,096,309 m³/yr	
		Baseline Concentrations		Mean	HQ				90th Percentile	HQ	Mean	HQ	90th Percentile	HQ	Mean (Lake) 90th Percentile (Streams)	HQ		
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		MDMER	West Waste Rock Pile Source Terms										
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.																		

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Waste Rock and Ore Stormwater Discharge to the Mary River - Impact Statement SWSQ-11

Runoff discharged from the East Pond (Pond 2), containing both Waste Rock Stockpile runoff and pit water, has the potential to adversely affect water quality in the Mary River.

A mass balance approach similar to that used for the West Waste Rock Pond (SWSQ-10) was applied using the methodology described above to estimate water quality in the receiving waters under mean flow conditions and by discharging effluent following the natural hydrograph. Resultant water quality in the Mary River following discharge of the East Pond is presented in Table H.11, and the same analysis during the 10-year dry year is presented in Table H.12.

Residual Effects Rating

Magnitude

The mass balance modelling indicates that Level I magnitude effects to water quality will occur under both mean and low flow conditions (all indicator parameters <10x the applicable WQO) in the Mary River at each of the locations modelled:

- In the Mary River at MR-12 where tributary F0 containing the east pond discharge reports to the Mary River, under mean flow conditions (Table H.11) and the 10-year dry condition (Table H.12); and
- At the point of mixing of the discharge of stormwater from the main ore stockpiles, including the ROM stormwater discharge, under mean flow conditions (Table H.13) and the 10-year dry condition (Table H.14).

Fish habitat is present at the outlet of MR-12 (tributary F0), for which the resultant water quality in Mary River is shown on the far right of Tables H.11 and H.12. At this location, Level I water quality effects may be experienced based on an HQ >1 for mercury, selenium and silver (under mean flow conditions). Copper and chromium are added under the dry year condition. As discussed in the assessment of discharges from East Waste Rock Pond, the calculated baseline concentrations and source terms used in the modelling are from datasets where these parameters were predominantly non-detect. As such, a Level I magnitude rating is highly conservative.

Farther downstream, the ROM and main ore stockpiles will discharge into the Mary River. The resultant water quality in the Mary River considering these discharges as well as the east waste rock pond discharge discussed above is presented in Tables H.13 and H.14. Mercury, selenium and silver (under mean flow and low flow conditions), have a calculated HQ >1, suggesting a Level I magnitude effect with the same qualifiers as described above.

The resultant water quality downstream in Mary Lake was approximated considering discharges from the west stormwater pond via Camp Lake and the multiple discharges to Mary River, which also report to Mary Lake. Based on the average lake volume of 169,000,000 m³, HQs of 4, 1 and 1 were calculated for mercury,

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selenium and silver, respectively. Given that the modelling inputs (both baseline and source terms) for each of these parameters are based on MDLs, it is anticipated that the HQ values will be below 1, achieving a negligible effect on water quality in Mary Lake.

Duration

While the temporary ore stockpiles will discharge stormwater during the Operations phase only, a Level II duration rating is assigned to this effect. The east waste rock pond and pit will continue to discharge runoff in the long term; however the post-closure effects of this is assessed separately in SWSQ-13.

Frequency

The frequency of the potential effect will be annual, limited to the period between June and September when discharge is proposed. A Level II frequency rating was assigned.

Extent

The extent of the potential effect is expected to reach negligible levels where the Mary River discharges into Mary Lake, so, given that the effect is expected to be limited to the Mine Site freshwater LSA, a Level I extent rating was assigned.

Reversibility

The potential effects associated with the discharge of mine contact water from the Waste Rock Stockpile into the Mary River system are anticipated to be partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-11 – Waste Rock and Ore Stormwater Discharge to the Mary River

Based on these ratings, discharge of mine contact water from the Waste Rock Stockpile, ROM stockpile and Main Ore Stockpile into the Mary River is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence is High due to the quantitative and conservative nature of the assessment.

Table H.11: Predicted Water Quality in the Mary River Under Mean Flow Conditions (East Discharge)

Parameter	Units	Baseline Water Quality in Trib F0 (F0-01, F0-05)			Baseline Water Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	Discharge Scenario			COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)			
									Flows Used				Mean Volume of Effluent Discharged from East Pond and Open Pit = 595,116 m³/yr Mean Volume to mix at MR-12 = 4,152,146 m³/yr				Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m³/yr Mean Volume to mix in Mary River = 78,185,678 m³/yr			
		Baseline Concentrations			Mean	Mean	HQ					90th Percentile	HQ	Mean	HQ	90th Percentile	HQ			
		MDME R	Pit Water Source Terms (Year 21)	East Waste Rock Source Terms																
pH								6.5 - 9.0	-	4.20	6.9	5.88	7.74	-	8.01	-	7.83	-	8.19	-
Hardness	mg/L CaCO ₃	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	4.2	0.095	1.65	0.22	0.2	0.24	0.3	0.19	0.2	0.39	0.4
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.008	0.0025	0.0046	-	-	0.001	-	-	-	0.00015	-
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.007	0.0020	0.0039	-	-	0.001	0.3	-	-	0.00102	0.2
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0340	0.051	0.045	0.014	-	0.015	-	0.010	-	0.013	-
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.11	0.020	0.054	-	-	0.016	0.01	-	-	0.010	0.01
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00016	0.000016	0.00007	-	-	0.000026	0.9	-	-	0.000020	0.7
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.019	0.0023	0.0086	0.0020	0.4	0.0020	0.4	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.053	0.00063	0.020	0.0027	-	0.0028	-	0.00035	-	0.00035	-
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.074	0.0025	0.030	-	-	0.0045	1.0	-	-	0.0020	0.4
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.22	<0.002	0.084	0.045	0.04	0.054	0.05	0.17	0.1	0.34	0.3
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0022	0.00016	0.0009	0.00026	0.3	0.00029	0.3	0.00029	0.3	0.00084	0.8
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.57	0.00004	0.22	0.029	-	0.036	-	0.0053	-	0.011	-
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0016	0.00045	0.0009	-	-	0.00020	8	-	-	0.00011	4.1
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.027	0.0078	0.015	0.0046	0.06	0.0063	0.09	0.0030	0.04	0.0051	0.07
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.11	0.0015	0.043	0.0081	0.1	0.010	0.1	0.0034	0.04	0.0053	0.06
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.022	0.0051	0.011	-	-	0.0023	2.3	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0008	0.000051	0.00033	-	-	0.00013	1.3	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0009	0.00023	0.00048	-	-	0.00015	0.185	-	-	0.00010	0.1
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0029	0.00083	0.0016	-	-	0.0011	0.179	-	-	0.0010	0.2
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.062	0.010	0.030	-	-	0.012	0.386	-	-	0.0063	0.2
NOTES: 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT. 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON. 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE. 7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.																				

Table H.12: Predicted Water Quality in the Mary River Under 10-Year Dry Conditions (East Discharge)

Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario		COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN RECEIVING WATERS								
													WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)				
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Flows Used		10-Year Low Flow Volume of Effluent from East Pond = 244,291 m³/yr -10-Year Low Flow Volume of Effluent from Open Pit = 148,485 m³/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 392,777 m³/yr 10-Year Low Flow Volume to mix at MR- 12 = 2,740,417 m³/yr	10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m³/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m³/yr	Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile
										Pit Water Source Terms (Year 21)	East Waste Rock Source Terms										
pH	0	8.01	8.31		7.83	8.20		6.5 - 9.0	-	4.20	6.9	5.88	7.74	-	8.01	-	7.83	-	8.19	-	
Hardness	mg/L CaCO ₃	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-	
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	6.4	0.144	2.50	0.33	0.4	0.35	0.4	0.20	0.2	0.39	0.4	
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.012	0.004	0.01	-	-	0.0012	-	-	-	0.00016	-	
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.011	0.003	0.006	-	-	0.002	0.3	-	-	0.001	0.2	
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0515	0.077	0.07	0.01673	-	0.018	-	0.010	-	0.013	-	
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-	
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.17	0.030	0.082	-	-	0.019	0.01	-	-	0.011	0.01	
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00024	0.00002	0.0001	-	-	0.00003	1.1	-	-	0.00002	0.7	
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.029	0.003	0.013	0.003	0.5	0.003	0.5	0.0018	0.4	0.0020	0.4	
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.080	0.0010	0.031	0.004	-	0.004	-	0.0004	-	0.0004	-	
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.112	0.004	0.045	-	-	0.006	1.4	-	-	0.0021	0.4	
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.33	0.002	0.13	0.051	0.04	0.060	0.05	0.17	0.1	0.34	0.3	
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0033	0.0002	0.001	0.0003	0.3	0.0004	0.4	0.00029	0.3	0.00084	0.8	
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.86	0.00006	0.33	0.043	-	0.050	-	0.006	-	0.01221	-	
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0024	0.001	0.001	-	-	0.0003	9.8	-	-	0.00011	4.2	
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.041	0.012	0.023	0.006	0.08	0.007	0.1	0.0030	0.04	0.0051	0.07	
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.17	0.002	0.064	0.011	0.1	0.012	0.1	0.004	0.04	0.0054	0.07	
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.033	0.008	0.02	-	-	0.003	3.1	-	-	0.0011	1.1	
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0012	0.0001	0.001	-	-	0.0002	1.5	-	-	0.00010	1.0	
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0014	0.0003	0.001	-	-	0.0002	0.2	-	-	0.00010	0.1	
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-	
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0044	0.001	0.002	-	-	0.001	0.2	-	-	0.0010	0.2	
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.094	0.015	0.045	-	-	0.014	0.5	-	-	0.0064	0.2	
NOTES 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT. 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON. 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE. 7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT																					

Table H.13: Predicted Water Quality in the Mary River Under Mean Flow Conditions (All Discharges)

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDME R	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (FROM TABLE 7-3.18)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m³/yr Mean Volume to mix in Mary River = 78,185,678 m3/yr		Mean Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 82,932,940 m³/yr Mean Volume of ROM Pond = 18,203 m³/yr Mean Volume of Effluent from Main Ore Stockpiles = 143,489 m³/yr Total Ore Effluent = 161,692 m³/yr Additional Dilution in Mary River = 5,333,330 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects			Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)						Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010- 09-07)	Fine Ore Total Metals (2010- 09-19)	Mean Ore Stockpile Source Terms	95th Percentile Ore Stockpile Source Terms						
pH	0	7.83	8.20		6.– - 9.0	-	5.76	5.93	6.68	6.48	6.21	6.65	7.8	8.2	7.8	-	8.2	-
Hardness	mg/L CaCO ₃	58	105		-	-												
Aluminum	mg/L	0.191	0.394	81%	0.94	-	0.127	<0.015	<0.02	<0.06	0.044	0.112	0.19	0.39	0.19	0.2	0.39	0.4
Antimony	mg/L	-	0.0001	0%	-	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.00015	-	-	0.00015	-
Arsenic	mg/L	-	0.0010	4%	0.005	0.50	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.0010	-	-	0.0010	0.2
Barium	mg/L	0.01011	0.01319	47%	-	-	0.0236	0.0251	0.0213	0.0115	0.020	0.025	0.010	0.013	0.010	-	0.013	-
Beryllium	mg/L	-	0.0005	0%	0.0053	-	<0.0025	<0.0025	<0.01	<0.01	0.003	0.005	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	1.5	-	0.16	0.16	0.21	0.31	0.210	0.295	-	0.010	-	-	0.011	0.007
Cadmium	mg/L	0.00003	0.00010	0%	0.000029	-	0.000203	0.000198	<0.0002	0.00057	0.00027	0.00051	-	0.00002	-	-	0.00003	0.9
Chromium	mg/L	0.0018	0.0020	8%	0.0047	-	<0.0025	<0.0025	<0.01	<0.01	0.003	0.0050	0.0018	0.0020	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0002	4%	-	-	0.09740	0.1080	0.0462	0.1400	0.098	0.1352	0.0003	0.0004	0.00058	-	0.00059	-
Copper	mg/L	0.0012	0.0018	38%	0.0047	0.30	0.00183	<0.0025	<0.002	<0.01	0.002	0.0045	-	0.0020	-	-	0.0019	0.4
Iron	mg/L	0.18	0.36	19%	1.2	-	0.825	0.031	0.041	0.082	0.24	0.714	0.17	0.34	0.17	0.1	0.34	0.3
Lead	mg/L	0.00029	0.00087	13%	0.001	0.20	<0.0003	0.001	<0.001	<0.001	0.0005	0.0009	0.00029	0.00084	0.00029	0.3	0.00084	0.8
Manganese	mg/L	0.00386	0.01000	32%	-	-	18.4	21.5	65.5	112	54.4	105.0	0.005	0.01147	0.197	-	0.203	-
Mercury	mg/L	-	0.00010	0%	0.000026	-	<0.00001	0.00004	<0.00001	<0.00001	0.00001	0.00003	-	0.00011	-	-	0.00011	4.0
Molybdenum	mg/L	0.00288	0.00500	38%	0.073	-	<0.00025	<0.00025	<0.001	0.0012	0.0005	0.001	0.0030	0.0051	0.0030	0.04	0.0051	0.1
Nickel	mg/L	0.0031	0.0050	10%	0.083	0.50	0.0977	0.107	0.035	0.113	0.088	0.112	0.0034	0.0053	0.0036	0.04	0.005	0.1
Selenium	mg/L	-	0.001	0%	0.001	-	<0.005	0.0051	<0.02	<0.02	0.007	0.010	-	0.0011	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	0.0001	-	<0.00005	<0.00005	<0.0002	<0.0002	0.00006	0.00010	-	0.00010	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	0.0008	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.00010	-	-	0.00010	0.1
Uranium	mg/L	0.00252	0.00468	100%	0.015	-	0.00010	<0.00005	<0.0002	<0.0002	0.00008	0.00010	-	-	-	-	-	-
Vanadium	mg/L	0.001	0.001	0%	0.006	-	<0.005	<0.005	<0.02	<0.02	0.006	0.010	-	0.0010	-	-	0.0010	0.2
Zinc	mg/L	0.003	0.006	8%	0.03	0.50	<0.005	<0.015	<0.02	<0.06	0.013	0.027	-	0.0063	-	-	0.0063	0.2
NOTES																		
1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER																		
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT																		
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).																		
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.																		
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON																		
6. DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE																		

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDME R	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (FROM TABLE 7-3.18)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m³/yr Mean Volume to mix in Mary River = 78,185,678 m3/yr		Mean Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 82,932,940 m³/yr Mean Volume of ROM Pond = 18,203 m³/yr Mean Volume of Effluent from Main Ore Stockpiles = 143,489 m³/yr Total Ore Effluent = 161,692 m³/yr Additional Dilution in Mary River = 5,333,330 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects									Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	Mean Ore Stockpile Source Terms	95th Percentile Ore Stockpile Source Terms						
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT																		

Table H.14: Predicted Water Quality in the Mary River Under 10-Year Dry Conditions (All Discharges)

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (TABLE 7-3.19)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m3/yr		10-Year Low Flow Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 56,299,454 m³/yr 10-Year Low Flow Volume of ROM Pond = 12,378 m³/yr 10-Year Low Flow Volume of Effluent from Main Ore Stockpiles = 97,573 m³/yr Total Ore Effluent = 109,951 m³/yr Additional Dilution in Mary River = 3,626,664 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects									Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	95th Percentile Ore Stockpile For Mean Flows Source Terms	Ore Stockpile Source Terms (Dry Year)						
pH	0	7.83	8.20		6.-- 9.0	-	5.76	5.93	6.68	6.48	6.65	6.65	7.83	8.01	7.82	-	8.0	-
Hardness	mg/L CaCO ₃	58	105		-	-												
Aluminum	mg/L	0.191	0.394	81%	0.94	-	0.127	<0.015	<0.02	<0.06	0.112	0.170	0.20	0.39	0.20	0.2	0.39	0.4
Antimony	mg/L	-	0.0001	0%	-	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.000162	-	-	0.00016	-
Arsenic	mg/L	-	0.0010	4%	0.005	0.50	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.00103	-	-	0.00103	0.2
Barium	mg/L	0.01011	0.01319	47%	-	-	0.0236	0.0251	0.0213	0.0115	0.025	0.038	0.010	0.013	0.011	-	0.013	-
Beryllium	mg/L	-	0.0005	0%	0.0053	-	<0.0025	<0.0025	<0.01	<0.01	0.005	0.008	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	1.5	-	0.16	0.16	0.21	0.31	0.295	0.447	-	0.011	-	-	0.011	0.008
Cadmium	mg/L	0.00003	0.00010	0%	0.000029	-	0.000203	0.000198	<0.0002	0.00057	0.00051	0.00078	-	0.000021	-	-	0.000027	0.9
Chromium	mg/L	0.0018	0.0020	8%	0.0047	-	<0.0025	<0.0025	<0.01	<0.01	0.0050	0.008	0.0018	0.0020	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0002	4%	-	-	0.09740	0.1080	0.0462	0.1400	0.1352	0.205	0.0004	0.0004	0.0008	-	0.0008	-

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (TABLE 7-3.19)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m3/yr		10-Year Low Flow Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 56,299,454 m³/yr 10-Year Low Flow Volume of ROM Pond = 12,378 m³/yr 10-Year Low Flow Volume of Effluent from Main Ore Stockpiles = 97,573 m³/yr Total Ore Effluent = 109,951 m³/yr Additional Dilution in Mary River = 3,626,664 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects									Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)					
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	95th Percentile Ore Stockpile For Mean Flows Source Terms	Ore Stockpile Source Terms (Dry Year)						
Copper	mg/L	0.0012	0.0018	38%	0.0047	0.30	0.00183	<0.0025	<0.002	<0.01	0.0045	0.007	-	0.0021	-	-	0.0020	0.4
Iron	mg/L	0.18	0.36	19%	1.2	-	0.825	0.031	0.041	0.082	0.714	1.08	0.17	0.34	0.17	0.1	0.35	0.3
Lead	mg/L	0.00029	0.00087	13%	0.001	0.20	<0.0003	0.001	<0.001	<0.001	0.0009	0.001	0.00029	0.00084	0.0003	0.3	0.00084	0.8
Manganese	mg/L	0.00386	0.01000	32%	-	-	18.4	21.5	65.5	112	105.0	159.1	0.006	0.012	0.30	-	0.30	-
Mercury	mg/L	-	0.00010	0%	0.000026	-	<0.00001	0.00004	<0.00001	<0.00001	0.00003	0.00005	-	0.00011	-	-	0.00011	4.2
Molybdenum	mg/L	0.00288	0.00500	38%	0.073	-	<0.00025	<0.00025	<0.001	0.0012	0.001	0.0017	0.0030	0.0051	0.0030	0.04	0.0051	0.1
Nickel	mg/L	0.0031	0.0050	10%	0.083	0.50	0.0977	0.107	0.035	0.113	0.112	0.170	0.004	0.0054	0.0038	0.05	0.0057	0.1
Selenium	mg/L	-	0.001	0%	0.001	-	<0.005	0.0051	<0.02	<0.02	0.010	0.015	-	0.0011	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	0.0001	-	<0.00005	<0.00005	<0.0002	<0.0002	0.0001	0.0002	-	0.00010	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	0.0008	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.00010	-	-	0.00011	0.1
Uranium	mg/L	0.00252	0.00468	100%	0.015	-	0.00010	<0.00005	<0.0002	<0.0002	0.0001	0.0002	-	-	-	-	-	-
Vanadium	mg/L	0.001	0.001	0%	0.006	-	<0.005	<0.005	<0.02	<0.02	0.010	0.015	-	0.0010	-	-	0.0010	0.2
Zinc	mg/L	0.003	0.006	8%	0.03	0.50	<0.005	<0.015	<0.02	<0.06	0.027	0.041	-	0.0064	-	-	0.0065	0.2
NOTES: 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT. 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON. 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.																		

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Pit Lake Water and Waste Rock Discharges to Mary River in Post-Closure – Impact Statement SWSQ-13

At the end of mining, the open pit will gradually fill with water from precipitation; time is estimated at 85 to 147 years, depending on annual precipitation, evaporation and other factors (Knight Piésold, 2008).

During the years that the pit is filling, runoff will continue to discharge to tributary F0 and the Mary River from the East Waste Rock Pond.

AMEC (2012b) developed water quality estimates for pit water for the final year of mining (Year 21), which were applied in a water quality model under the assumption that, once the pit has filled, in each subsequent (post-Closure) year all precipitation into the open pit will accumulate and spill over the southern edge facing the Mary River, behaving like a spillway, and that water will be released during the open water period according to the natural hydrograph.

Based on pit water quality for Year 21 of mining, it is possible the water will have a pH of around 4.2, which is outside of the pH range of the MDMR (6.0 to 9.0). Adjustment of pH will be carried out periodically through post-closure using either batch lime treatment or in-line treatment, drawing down the pit lake periodically. As mentioned in above, the mass loading modelling carried out is based on conservative assumptions and Baffinland is continuing to study the geochemistry of waste rock and ore to further refine predictions, management plans, and post-closure strategies.

Residual Effects Ratings

Magnitude

The estimated water quality in the Mary River from pit water and waste rock stormwater discharges, assuming no treatment to adjust pH of pit water, is presented in Table H.15. The mass balance modelling indicates that Level I magnitude effects to water quality will occur under low flow conditions, with a calculated HQ between 1 and 10 for mercury, selenium and silver. It is noted that an HQ >10 was calculated for mercury within the F0 tributary, upstream of fish; however, since the assessment of water and sediment quality is based on fish as the receptor, the effects assessment considers the resultant water quality at fish habitat within the Mary River, where all parameters have an HQ value less than 10.

Duration

The effects associated with the discharge of pit water and waste rock runoff into the Mary River are permanent; Level III duration. The waste rock seepage will run off into the Mary River starting in the first year post-closure, whereas the pit water is not expected to discharge to the Mary River until the pit fills, after 80 years or more.

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Frequency

The frequency of the potential effect will be annual, limited to the period between June and September when discharge is proposed. A Level II frequency rating was assigned.

Extent

The extent of the potential effect is likely to be limited to the Mine Site freshwater LSA; a Level I extent rating was assigned.

Reversibility

The effects associated with the discharge of pit water and waste rock runoff into the Mary River is partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-13 – Pit Lake Water and Waste Rock Discharges to Mary River in Post-Closure

Based on these ratings, discharge of pit water and stormwater from the East Waste Rock Sedimentation Pond into the Mary River is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence (Table H.8) is Medium, due to the assumptions made in the mass loading models and the consequently highly conservative nature of the effect prediction.

Table H.15: Predicted Water Quality in the Mary River During Post-Closure Due to Discharges of Pit Water and Waste Rock Stormwater Under 10-Year Low Flow Conditions

										COMBINED EFFLUENT			WATER QUALITY IN RECEIVING WATERS								
Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario			DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN TRIB MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 (FISH HABITAT)			
										Flows Used			10-Year Low Flow Volume of Effluent from East Pond = 244,291 m³/yr 10-Year Low Flow Volume of Effluent from Open Pit = 296,971 m³/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 541,262 m³/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m³/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond & Open Pit = 3,281,679 m³/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m³/yr			
		Baseline Concentrations			Mean	Mean	HQ						90th Percentile	HQ	Mean	HQ	90th Percentile	HQ			
										Pit Water Source Terms (Year 21)	East Waste Rock Source Term (Mean Flows)	East Waste Rock Source Terms (Dry Year)									
pH	0	8.01	8.31		7.83	8.20		6.5 - 9.0	-	4.20	6.9	6.9	5.42	7.58	-	7.83	-	7.82	-	8.18	-
Hardness	mg/L CaCO₃	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	mg/L	5.7	18.6		8.3	17.0		120	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	-	2		3	6		15	15.00	-	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity	mg/L CaCO₃	74	108		47	81		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L	0.06	0.11		0.05	0.07		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate	mg/L	0.1	0.1		-	0.1		13	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite	mg/L	0.011	0.017		0.010	0.014		0.06	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	mg/L	2	4		3	5		-	-	239	26	39	149	26	-	28	-	4	-	6	-
Total Phosphorous	mg/L	0.013	0.030		0.013	0.026		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	6.4	0.095	0.144	3.56	0.60	0.6	0.62	0.7	0.21	0.229	0.41	0.4
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.012	0.003	0.004	0.01	-	-	0.0017	-	-	-	0.00019	-
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.011	0.002	0.003	0.007	-	-	0.0020	0.4	-	-	0.00106	0.2
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0515	0.051	0.077	0.06	0.01831	-	0.019	-	0.011	-	0.014	-
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.17	0.020	0.030	0.105	-	-	0.026	0.02	-	-	0.011	0.01
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00024	0.00002	0.00002	0.0001	-	-	0.000040	1.4	-	-	0.000021	0.7
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.029	0.002	0.003	0.017	0.004	0.8	0.0037	0.8	0.0019	0.406	0.0021	0.4
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.080	0.0006	0.0010	0.044	0.008	-	0.0076	-	0.0006	-	0.00063	-
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.112	0.003	0.004	0.063	-	-	0.011	2.4	-	-	0.0023	0.5
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.33	0.001	0.002	0.18	0.064	0.1	0.072	0.06	0.17	0.144	0.34	0.3
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0033	0.0002	0.0002	0.002	0.0005	0.5	0.00049	0.5	0.00030	0.299	0.00085	0.8
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.86	0.00004	0.00006	0.47	0.080	-	0.087	-	0.008	-	0.01445	-
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0024	0.00045	0.00068	0.002	-	-	0.00035	13.6	-	-	0.00011	4.4
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.041	0.008	0.012	0.028	0.007	0.1	0.0088	0.12	0.0031	0.043	0.0052	0.07
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.17	0.002	0.002	0.092	0.018	0.2	0.019	0.2	0.004	0.048	0.0058	0.07
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.033	0.005	0.008	0.02	-	-	0.0044	4.4	-	-	0.0012	1.2

										COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND			WATER QUALITY IN RECEIVING WATERS									
Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario			WATER QUALITY IN TRIB MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 (FISH HABITAT)					
										Flows Used			10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 541,262 m³/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m³/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond & Open Pit = 3,281,679 m³/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m³/yr					
		Baseline Concentrations			Mean	Mean	HQ						90th Percentile	HQ	Mean	HQ	90th Percentile	HQ				
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Pit Water Source Terms (Year 21)	East Waste Rock Source Term (Mean Flows)	East Waste Rock Source Terms (Dry Year)										
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0012	0.0001	0.0001	0.001	-	-	0.00020	2.0	-	-	0.00011	1.1	
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0014	0.0002	0.0003	0.001	-	-	0.00023	0.3	-	-	0.00011	0.1	
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-	
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0044	0.001	0.001	0.003	-	-	0.0013	0.2	-	-	0.0010	0.2	
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.094	0.010	0.015	0.058	-	-	0.017	0.6	-	-	0.0066	0.2	
NOTES: 1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER. 2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT. 3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012). 4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON. 5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. 6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE. 7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.																						

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References

1. AMEC 2012c. Interim Mine Rock ML/ARD Report, Mary River Project, January 2012.
2. AMEC. 2012a. Interim Waste Rock Stockpile Seepage Quality Model Report, Mary River Project. January 2012.
3. AMEC. 2012b. Interim Open Pit Water Quality Model Technical Memorandum, Mary River Project. January 2012.

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Appendix I

Phase 2 Marginal Closure and Reclamation Financial Security Estimate



Phase 2 Marginal Closure and Reclamation Financial Security Estimate

30 April 2019

2019-04-30	0	Issued for Permitting					
			C. Murray	M. Lord-Hoyle	S. Proulx	P. Du Toit	B. Penney
Date	Rev.	Status	Prepared By	Checked By			Approved By

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1. Introduction

1.1 Purpose

The purpose of this Phase 2 Marginal Closure and Reclamation Financial Security Estimate ('Phase 2 Estimate') is to provide a summary of the closure and reclamation security estimated to be required for Phase 2 of the Mary River Project (the Project) to meet reclamation objectives as outlined in the Interim Closure and Reclamation Plan (BAF-PH1-830-P16-0012). The total 'global' closure and reclamation security estimated to be required takes into consideration the existing reclamation estimate and planned work conducted under the existing and approved Type "A" Water Licence 2AM-MRY1325, Amendment No. 1 and the Qikiqtani Inuit Association's (QIA) Commercial Lease No. Q13C301, and the new Phase 2 construction and infrastructure currently under consideration by the Nunavut Impact Review Board (NIRB) and the Nunavut Water Board (NWB) project amendment process. For clarity, all existing works and infrastructure for the approved Mary River Project are not under review in this Phase 2 Estimate, which only considers the marginal increase associated with the Phase 2 proposal.

The Phase 2 Estimate is intended to be inclusive of all closure and reclamation costs estimated to be required for a 3rd Party Contractor to perform the work in a 'worst-case' scenario for all disturbed areas, project components and project activities existing on the Mary River Project site upon conclusion of the Phase 2 proposal.

In order for the Phase 2 Estimate to accurately reflect the total 'global' closure and reclamation security estimated to be required for the Project, this document also provides a summary of the identified Project components and activities that have materially changed from the position presented by Baffinland Iron Mines Corporation (Baffinland) during the Annual Security Review (ASR) process for the Approved project. Based on these identified material changes, the resulting associated security impacts (+/- \$) are also presented for incorporation into the Phase 2 Estimate to ensure accurate representation of the Project based on current planning.

1.2 Regulatory Context

This Phase 2 Estimate was prepared in support of the permitting process for the Phase 2 proposal, currently under review. Baffinland is seeking an amendment to Project Certificate No. 005 and the Type 'A' Water Licence 2AM-MRY1325, Amendment No. 1. The Phase 2 Estimate represented Baffinland's proposed adjustment to reclamation security to account for work planned in the Phase 2 proposal, based on an estimate of the highest reclamation liability for the execution of the Phase 2 proposal.

Under the Approved project, an annual adjustment to reclamation security is required under Section 9.2 of the Commercial Lease, No. Q13C301, agreed to between Baffinland and the QIA, as well as a requirement under the Type 'A' Water Licence 2AM-MRY1325, Amendment No. 1 (Part J, Item 3), and in consideration of the QIA Abandonment and Reclamation (A&R) Policy (QIA, 2013). Additionally, Part C, Item 3 of the Type 'A' Water Licence 2 AM-MRY1325 and Section 9.2, Part i) of the Commercial Lease, No. Q13C301 allows for Baffinland (the Licensee) to request a change to the total amount of security outside of the ASR process.

1.3 Applied Rates

The 2019 Estimate was developed by applying the direct cost unit rates established in the 2014 Complete Project Financial Security Assessment¹ to quantities of functional units of each activity or project component proposed/changed under the 2019 Estimate, unless indicated otherwise. As a result of ongoing discussions with QIA regarding the High Uncertainty Items for the Mary River Project Financial Security Estimate, an evaluation and update of the unit rates was completed in 2018. Updated unit rates from 2018 were utilized in the preparation of this estimate, outlined in Section 1.3.1.

Based on the direct cost estimate, indirect costs required to support direct cost work were accounted for proportional to assumptions and considerations applied in the 2014 Complete Project Financial Security Assessment. Indirect costs are additional costs outside of costs required for direct reclamation activities that are required to ensure reclamation objectives are met. The sum of direct and indirect estimated costs for the 2019 Estimate was then differentiated based on geographic liability allocation (IOL vs. Crown land) and relation to land or water liability. Appendix A presents the Mary River Project Estimate Breakdown Structure (EBS) which demonstrates the results of this process for all activities or project components proposed under the 2019 Estimate and all previous project financial security liabilities as described in previous ASR submissions.

All costs are in Canadian Dollars (CAD). All monetary totals are rounded to the nearest '000.

1.3.1 Unit Rates

Through discussions with QIA on the High Uncertainty Items, it was determined that an evaluation of labour and equipment rates should be completed to update the direct cost unit rates to be reflective of current market rates. Based on the updated labour (\$75/hr) and equipment rates (\$125/hr) for the Project, the direct cost unit rates for all reclamation activities have been updated, and are presented in Table 1-1 for reference.

Table 1-1. Unit Rate Table

Description	Unit	Unit Rate (\$/unit)
Fill Application	m ²	38.83
Grade & Re-Contour	m ²	1.49
Grade & Re-Contour with Liner	m ²	4.12
Culvert Removal	m	50
Liner Removal	m ²	2.62
Open Pit Stabilization	m ³	5.49
Light Mechanical Equipment	Ea	1,583.75
Medium Mechanical Equipment	Ea	3,392.50
Heavy Mechanical Equipment	Ea	32,950.00
Light Mobile Equipment	Ea	729.17
Medium Mobile Equipment	Ea	1,162.50
Heavy Mobile Equipment	Ea	2,075.00
Light Tanks	Ea	1,710.42
Medium Tanks	Ea	5,900.00

¹ As described in 2014 Complete Project Financial Security Assessment, H349000-1000-07-126-0018, Rev.1. Hatch. Submitted to parties October 31, 2014.

Description	Unit	Unit Rate (\$/unit)
Light Diesel Tanks	Ea	2,950.00
Medium Mobile Diesel Tanks	Ea	8,381.25
Medium Diesel Tanks	Ea	12,928.50
Large Diesel Tanks	Ea	85,157.50
Largest Diesel Tanks	Ea	137,277.50
Modular Building Not Contaminated	m ²	47.64
Modular Building Contaminated	m ²	114.89
Fold Away Building Not Contaminated	m ²	33.34
Fold Away Building Contaminated	m ²	114.04
Soft Walled Building (tent) Not Contaminated	m ²	38.11
Soft Walled Building (tent) Contaminated	m ²	128.86
ISO Container	m ²	23.82
Timber Cribbing	m ²	16.67
Precast Concrete Foundations	m ²	30.86
Slab on Grade	m ²	30.00
Bridge Removal	Lot	161,904.76
Incinerator	Ea	7,925.00
Potable Water	Ea	7,925.00
Sewage Treatment Plant	Ea	8,775.00
Ship Loader	Lot	3,070,200.00
Waste Rock Facility Water Treatment Plan	Lot	61,750.00
Reclaim Conveyor	Lot	1,066,410.00
Piping	m	53.13
Cabling	m	21.25
Miscellaneous Items (Minor)	ea	425.00
Removal of Airstrip Lighting	m	21.25

1.4 Document Structure

The following outlines the structure of the Phase 2 Estimate document:

- Section 1 presents the purpose, regulatory context, applied rates used, and document structure applicable to the Phase 2 Estimate;
- Section 2 describes the 'Approved Project Reconciliation' process, and its resulting impacts to the Phase 2 Estimate;
- Section 3 provides a summary of the financial security estimated to be required for marginal closure and reclamation liability increase associated with the Mary River Project Phase 2 proposal;
- Section 4 summarizes net impacts to the Phase 2 Estimate; and
- Section 5 lists supporting documentation that was available to determine costs and quantities for the purpose of the Phase 2 Estimate.

2. Project Reconciliation

In order for the Phase 2 Estimate to accurately reflect the total ‘global’ closure and reclamation security estimated to be required for the Phase 2 project, the Approved Project estimates need to be reconciled to ensure applicability.

The current ‘global’ estimate for the Approved Project contained items that were to arrive on sealift in 2019 associated with the Phase 2 proposal. These materials, referred to as the Phase 2 Expansion Project Materials and Equipment, or the “Modules”, consisted of large pieces of pre-fabricated structures and equipment that would support the construction of Phase 2 once approved, but would need to be backhauled from the Site in event of closure prior to approval and construction of the Phase 2 proposal. The cost allocation existing in the ‘global’ estimate for these items is for the backhaul of this equipment, and not the disassembly and disposal of the structures and equipment. As the Phase 2 Estimate contains the costs associated with this infrastructure once constructed, the backhaul cost estimate is removed from the global estimate. A breakdown of the cost outline per module to be removed from the global estimate is provided in the following Table 3-7.

Table 3-7: 2019 Phase 2 Expansion Project Materials and Equipment

Description	Unit Rate (\$/m ³)	Quantity (m ³)	Cost (\$)¹
Rail Construction Materials	68	- 18,172	- 1,235,696
BMH Conveyors	68	- 49,868	- 3,391,024
Car Dumper Module	68	- 24,756	- 1,683,408
Screening Module	68	- 33,278	- 2,262,904
Shiploader Module	68	- 81,400	- 5,535,200
Crushing Module	68	- 21,815	- 1,483,420
TOTAL		- 229,289	- 15,592,000

3. Phase 2 Estimate

3.1 Introduction

The purpose of this section of the document is to provide a summary of the additional financial security estimated to be required for work items described in the Phase 2 Project Addendum to the Final Environmental Impact Statement for the Mary River Project (October 2018). The estimated marginal closure and reclamation financial security required to account for the Phase 2 proposal is intended to be aggregated with the reconciled items in the above Section 2 and previous Project closure and reclamation security bonding. The combination of the reconciliation in Section 2 and the estimate presented in this Section 3 will provide a comprehensive update to the 'global' estimate and the marginal increase required for Phase 2. The result of this approach, the estimated project-wide or 'global' closure and reclamation security bonding totals for the Mary River Project to-date, are presented in Section 4.

A detailed description of the work activities captured in the 2019 Work Plan Security Estimate are described in the Baffinland 2019 Work Plan and are summarized in Section 3.2 below.

3.1.1 Closure Scenario

The Phase 2 Estimate is based on a scenario that assumes all planned activities associated with Phase 2 have taken place on site and all material/consumables (excluding fuel) that are mobilized to site are in full inventory. All other assumptions relating to the estimation of direct and indirect costs, including fuel, associated with the Phase 2 Estimate are consistent with the assumptions established in the 2014 Complete Project Financial Security Assessment and previous ASR documentation unless noted otherwise.

3.2 Phase 2 Planned Activities

As described in the Phase 2 Proposal, planned work is to be conducted under the amended Project Certificate No. 005 Amendment No. 3, QIA Commercial Lease No. Q13C301, Type 'A' Water Licence 2AM-MRY1325, Amendment No. 2 and Type 'B' Water Licence 8BC-MRY1416.

The following list represents the activities from the Phase 2 Proposal planned, but will only proceed following the applicable regulatory approvals where required, and approval from QIA including the posting of any relevant marginal security adjustments or adjustments to the Commercial Lease (e.g. OEN, TRAN). This planned work includes:

1. Development and operation of the mine, ore crushing and land transportation, stockpiling and marine shipment of ore;
2. The continued development and construction of infrastructure required at Milne Port and the Mary River Mine Site (Mine Site) and along the Tote Road for the Mary River Project;
3. Construction and operation of a 110 km rail line within the Northern Transportation Corridor, along with associated water management infrastructure (bridges and culverts), and access roads;
4. Continued operation of Mine Site and Milne Port Camps to support ongoing operations and construction activities which will include the use of water and deposition of waste as authorized under existing permits. Additionally, mobile construction camps will be utilized within the Northern Transportation Corridor to support Phase 2 construction activities;

5. On-going operation and expansion of permitted quarry and borrow sources; additionally, new quarries have been identified along the Tote Road and rail infrastructure within the Northern Transportation Corridor to support construction as well as ongoing maintenance;
6. At Milne Port, vessels carrying fuel, equipment and supplies for use at the Mine Site and Milne Port will arrive in the nominal shipping window from July 1 to November 15. Material, fuel and supplies required for operational and construction activities will be transported to the Mine Site year round via the Tote Road;
7. Ongoing environmental effects studies and baseline data collection will continue to support the construction and operation of the Project as well as for future engineering requirements;
8. Continued environmental monitoring in accordance with the approved Project Certificate, licenses, authorizations, management plans and environmental effects monitoring plans;
9. On-going exploration activities including drilling, mapping, prospecting, sampling, and geophysics;
10. Tote Road improvements to address safety concerns, freshet runoff issues and poor road conditions during the spring and summer periods;
11. Continued construction of additional fuel storage at the project, including an additional 30 ML of arctic diesel storage tanks at the Mine Site;
12. Expansion and additional of facilities at Milne Port, including: rail car offloading, movement of secondary crushing and screening to Milne Port using pre-fabricated crushing and screening modules, expansion of ore stockpiles, installation of a new stacker/reclaimer system, a second shiploader, and a second ore dock; and
13. Expansion and addition of facilities and equipment at the Mine Site, including: rail car loading, rail loop, relocated primary crushing facility with new sedimentation pond, and increased number of large mine haul trucks (CAT 973).

A detailed description of these work activities is provided in the Phase 2 Proposal.

3.3 Phase 2 Security Estimate Assumptions

3.3.1 Direct Cost Assumptions

The following sub-sections describe the assumptions used to establish the direct costs allocated in the Phase 2 Estimate based on the Phase 2 Proposal. Please refer to Appendix A for details of this cost allocation based on the Estimate Breakdown Structure (EBS), Appendix B for locations of below noted facilities, and Appendix C for supporting documentation relating to estimated unit quantities (where available). Direct cost allocations were applied to quantities as indicated in the Phase 2 Proposal and consistent with the direct cost assumptions described in the 2014 Complete Project Financial Security Assessment.

3.3.1.1 *Buildings and Foundations*

The Phase 2 Estimate allocates \$229,000 plus proportional cover material application costs, in direct costs to account for a marginal increase of buildings and foundations associated with

Phase 2. This marginal increase of buildings and foundations is itemized in the EBS as presented in Appendix A. This additional cost allocation is based on:

- Construction of the Car Dumper, Crushing and Screening buildings at Milne Port, with associated concrete foundations; and
- Mobilization of three (3) 50 person rapid deployment camps consisting of soft walled tents during the construction of the railway along the Northern Transportation Corridor.

A summary of security costs associated with the marginal increase of buildings and foundations associated with Phase 2 is shown in Table 3-1 and Table 3-2.

Table 3-1: Summary of Marginal Increase of Buildings

Description	Unit Rate Type	Unit Rate (\$/ea)	Quantity (ea)	Cost (\$)¹
Milne Port				
Car Dumper Building	Steel Building Teardown	51,875	1	51,875
Crushing Building	Steel Building Teardown	51,875	1	51,875
Screening Building	Steel Building Teardown	51,875	1	51,875
Description	Unit Rate Type	Unit Rate (\$/m²)	Quantity (m²)	Cost (\$)¹
Northern Transportation Corridor				
50 Person Rapid Deployment Construction Camps	Soft Walled Modular Building (Not Contaminated)	38.11	1,000	38,108
		TOTAL	3	194,000

NOTES:

- 1) Grand total rounded to nearest '000

Table 3-2: Summary of Marginal Increase of Foundation Areas

Description	Unit Rate Type	Unit Rate (\$/m²)	Quantity (m²)	Cost (\$)¹
Milne Port				
Car Dumper Building	Steel Building Teardown	30.86	320	9,874
Crushing Building	Steel Building Teardown	30.86	400	12,343
Screening Building	Steel Building Teardown	30.86	400	12,343
		TOTAL	3	35,000

NOTES:

- 1) Grand total rounded to nearest '000

3.3.1.2 Mechanical and Mobile Equipment

The Phase 2 Estimate allocates \$9,974,000, plus cover material application costs, in direct costs to account for a marginal increase of mechanical and mobile equipment. This cost allocation is based on an additional 261 pieces of Baffinland owned mechanical or mobile equipment to be mobilized to site. This is in addition to 11 pieces of 3rd Party 'Heavy Mobile Equipment', and 5 pieces of 3rd Party Light Mobile Equipment', to update the 'Typical' 3rd Party equipment fleet adopted in the 2017 ASR Process to Phase 2 expectations. In addition, this estimate also includes new transfer and reclaim conveyors, as well as a second shiploader at Milne Port. A summary of the marginal increase of costs associated with mechanical or mobile equipment and associated unit rates is shown in Table 3-3.

Table 3-3: Summary of Marginal Increase of Mechanical and Mobile Equipment

Description	Unit Rate Type	Unit Rate (\$/pcs)	Quantity (pcs)	Cost (\$)¹
Reclaim Conveyor for Stockpile No. 2	Reclaim Conveyor	1,066,410	3	3,199,230
Transfer Conveyor – Car Dumper to crushing	Reclaim Conveyor	1,066,410	1	1,066,410
Shiploader No. 2	Shiploader	3,070,200	1.5	4,605,300
Cone crusher (secondary crushing)	Heavy Equipment	32,950.0	2	65,900
De-dusting filter	Heavy Equipment	32,950.0	1	32,950
Screener	Heavy Equipment	32,950.0	2	65,900
Car Dumper	Heavy Equipment	32,950.0	1	32,950
Stacker/Reclaimer	Heavy Equipment	32,950.0	2	65,900
Hopper	Heavy Equipment	32,950.0	1	32,950
Apron Feeder	Heavy Equipment	32,950.0	1	32,950
Rail Car Dumper	Heavy Equipment	32,950.0	1	32,950
Discharge Conveyor	Medium Equipment	3,393	1	3,393
Crushing Bin	Medium Equipment	3,393	1	3,393
Overhead Crane	Medium Equipment	3,393	2	6,785
Conveyor	Medium Equipment	3,393	2	6,785
Chutes	Medium Equipment	3,393	2	6,785
Screening Bin	Medium Equipment	3,393	1	3,393
Generator – 1.35 MW	Medium Equipment	3,393	4	13,570
Locomotive	Heavy Mobile Equipment	2,075.0	9	16,600
Rail Cars (ore transport)	Heavy Mobile Equipment	2,075.0	212	439,900
CAT 793 Haul Truck	Heavy Mobile Equipment	2,075.0	12	24,900
CAT 834H Wheel Dozer	Heavy Mobile Equipment	2,075.0	1	2,075
CAT D9 Dozer	Heavy Mobile Equipment	2,075.0	2	4,150
CAT 6060 Shovel	Heavy Mobile Equipment	2,075.0	1	2,075
3rd Party Heavy Mobile Equipment (make up for 'typical' fleet)	Heavy Mobile Equipment	2,075.0	11	22,825
3rd Party Light Mobile Equipment (make up for 'typical' fleet)	Light Mobile Equipment	729.2	5	3,646
TOTAL			283	9,974,000

NOTES:

1) Grand total rounded to nearest '000

3.3.1.3 Site Works

The Phase 2 Estimate allocates \$5,723,000 in direct costs to account for a marginal increase of disturbed areas that would have to be graded and re-contoured associated with Phase 2. This additional cost allocation is based on:

- Construction of settling ponds at Milne Port to support material handling infrastructure, including crushing, screening and stockpiling, with a total pond footprint of 2,260 m²;
- Development of various quarries and laydowns in the Northern Transportation Corridor, with a total footprint of 3,300,609 m²;
- Construction of access roads in the Northern Transportation Corridor totaling a footprint of 450,000 m²; and
- Relocation of the Mine Site Crusher Pad (50,000 m²) and associated sedimentation pond (9,000 m²).

This marginal increase is based on an additional 3,811,869 m² of disturbed areas at a revised unit rate of \$1.49/m² for unlined or \$4.12/m² for lined, and is itemized in the EBS as presented in Appendix A and outlined in Table 3-4.

Table 3-4: Summary of Marginal Increase of Disturbed Areas Requiring Grade and Re-Contour

Description	Unit Rate Type	Unit Rate (\$/m ²)	Quantity (m ²)	Cost (\$)¹
Milne Port				
Crushing Feed Sedimentation Pond	Grade and Re-Contour With Liner	4.12	500	2,071
Fines Stockpile Sedimentation Pond	Grade and Re-Contour With Liner	4.12	60	249
Western Berm Settling Ditch	Grade and Re-Contour With Liner	4.12	1,700	7,042
Northern Transportation Corridor				
Laydown LD-1	Grade and Contour	1.49	34,287	51,206
Laydown LD-2	Grade and Contour	1.49	26,370	39,381
Laydown LD-3	Grade and Contour	1.49	20,238	30,223
Laydown LD-4	Grade and Contour	1.49	28,304	42,270
Laydown LD-5	Grade and Contour	1.49	15,000	22,401
Laydown LD-6	Grade and Contour	1.49	10,419	15,559
Laydown LD-7	Grade and Contour	1.49	16,271	24,300
Laydown LD-8	Grade and Contour	1.49	6,378	9,525
Laydown LD-9	Grade and Contour	1.49	3,877	5,791
Laydown LD-10	Grade and Contour	1.49	12,229	18,263
Laydown LD-11	Grade and Contour	1.49	9,592	14,324
Laydown LD-12	Grade and Contour	1.49	25,000	37,336
Laydown LD-13	Grade and Contour	1.49	19,594	29,261
Laydown LD-14	Grade and Contour	1.49	3,336	4,981
Laydown LD-15	Grade and Contour	1.49	17,383	25,960
Laydown LD-16	Grade and Contour	1.49	15,088	22,533
Laydown LD-17	Grade and Contour	1.49	23,260	34,737
Laydown LD-18	Grade and Contour	1.49	17,208	25,699
Laydown LD-19	Grade and Contour	1.49	18,664	27,874
Quarry Q4	Grade and Contour	1.49	7,687	11,480
Quarry Q6	Grade and Contour	1.49	6,348	9,480
Quarry Q10	Grade and Contour	1.49	14,140	21,117
Quarry Q11	Grade and Contour	1.49	3,992	5,961
Quarry Q13	Grade and Contour	1.49	78,830	117,726
Quarry Q16	Grade and Contour	1.49	54,478	81,359
Quarry Q19	Grade and Contour	1.49	28,114	41,986
Quarry Q21	Grade and Contour	1.49	11,075	16,539
Quarry Q23	Grade and Contour	1.49	4,041	6,034
Quarry Q24	Grade and Contour	1.49	42,412	63,339
Quarry Q27	Grade and Contour	1.49	90,724	135,489
Quarry Q42	Grade and Contour	1.49	65,788	98,249
Quarry PQ5A	Grade and Contour	1.49	185,619	277,207
Quarry PQ9A	Grade and Contour	1.49	64,483	96,301
Quarry PQ9B	Grade and Contour	1.49	21,836	32,610
Quarry PQ10B	Grade and Contour	1.49	96,596	144,259
Quarry PQ13	Grade and Contour	1.49	446,781	667,232
Quarry PQ14B	Grade and Contour	1.49	94,522	141,161
Quarry PQ15A	Grade and Contour	1.49	83,188	124,235
Quarry PQ15B	Grade and Contour	1.49	61,443	91,761
Quarry PQ4B	Grade and Contour	1.49	122,789	183,376
Quarry PQ5B	Grade and Contour	1.49	472,314	705,363

Description	Unit Rate Type	Unit Rate (\$/m ²)	Quantity (m ²)	Cost (\$)¹
Quarry PQ6B	Grade and Contour	1.49	223,555	333,862
Quarry PQ10A	Grade and Contour	1.49	134,666	201,113
Quarry PQ12B	Grade and Contour	1.49	204,335	305,158
Quarry PQ14A	Grade and Contour	1.49	45,752	68,326
Quarry PQ2B	Grade and Contour	1.49	233,079	348,085
Rail Sand Pit	Grade and Contour	1.49	79,524	118,763
Rail Access Roads (75 km max, 6 m width)	Grade and Contour	1.49	450,000	672,709
Mine Site				
Crusher Pad Relocation	Grade and Re-Contour	1.49	50,000	74,745
Crusher Pad Sedimentation Pond	Grade and Re-Contour With Liner	4.12	9,000	37,280
TOTAL			3,811,869	5,723,000

NOTES:

1) Grand total rounded to nearest '000

3.3.1.4 Storage Tanks

The Phase 2 Estimate allocates \$275,000 in direct costs to account for the mobilization of additional fuel tanks to the Project for Phase 2, including the construction of two (2) 15 million litre arctic diesel tanks at the Mine Site. A summary of the marginal increase of costs associated with water and fuel tanks and their associated unit rates is shown in Table 3-5 and is itemized in the EBS as presented in Appendix A.

Table 3-5: Summary of Marginal Increase of Storage Tanks

Description	Unit Rate Type	Unit Rate (\$/ea)	Quantity (ea)	Cost (\$)¹
Fuel Tanks	Largest Diesel Tanks	137,277.5	2	274,555
TOTAL			2	275,000

NOTES:

1) Grand total rounded to nearest '000

3.3.1.5 Culverts

The Phase 2 Estimate allocates \$316,000 to account for the installation of 6316 m of new culverts in the Northern Transportation Corridor, along the railway alignment. The cost allocation is based on a total of 6316 m of culvert at a unit rate of \$50 per metre and is presented in Table 3-6, and itemized in the EBS presented in Appendix A.

Table 3-6: Summary of Marginal Increase for Culvert Removal

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
Tote Road				
CV-0-1	Culvert Removal Per Metre	50.0	6	300
CV-0-3	Culvert Removal Per Metre	50.0	12	600
CV-1-1	Culvert Removal Per Metre	50.0	12	600
CV-1-2	Culvert Removal Per Metre	50.0	12	600
CV-1-3	Culvert Removal Per Metre	50.0	12	600
CV-1-4	Culvert Removal Per Metre	50.0	12	600
CV-1-5	Culvert Removal Per Metre	50.0	12	600
CV-1-6	Culvert Removal Per Metre	50.0	12	600

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-1-7	Culvert Removal Per Metre	50.0	12	600
CV-1-8	Culvert Removal Per Metre	50.0	12	600
CV-1-9	Culvert Removal Per Metre	50.0	12	600
CV-2-1	Culvert Removal Per Metre	50.0	12	600
CV-2-2	Culvert Removal Per Metre	50.0	12	600
CV-3-1	Culvert Removal Per Metre	50.0	12	600
CV-3-2	Culvert Removal Per Metre	50.0	12	600
CV-4-1	Culvert Removal Per Metre	50.0	12	600
CV-4-2	Culvert Removal Per Metre	50.0	12	600
CV-4-3	Culvert Removal Per Metre	50.0	12	600
CV-4-4	Culvert Removal Per Metre	50.0	12	600
CV-4-5	Culvert Removal Per Metre	50.0	12	600
CV-5-1	Culvert Removal Per Metre	50.0	10	500
CV-5-2	Culvert Removal Per Metre	50.0	10	500
CV-5-3	Culvert Removal Per Metre	50.0	10	500
CV-5-4	Culvert Removal Per Metre	50.0	10	500
CV-5-5	Culvert Removal Per Metre	50.0	10	500
CV-5-6	Culvert Removal Per Metre	50.0	10	500
CV-5-7	Culvert Removal Per Metre	50.0	10	500
CV-6-1	Culvert Removal Per Metre	50.0	24	1,200
CV-6-2	Culvert Removal Per Metre	50.0	10	500
CV-6-3	Culvert Removal Per Metre	50.0	10	500
CV-6-4	Culvert Removal Per Metre	50.0	10	500
CV-7-1	Culvert Removal Per Metre	50.0	12	600
CV-7-2	Culvert Removal Per Metre	50.0	12	600
CV-7-3	Culvert Removal Per Metre	50.0	12	600
CV-7-4	Culvert Removal Per Metre	50.0	12	600
CV-7-5	Culvert Removal Per Metre	50.0	12	600
CV-7-6	Culvert Removal Per Metre	50.0	12	600
CV-7-7	Culvert Removal Per Metre	50.0	12	600
CV-8-1	Culvert Removal Per Metre	50.0	12	600
CV-8-2	Culvert Removal Per Metre	50.0	18	900
CV-8-3	Culvert Removal Per Metre	50.0	12	600
CV-8-4	Culvert Removal Per Metre	50.0	12	600
CV-9-1	Culvert Removal Per Metre	50.0	12	600
CV-10-1	Culvert Removal Per Metre	50.0	6	300
CV-10-2	Culvert Removal Per Metre	50.0	6	300
CV-10-3	Culvert Removal Per Metre	50.0	6	300
CV-10-4	Culvert Removal Per Metre	50.0	6	300
CV-10-5	Culvert Removal Per Metre	50.0	12	600
CV-11-1	Culvert Removal Per Metre	50.0	6	300
CV-11-2	Culvert Removal Per Metre	50.0	12	600
CV-11-3	Culvert Removal Per Metre	50.0	12	600
CV-11-4	Culvert Removal Per Metre	50.0	12	600
CV-11-5	Culvert Removal Per Metre	50.0	12	600
CV-12-1	Culvert Removal Per Metre	50.0	18	900

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-12-2	Culvert Removal Per Metre	50.0	18	900
CV-12-3	Culvert Removal Per Metre	50.0	12	600
CV-12-4	Culvert Removal Per Metre	50.0	6	300
CV-12-5	Culvert Removal Per Metre	50.0	10	500
CV-13-1	Culvert Removal Per Metre	50.0	12	600
CV-13-2	Culvert Removal Per Metre	50.0	12	600
CV-13-3	Culvert Removal Per Metre	50.0	7.5	375
CV-13-4	Culvert Removal Per Metre	50.0	18	900
CV-13-5	Culvert Removal Per Metre	50.0	12	600
CV-14-1	Culvert Removal Per Metre	50.0	12.5	625
CV-14-2	Culvert Removal Per Metre	50.0	12	600
CV-14-3	Culvert Removal Per Metre	50.0	12	600
CV-15-1	Culvert Removal Per Metre	50.0	12	600
CV-15-2	Culvert Removal Per Metre	50.0	24	1,200
CV-15-3	Culvert Removal Per Metre	50.0	17.5	875
CV-15-4	Culvert Removal Per Metre	50.0	15	750
CV-16-1	Culvert Removal Per Metre	50.0	15	750
CV-16-2	Culvert Removal Per Metre	50.0	12.5	625
CV-16-3	Culvert Removal Per Metre	50.0	12	600
CV-17-1	Culvert Removal Per Metre	50.0	17.5	875
CV-18-1	Culvert Removal Per Metre	50.0	30	1,500
CV-18-2	Culvert Removal Per Metre	50.0	18	900
CV-18-3	Culvert Removal Per Metre	50.0	18	900
CV-18-4	Culvert Removal Per Metre	50.0	15	750
CV-19-1	Culvert Removal Per Metre	50.0	18	900
CV-19-2	Culvert Removal Per Metre	50.0	30	1,500
CV-19-3	Culvert Removal Per Metre	50.0	18	900
CV-20-1	Culvert Removal Per Metre	50.0	12	600
CV-21-1	Culvert Removal Per Metre	50.0	12	600
CV-21-2	Culvert Removal Per Metre	50.0	12	600
CV-21-3	Culvert Removal Per Metre	50.0	18	900
CV-21-4	Culvert Removal Per Metre	50.0	18	900
CV-22-1	Culvert Removal Per Metre	50.0	12	600
CV-22-2	Culvert Removal Per Metre	50.0	12	600
CV-22-3	Culvert Removal Per Metre	50.0	12	600
CV-23-1	Culvert Removal Per Metre	50.0	18	900
CV-23-2	Culvert Removal Per Metre	50.0	12	600
CV-23-3	Culvert Removal Per Metre	50.0	12	600
CV-23-4	Culvert Removal Per Metre	50.0	18	900
CV-24-1	Culvert Removal Per Metre	50.0	12	600
CV-24-2	Culvert Removal Per Metre	50.0	18	900
CV-24-3	Culvert Removal Per Metre	50.0	12	600
CV-25-1	Culvert Removal Per Metre	50.0	12	600
CV-25-2	Culvert Removal Per Metre	50.0	13.6	680
CV-25-3	Culvert Removal Per Metre	50.0	20.6	1,030
CV-26-3	Culvert Removal Per Metre	50.0	12	600

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-26-4	Culvert Removal Per Metre	50.0	12	600
CV-26-5	Culvert Removal Per Metre	50.0	12	600
CV-27-1	Culvert Removal Per Metre	50.0	13.6	680
CV-27-2	Culvert Removal Per Metre	50.0	13.6	680
CV-27-3	Culvert Removal Per Metre	50.0	12.5	625
CV-27-4	Culvert Removal Per Metre	50.0	12.5	625
CV-27-5	Culvert Removal Per Metre	50.0	12	600
CV-28-1	Culvert Removal Per Metre	50.0	12	600
CV-28-2	Culvert Removal Per Metre	50.0	12	600
CV-28-3	Culvert Removal Per Metre	50.0	18	900
CV-28-4	Culvert Removal Per Metre	50.0	18	900
CV-28-5	Culvert Removal Per Metre	50.0	18	900
CV-28-6	Culvert Removal Per Metre	50.0	17.5	875
CV-28-7	Culvert Removal Per Metre	50.0	15	750
CV-29-1	Culvert Removal Per Metre	50.0	17.5	875
CV-29-2	Culvert Removal Per Metre	50.0	25	1,250
CV-29-3	Culvert Removal Per Metre	50.0	18	900
CV-29-4	Culvert Removal Per Metre	50.0	12	600
CV-29-5	Culvert Removal Per Metre	50.0	12	600
CV-30-1	Culvert Removal Per Metre	50.0	18	900
CV-30-2	Culvert Removal Per Metre	50.0	18	900
CV-30-3	Culvert Removal Per Metre	50.0	24	1,200
CV-30-4	Culvert Removal Per Metre	50.0	12	600
CV-30-5	Culvert Removal Per Metre	50.0	7.5	375
CV-30-6	Culvert Removal Per Metre	50.0	12	600
CV-30-7	Culvert Removal Per Metre	50.0	12.5	625
CV-31-1	Culvert Removal Per Metre	50.0	20	1,000
CV-31-2	Culvert Removal Per Metre	50.0	20	1,000
CV-31-3	Culvert Removal Per Metre	50.0	12	600
CV-31-4	Culvert Removal Per Metre	50.0	18	900
CV-32-1	Culvert Removal Per Metre	50.0	18	900
CV-32-2	Culvert Removal Per Metre	50.0	12	600
CV-32-3	Culvert Removal Per Metre	50.0	12	600
CV-32-4	Culvert Removal Per Metre	50.0	12	600
CV-33-1	Culvert Removal Per Metre	50.0	12	600
CV-33-2	Culvert Removal Per Metre	50.0	12	600
CV-33-3	Culvert Removal Per Metre	50.0	12	600
CV-33-4	Culvert Removal Per Metre	50.0	18	900
CV-33-5	Culvert Removal Per Metre	50.0	12	600
CV-33-6	Culvert Removal Per Metre	50.0	18	900
CV-33-7	Culvert Removal Per Metre	50.0	10	500
CV-34-1	Culvert Removal Per Metre	50.0	24	1,200
CV-34-2	Culvert Removal Per Metre	50.0	12	600
CV-35-2	Culvert Removal Per Metre	50.0	22.5	1,125
CV-35-4	Culvert Removal Per Metre	50.0	12	600
CV-37-1	Culvert Removal Per Metre	50.0	12	600

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-38-1	Culvert Removal Per Metre	50.0	30	1,500
CV-38-2	Culvert Removal Per Metre	50.0	36	1,800
CV-38-3	Culvert Removal Per Metre	50.0	30	1,500
CV-39-1	Culvert Removal Per Metre	50.0	36	1,800
CV-40-1	Culvert Removal Per Metre	50.0	18	900
CV-40-2	Culvert Removal Per Metre	50.0	18	900
CV-40-3	Culvert Removal Per Metre	50.0	18	900
CV-40-4	Culvert Removal Per Metre	50.0	18	900
CV-41-1	Culvert Removal Per Metre	50.0	12.5	625
CV-41-2	Culvert Removal Per Metre	50.0	18	900
CV-41-3	Culvert Removal Per Metre	50.0	12	600
CV-41-4	Culvert Removal Per Metre	50.0	24	1,200
CV-42-1	Culvert Removal Per Metre	50.0	24	1,200
CV-42-2	Culvert Removal Per Metre	50.0	22.5	1,125
CV-43-1	Culvert Removal Per Metre	50.0	18	900
CV-43-2	Culvert Removal Per Metre	50.0	12	600
CV-43-3	Culvert Removal Per Metre	50.0	18	900
CV-43-4	Culvert Removal Per Metre	50.0	18	900
CV-43-5	Culvert Removal Per Metre	50.0	30	1,500
CV-44-1	Culvert Removal Per Metre	50.0	12	600
CV-44-2	Culvert Removal Per Metre	50.0	18	900
CV-44-3	Culvert Removal Per Metre	50.0	12	600
CV-45-1	Culvert Removal Per Metre	50.0	12	600
CV-46-1	Culvert Removal Per Metre	50.0	18	900
CV-46-2	Culvert Removal Per Metre	50.0	12	600
CV-46-3	Culvert Removal Per Metre	50.0	12	600
CV-46-4	Culvert Removal Per Metre	50.0	12	600
CV-46-6	Culvert Removal Per Metre	50.0	12	600
CV-47-1A	Culvert Removal Per Metre	50.0	12	600
CV-47-1B	Culvert Removal Per Metre	50.0	12	600
CV-47-1	Culvert Removal Per Metre	50.0	13.6	680
CV-47-2	Culvert Removal Per Metre	50.0	15	750
CV-47-3	Culvert Removal Per Metre	50.0	17.5	875
CV-48-1	Culvert Removal Per Metre	50.0	12	600
CV-48-2	Culvert Removal Per Metre	50.0	12	600
CV-48-3	Culvert Removal Per Metre	50.0	12	600
CV-48-4	Culvert Removal Per Metre	50.0	27.5	1,375
CV-49-1	Culvert Removal Per Metre	50.0	12	600
CV-49-2	Culvert Removal Per Metre	50.0	16.1	805
CV-49-3	Culvert Removal Per Metre	50.0	12	600
CV-50-1	Culvert Removal Per Metre	50.0	12	600
CV-50-2	Culvert Removal Per Metre	50.0	12	600
CV-50-3	Culvert Removal Per Metre	50.0	12	600
CV-50-4	Culvert Removal Per Metre	50.0	12	600
CV-50-4a	Culvert Removal Per Metre	50.0	12	600
CV-50-4b	Culvert Removal Per Metre	50.0	12	600

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-50-5	Culvert Removal Per Metre	50.0	30	1,500
CV-50-6	Culvert Removal Per Metre	50.0	30	1,500
CV-51-1	Culvert Removal Per Metre	50.0	24	1,200
CV-51-2	Culvert Removal Per Metre	50.0	30	1,500
CV-52-1	Culvert Removal Per Metre	50.0	12	600
CV-52-2	Culvert Removal Per Metre	50.0	18	900
CV-52-3	Culvert Removal Per Metre	50.0	12	600
CV-53-1	Culvert Removal Per Metre	50.0	12	600
CV-53-2	Culvert Removal Per Metre	50.0	36	1,800
CV-54-1	Culvert Removal Per Metre	50.0	24	1,200
CV-54-2	Culvert Removal Per Metre	50.0	12.5	625
CV-55-1	Culvert Removal Per Metre	50.0	18	900
CV-55-2	Culvert Removal Per Metre	50.0	12	600
CV-55-3	Culvert Removal Per Metre	50.0	12.5	625
CV-56-1	Culvert Removal Per Metre	50.0	12.2	610
CV-57-1	Culvert Removal Per Metre	50.0	12.2	610
CV-57-2	Culvert Removal Per Metre	50.0	12.2	610
CV-58-1	Culvert Removal Per Metre	50.0	9.76	488
CV-58-2	Culvert Removal Per Metre	50.0	9.76	488
CV-58-3	Culvert Removal Per Metre	50.0	9.76	488
CV-58-4	Culvert Removal Per Metre	50.0	12.2	610
CV-58-4a	Culvert Removal Per Metre	50.0	12.2	610
CV-58-5	Culvert Removal Per Metre	50.0	12.2	610
CV-58-6	Culvert Removal Per Metre	50.0	12.2	610
CV-59-1	Culvert Removal Per Metre	50.0	9.76	488
CV-59-2	Culvert Removal Per Metre	50.0	14.64	732
CV-59-3	Culvert Removal Per Metre	50.0	9.76	488
CV-59-4	Culvert Removal Per Metre	50.0	21.96	1,098
CV-59-5	Culvert Removal Per Metre	50.0	12.2	610
CV-60-1	Culvert Removal Per Metre	50.0	9.76	488
CV-60-2	Culvert Removal Per Metre	50.0	17.08	854
CV-60-3	Culvert Removal Per Metre	50.0	24.4	1,220
CV-60-4	Culvert Removal Per Metre	50.0	9.76	488
CV-60-5	Culvert Removal Per Metre	50.0	26.84	1,342
CV-60-6	Culvert Removal Per Metre	50.0	26.84	1,342
CV-61-1	Culvert Removal Per Metre	50.0	31.72	1,586
CV-61-2	Culvert Removal Per Metre	50.0	9.76	488
CV-62-1	Culvert Removal Per Metre	50.0	51.24	2,562
CV-62-2	Culvert Removal Per Metre	50.0	12.2	610
CV-62-4	Culvert Removal Per Metre	50.0	9.76	488
CV-62-5	Culvert Removal Per Metre	50.0	12.2	610
CV-63-1	Culvert Removal Per Metre	50.0	14.64	732
CV-63-2	Culvert Removal Per Metre	50.0	12.2	610
CV-63-3	Culvert Removal Per Metre	50.0	14.64	732
CV-63-4	Culvert Removal Per Metre	50.0	12.2	610
CV-63-4a	Culvert Removal Per Metre	50.0	12.2	610

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-63-5	Culvert Removal Per Metre	50.0	12.2	610
CV-64-1	Culvert Removal Per Metre	50.0	9.76	488
CV-64-2	Culvert Removal Per Metre	50.0	12.2	610
CV-64-3	Culvert Removal Per Metre	50.0	12.2	610
CV-64-4	Culvert Removal Per Metre	50.0	19.52	976
CV-64-5	Culvert Removal Per Metre	50.0	12.2	610
CV-64-6	Culvert Removal Per Metre	50.0	12.2	610
CV-65-1	Culvert Removal Per Metre	50.0	17.08	854
CV-65-2	Culvert Removal Per Metre	50.0	21.96	1,098
CV-66-1	Culvert Removal Per Metre	50.0	12.2	610
CV-66-2	Culvert Removal Per Metre	50.0	14.64	732
CV-66-3	Culvert Removal Per Metre	50.0	19.52	976
CV-66-4	Culvert Removal Per Metre	50.0	12.2	610
CV-66-5	Culvert Removal Per Metre	50.0	14.64	732
CV-66-6	Culvert Removal Per Metre	50.0	9.76	488
CV-66-7	Culvert Removal Per Metre	50.0	9.76	488
CV-66-8	Culvert Removal Per Metre	50.0	9.76	488
CV-67-1	Culvert Removal Per Metre	50.0	14.64	732
CV-67-2	Culvert Removal Per Metre	50.0	9.76	488
CV-68-1a	Culvert Removal Per Metre	50.0	33	1,650
CV-68-1	Culvert Removal Per Metre	50.0	31.72	1,586
CV-68-2	Culvert Removal Per Metre	50.0	21.96	1,098
CV-68-3	Culvert Removal Per Metre	50.0	21.96	1,098
CV-68-4	Culvert Removal Per Metre	50.0	12.2	610
CV-68-5	Culvert Removal Per Metre	50.0	26.84	1,342
CV-69-1	Culvert Removal Per Metre	50.0	12.2	610
CV-69-2	Culvert Removal Per Metre	50.0	14.64	732
CV-69-3	Culvert Removal Per Metre	50.0	14.64	732
CV-69-4	Culvert Removal Per Metre	50.0	12.2	610
CV-70-1	Culvert Removal Per Metre	50.0	12.2	610
CV-70-2	Culvert Removal Per Metre	50.0	17.08	854
CV-71-1	Culvert Removal Per Metre	50.0	17.08	854
CV-71-3	Culvert Removal Per Metre	50.0	12.2	610
CV-71-4	Culvert Removal Per Metre	50.0	9.76	488
CV-72-1	Culvert Removal Per Metre	50.0	17.08	854
CV-72-1a	Culvert Removal Per Metre	50.0	12.2	610
CV-72-2	Culvert Removal Per Metre	50.0	12.2	610
CV-72-3	Culvert Removal Per Metre	50.0	12.2	610
CV-72-3a	Culvert Removal Per Metre	50.0	12.2	610
CV-72-4	Culvert Removal Per Metre	50.0	9.76	488
CV-73-1	Culvert Removal Per Metre	50.0	9.76	488
CV-73-2	Culvert Removal Per Metre	50.0	16.1	805
CV-73-3	Culvert Removal Per Metre	50.0	16.1	805
CV-73-4	Culvert Removal Per Metre	50.0	13.6	680
CV-74-1	Culvert Removal Per Metre	50.0	20.6	1,030
CV-74-2	Culvert Removal Per Metre	50.0	20.6	1,030

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-74-3	Culvert Removal Per Metre	50.0	14.64	732
CV-74-4	Culvert Removal Per Metre	50.0	14.64	732
CV-74-6	Culvert Removal Per Metre	50.0	9.76	488
CV-75-1	Culvert Removal Per Metre	50.0	12.2	610
CV-75-1a	Culvert Removal Per Metre	50.0	12.2	610
CV-75-2	Culvert Removal Per Metre	50.0	17.08	854
CV-76-1	Culvert Removal Per Metre	50.0	19.52	976
CV-76-1a	Culvert Removal Per Metre	50.0	19.52	976
CV-76-2	Culvert Removal Per Metre	50.0	9.76	488
CV-76-3	Culvert Removal Per Metre	50.0	19.52	976
CV-77-1	Culvert Removal Per Metre	50.0	19.52	976
CV-77-2	Culvert Removal Per Metre	50.0	39.04	1,952
CV-77-3	Culvert Removal Per Metre	50.0	9.76	488
CV-78-1	Culvert Removal Per Metre	50.0	14.64	732
CV-78-2	Culvert Removal Per Metre	50.0	14.64	732
CV-78-3	Culvert Removal Per Metre	50.0	29.28	1,464
CV-78-4	Culvert Removal Per Metre	50.0	9.76	488
CV-78-5	Culvert Removal Per Metre	50.0	9.76	488
CV-78-6	Culvert Removal Per Metre	50.0	10	500
CV-79-0	Culvert Removal Per Metre	50.0	10	500
CV-79-1	Culvert Removal Per Metre	50.0	17.08	854
CV-80-1	Culvert Removal Per Metre	50.0	24.4	1,220
CV-80-1a	Culvert Removal Per Metre	50.0	12.2	610
CV-80-2	Culvert Removal Per Metre	50.0	10	500
CV-80-2a	Culvert Removal Per Metre	50.0	10	500
CV-80-2b	Culvert Removal Per Metre	50.0	10	500
CV-80-3	Culvert Removal Per Metre	50.0	10	500
CV-80-4	Culvert Removal Per Metre	50.0	10	500
CV-80-5	Culvert Removal Per Metre	50.0	10	500
CV-81-1	Culvert Removal Per Metre	50.0	9.76	488
CV-81-2	Culvert Removal Per Metre	50.0	12.2	610
CV-81-3	Culvert Removal Per Metre	50.0	12.2	610
CV-81-4	Culvert Removal Per Metre	50.0	12.2	610
CV-82-1	Culvert Removal Per Metre	50.0	12.2	610
CV-82-2	Culvert Removal Per Metre	50.0	9.76	488
CV-82-3	Culvert Removal Per Metre	50.0	12.2	610
CV-82-4	Culvert Removal Per Metre	50.0	13.2	660
CV-83-1	Culvert Removal Per Metre	50.0	12.2	610
CV-83-1a	Culvert Removal Per Metre	50.0	12.2	610
CV-83-2	Culvert Removal Per Metre	50.0	12.2	610
CV-84-1	Culvert Removal Per Metre	50.0	17.08	854
CV-84-2	Culvert Removal Per Metre	50.0	12.2	610
CV-84-3	Culvert Removal Per Metre	50.0	14.64	732
CV-85-1	Culvert Removal Per Metre	50.0	12.2	610
CV-85-2	Culvert Removal Per Metre	50.0	17.08	854
CV-85-4	Culvert Removal Per Metre	50.0	17.08	854

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-86-1	Culvert Removal Per Metre	50.0	9.76	488
CV-86-2	Culvert Removal Per Metre	50.0	19.52	976
CV-87-1	Culvert Removal Per Metre	50.0	9.76	488
CV-87-2	Culvert Removal Per Metre	50.0	12.2	610
CV-87-3	Culvert Removal Per Metre	50.0	9.76	488
CV-87-4	Culvert Removal Per Metre	50.0	9.76	488
CV-88-1	Culvert Removal Per Metre	50.0	9.76	488
CV-88-2	Culvert Removal Per Metre	50.0	14.64	732
CV-88-3	Culvert Removal Per Metre	50.0	12.2	610
CV-88-4	Culvert Removal Per Metre	50.0	15	750
CV-89-1	Culvert Removal Per Metre	50.0	24.4	1,220
CV-89-2	Culvert Removal Per Metre	50.0	12.2	610
CV-90-1	Culvert Removal Per Metre	50.0	12.2	610
CV-90-3	Culvert Removal Per Metre	50.0	12.2	610
CV-91-0	Culvert Removal Per Metre	50.0	12.2	610
CV-91-1	Culvert Removal Per Metre	50.0	12.2	610
CV-91-2	Culvert Removal Per Metre	50.0	9.76	488
CV-92-1	Culvert Removal Per Metre	50.0	9.76	488
CV-92-2	Culvert Removal Per Metre	50.0	9.76	488
CV-92-3	Culvert Removal Per Metre	50.0	9.76	488
CV-92-4	Culvert Removal Per Metre	50.0	12.2	610
CV-92-5	Culvert Removal Per Metre	50.0	14.64	732
CV-92-6	Culvert Removal Per Metre	50.0	9.76	488
CV-92-7	Culvert Removal Per Metre	50.0	14.64	732
CV-92-8	Culvert Removal Per Metre	50.0	12.2	610
CV-92-9	Culvert Removal Per Metre	50.0	12.2	610
CV-93-1	Culvert Removal Per Metre	50.0	14.64	732
CV-93-2	Culvert Removal Per Metre	50.0	17.08	854
CV-93-3	Culvert Removal Per Metre	50.0	12.2	610
CV-93-3a	Culvert Removal Per Metre	50.0	24.4	1,220
CV-93-4a	Culvert Removal Per Metre	50.0	12.2	610
CV-93-4b	Culvert Removal Per Metre	50.0	24.2	1,210
CV-93-4	Culvert Removal Per Metre	50.0	24.4	1,220
CV-94-1	Culvert Removal Per Metre	50.0	12.2	610
CV-94-2	Culvert Removal Per Metre	50.0	12	600
CV-95-2	Culvert Removal Per Metre	50.0	9.76	488
CV-95-3	Culvert Removal Per Metre	50.0	12.2	610
CV-95-4	Culvert Removal Per Metre	50.0	12.2	610
CV-95-5	Culvert Removal Per Metre	50.0	12.2	610
CV-95-5a	Culvert Removal Per Metre	50.0	12.2	610
CV-95-6	Culvert Removal Per Metre	50.0	12.2	610
CV-95-7	Culvert Removal Per Metre	50.0	12.2	610
CV-96-1	Culvert Removal Per Metre	50.0	26.84	1,342
CV-96-2	Culvert Removal Per Metre	50.0	26.84	1,342
CV-96-3	Culvert Removal Per Metre	50.0	26.84	1,342
CV-97-1	Culvert Removal Per Metre	50.0	12.2	610

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-97-2	Culvert Removal Per Metre	50.0	21.96	1,098
CV-97-3	Culvert Removal Per Metre	50.0	9.76	488
CV-97-4	Culvert Removal Per Metre	50.0	19.52	976
CV-97-5	Culvert Removal Per Metre	50.0	12.2	610
CV-97-5b	Culvert Removal Per Metre	50.0	12.2	610
CV-97-7	Culvert Removal Per Metre	50.0	12	600
CV-97-7a	Culvert Removal Per Metre	50.0	12.2	610
CV-97-9	Culvert Removal Per Metre	50.0	19.52	976
CV-97-10	Culvert Removal Per Metre	50.0	19.52	976
CV-97-11	Culvert Removal Per Metre	50.0	12.2	610
CV-97-12	Culvert Removal Per Metre	50.0	14.64	732
CV-98-0	Culvert Removal Per Metre	50.0	19.52	976
CV-98-1	Culvert Removal Per Metre	50.0	19.52	976
CV-99-1	Culvert Removal Per Metre	50.0	12.2	610
CV-99-2	Culvert Removal Per Metre	50.0	12.2	610
CV-99-3	Culvert Removal Per Metre	50.0	12.2	610
CV-100-1	Culvert Removal Per Metre	50.0	7.32	366
CV-100-2	Culvert Removal Per Metre	50.0	9.76	488
CV-100-3	Culvert Removal Per Metre	50.0	9.76	488
CV-100-4	Culvert Removal Per Metre	50.0	12.2	610
CV-101-1	Culvert Removal Per Metre	50.0	9.76	488
CV-101-2	Culvert Removal Per Metre	50.0	9.76	488
CV-102-2	Culvert Removal Per Metre	50.0	21.96	1,098
CV-102-3	Culvert Removal Per Metre	50.0	14.64	732
CV-102-4	Culvert Removal Per Metre	50.0	9.76	488
CV-103-1	Culvert Removal Per Metre	50.0	41.48	2,074
CV-104-1	Culvert Removal Per Metre	50.0	17.08	854
CV-104-2	Culvert Removal Per Metre	50.0	21.96	1,098
CV-104-3	Culvert Removal Per Metre	50.0	26.84	1,342
CV-104-4	Culvert Removal Per Metre	50.0	12.2	610
CV-104-5	Culvert Removal Per Metre	50.0	21.96	1,098
CV-105-1	Culvert Removal Per Metre	50.0	9.76	488
CV-105-2	Culvert Removal Per Metre	50.0	9.76	488
CV-105-3	Culvert Removal Per Metre	50.0	9.76	488
CV-105-4	Culvert Removal Per Metre	50.0	14.64	732
CV-106-1	Culvert Removal Per Metre	50.0	12.2	610
CV-106-2	Culvert Removal Per Metre	50.0	12.2	610
CV-106-3	Culvert Removal Per Metre	50.0	14.64	732
CV-107-1	Culvert Removal Per Metre	50.0	19.52	976
CV-107-2	Culvert Removal Per Metre	50.0	19.52	976
CV-107-3	Culvert Removal Per Metre	50.0	24.4	1,220
CV-107-4	Culvert Removal Per Metre	50.0	26.84	1,342
CV-108-1	Culvert Removal Per Metre	50.0	17.08	854
CV-108-2	Culvert Removal Per Metre	50.0	17.08	854
CV-108-3	Culvert Removal Per Metre	50.0	9.76	488
CV-109-2	Culvert Removal Per Metre	50.0	12	600

Description	Unit Rate Type	Unit Rate (\$/m)	Quantity (m)	Cost (\$)¹
CV-109-3	Culvert Removal Per Metre	50.0	12	600
CV-110-1	Culvert Removal Per Metre	50.0	12	600
CV-110-2	Culvert Removal Per Metre	50.0	12	600
CV-110-3	Culvert Removal Per Metre	50.0	12	600
CV-110-4	Culvert Removal Per Metre	50.0	12	600
TOTAL			6316	316,000

NOTES:

1) Grand total rounded to nearest '000

3.3.1.6 Bridges

The Phase 2 Estimate allocates an additional \$98,000 to account for the removal and on site disposal of four (4) new bridges in the Northern Transportation Corridor along the rail alignment. This cost allocation is based on the established unit rate for bridge removal of \$161,904.76. A summary of the marginal increase associated with bridge removal is shown in Table 3-7.

Table 3-7: Marginal Increase for Bridge Removal

Description	Unit Rate (\$/Ea)	Quantity (ea)	Cost (\$)¹
Mine Site			
Bridge Removal	161,904.76	4	647,619
TOTAL		4	648,000

NOTES:

1) Grand total rounded to nearest '000

3.3.1.7 Railway Infrastructure

The Phase 2 Estimate allocates \$29,130,000 plus cover material application costs to account for the closure and reclamation costs of 110 km of railway infrastructure to be constructed in the Northern Transportation Corridor. This cost estimate is based on the assumption that reclamation of the railway (removal of rail and ties) would require 50% of the effort required to install the rail infrastructure. The contractor estimate for the installation of the rail allocates a total of 274,160 man hours.

3.3.1.8 Fill Application

The Phase 2 Estimate allocates an additional \$625,000 to account for application of cover material due to the marginal increase of demolition materials to be disposed of on-site. This cost allocation is based on an additional 16,094 m² of compacted material requiring fill application at an assumed disposal depth of six (6) meters. A summary of the marginal increase of fill application in the Phase 2 Security is shown in Table 3-8.

Table 3-8: Marginal Increase of Fill Application

Description	Unit Rate (\$/m ²)	Quantity (m ²)	Cost (\$)¹
Mine Site			
Fill Application for 2019 Estimate	38.8	16,094	624,943
TOTAL		16,094	625,000

NOTES:

1) Grand total rounded to nearest '000

3.3.2 Indirect Cost Assumptions

The following section describes the assumptions used to establish the indirect costs allocated for the purpose of the Phase 2 Estimate. Unless noted otherwise, see the 2014 Complete Project Financial Security Assessment (H349000-1000-07-126-0018, Rev. 1) for further supporting information on the specific indirect unit rates and multipliers used below.

3.3.2.1 *On-Site Fuel Demobilization and Reclamation Fuel Mobilization*

The Phase 2 Estimate allocates an additional \$2,657,000 to account for the demobilization of fuel stored on Site, and the mobilization of fuel required for the marginal increase in reclamation activities captured in the Phase 2 Estimate.

Based on the increased fuel capacity in Phase 2 of an additional 30,000,000 L at the Mine Site, it is assumed 50% of this fuel would need to be demobilized at closure. This is based both on the assumption that the tanks would be likely to be entirely full at closure, and that some fuel on Site would be available for reclamation activities. The fuel demobilization rate is assumed to be \$0.10/L. The increase in allocation for fuel demobilization associated with the additional Phase 2 storage is \$1,500,000.

The additional \$1,157,000 allocation for fuel mobilization is based on the cost of mobilizing 50% of the fuel required for marginal reclamation and closure activities, including direct activities, power generation, and heat production. Reclamation for the marginal increase in activities in Phase 2 are estimated to require an additional 2,956,000 L of Type-1 fuel (see Appendix A). Marginal increases in camp operation during reclamation is estimated to require an additional 24,500 person-days on-site. Each person-day on site is assumed to consume 116L of Type-1 fuel for heat and power generation. This totals 2,830,000 L of Type-1 fuel required to heat and power the camp. Fuel mobilization rate is assumed to be \$0.40/L.

See Appendix A for itemized person-day and fuel consumption quantities per item in the Phase 2 Estimate.

3.3.2.2 *Mobilization of Workers Required for Reclamation*

The Phase 2 Estimate allocates an additional \$2,017,000 for worker mobilization. Detailed assumptions for mobilization of workers required for marginal closure and reclamation activities are as follows.

Person-hours required to complete direct cost related on-site marginal reclamation activities is estimated to be 245,002 hrs or 24,500 person-days (based on 10hr/day productivity). See Appendix A for itemized person-day allocations per Phase 2 Estimate item.

- Assume 70% of hires (17,151 person-days) are from southern communities and 30% (7,351 person-days) are from northern communities.
- Cost per person-day on site for worker mobilization from southern communities is \$85.45/person-day on-site.
- Cost per person-day on site for worker mobilization from northern communities is \$75.00/person-day on-site

3.3.2.3 *Worker Accommodation & Camp Operation*

The Phase 2 Estimate allocates an additional \$5,452,000 for worker accommodation and camp operation during marginal reclamation activities associated with the Phase 2 Estimate. Assumptions for worker accommodation and camp operation are:

- Person-hours required to complete direct cost related on-site marginal reclamation activities is estimated to be 245,002 hrs or 24,500 person-days (based on 10hr/day productivity). See Appendix A for itemized person-day allocations.
- Cost for accommodation and camp operation is assumed to be \$225.50/person-day and includes camp maintenance, catering, housekeeping, and fuel costs.

3.3.2.4 *Mobilization and Demobilization of Equipment and Materials*

The Phase 2 Estimate allocates an additional \$4,679,000 to account for mobilization and demobilization of equipment and materials. These are indirect costs for moving equipment and materials to and from the reclamation site. The amount is based on the assumption that mobilization and demobilization cost are estimated as 10% of total direct costs.

As outlined in Section 2, the global estimate allocated \$15,592,000 to account for the demobilization of the Phase 2 Expansion Project Materials and Equipment (the 'Modules'). As these materials and equipment will be constructed for Phase 2, the estimate for their demobilization from Site can be removed from the overall estimate. Applying this reconciliation here will allow any associated contingency applied in the original estimate to also be reconciled. Therefore, the total for Mobilization and Demobilization of Equipment and Materials for the Phase 2 Estimate is \$-10,913,000.

3.3.2.5 *Post Closure Monitoring*

This estimate for Post Closure Monitoring does not require an update as a result of the Phase 2 Proposal and is consistent with the Interim Closure and Reclamation Plan (Draft Revision 6, May 1, 2019). The previous value allocated for Post Closure Monitoring was \$5,478,000, allocated in the 2019 Marginal Closure and Reclamation Financial Security Estimate.

3.3.2.6 *Supervision, Project Management and Contract Administration*

The Phase 2 Estimate includes a project supervision, management and contract administration indirect cost allowance of \$4,559,000 or 9.4% of total direct costs, contaminated soil treatment costs, care and maintenance costs, and closure monitoring/reporting costs. Project supervision, management and contract administration indirect costs include, but are not limited to:

- Contract strategy, administration and expediting;
- Construction logistics, planning, scheduling, supervision and manpower forecasts;

- Labour relations, safety;
- Field office management, temporary facilities;
- Materials receiving and warehousing;
- Progress monitoring, trending and reporting;
- Cost performance monitoring, trending and claims processing; and
- Quality assurance.

3.3.2.7 *Engineering Fees*

The Phase 2 Estimate includes an engineering, design and execution planning indirect cost allowance of \$1,825,000 or 3.9% of the total direct costs.

3.3.2.8 *Contingency*

The Phase 2 Estimate includes an additional contingency of \$5,641,000 or 12.5% of the total of direct costs, mobilization and demobilization of equipment and materials costs, worker accommodation and camp operation costs, mobilization of workers costs, care and maintenance costs, and closure monitoring/reporting costs.

3.3.3 *Exclusions*

The listed activities below are recognized by Baffinland as being required to be conducted in an unforeseen closure and reclamation scenario, but additional costs have not been included in the Phase 2 Estimate on the basis that it is Baffinland's position that the Phase 2 activities do not warrant additional cost allocations for these activities. Excluded activities from the Phase 2 Estimate are:

- Off Site Disposal of Hazardous and Non-Hazardous Waste – the current allocation for off site disposal is sufficient based on the scope of the Phase 2 Proposal; and
- Contaminated Soil Treatment – the current allocation for Contaminated Soil Treatment is sufficient based on the scope of the Phase 2 Proposal.

4. Phase 2 Estimate Summary

The Phase 2 Estimate is inclusive of all closure and reclamation costs estimated to be required for a 3rd Party Contractor to perform the work in a 'worst-case' scenario for all disturbed areas, project components and project activities existing on the Mary River Project site upon conclusion of the Phase 2 proposal, including legacy exploration phase liabilities. The estimated total marginal increase associated with the Phase 2 proposal is \$58,101,000.

Table 4-1 presents the 'global' closure and reclamation security estimated to be required (Column E) based on the most recent (2019) ASR Estimate (Column C) and the Phase 2 Estimate (Column D).

Table 4-1: Mary River Project 'Global' Closure and Reclamation Security Summary¹

	A	B	C	D	E
	Authorization	Liability	Global Estimate from 2019 ASR (\$)	Phase 2 Estimate Marginal (\$)	Total 'Global' Estimated Security for 2018 (\$)
					C + D = E
1	Type A 2AM- MRY1325	IOL ²	96,438,000	43,839,000	140,277,000
2		Crown	1,802,000	15,262,000	17,064,000
3		Water	1,387,000	1,424,000	2,811,000
4		Land	96,853,000	56,677,000	153,530,000
5	<i>Subtotal Type A</i>		<i>98,240,000</i>	<i>58,101,000</i>	<i>156,341,000</i>
6	Type B Exploration2BE- MRY1421 ³	IOL	165,000	-	165,000
7		Crown	1,082,000	-	1,082,000
8		Water	18,000	-	18,000
9		Land	1,229,000	-	1,229,000
10	<i>Subtotal Type B Exploration</i>		<i>1,247,000</i>		<i>1,247,000</i>
11	DFO Security Associated with Ore Dock	IOL ²	-	-	-
12		Crown	563,000	-	563,000
13		Water	563,000	-	563,000
14		Land	-	-	-
15	<i>Subtotal DFO</i>		<i>563,000</i>		<i>563,000</i>
16	AANDC Land Lease 47H/16-1- 2 ⁴	IOL ²	-	-	-
17		Crown	4,975,000	-	4,975,000
18		Water	-	-	-
19		Land	4,975,000	-	4,975,000
20	<i>Subtotal AANDC Land Lease</i>		<i>4,975,000</i>	-	<i>4,975,000</i>
21	GRAND TOTAL		105,025,000		163,126,000

NOTES:

- 1) Totals rounded to nearest '000 in CAD
- 2) Security relating to IOL held by Qikiqtani Inuit Association (QIA) under Commercial Lease No. Q13C301
- 3) As per Mary River Exploration Project Closure and Reclamation Plan (BAF-PH1-830-P16-0038, Rev 1)
- 4) As per Closure and Reclamation Strategy and Financial Security Estimate for Nunavut Lease #47H/16-1-2 (H349001-2000-07-126-0001, Rev.0)

5. Supporting Documents

In addition to information presented within this document, please refer to the following appendices for supporting information:

- Refer to Appendix A for the Phase 2 Estimate Breakdown Structure (EBS).
- Refer to Appendix B for updated Phase 2 Proposal Layouts.
- Refer to Appendix C for Supporting Documentation

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Appendix A:
Phase 2 Estimate Breakdown Structure (EBS)

[illegible]

Line	Area	Level 1 - Description	Level 1 - Code	Level 2 - Description	Level 2 - Code	Level 3 - Description	Level 3 - Code	ID CODE	Equipment Type	Price Code	Price Code Description	Qty Code	Area - QTY Code	QTY Code Description	Type	Description	Tag Number	QTY	Unit	Manhours per Unit	Unit Fuel Consumption	Unit Labor	Unit Equipment	Unit Rate	Total Manhours	Total Fuel Consumption	Total Labor	Total Equipment	Total Cost (\$)	Unit Material Cost (\$)	Fuel Cost (\$)	LOL (%)	Gross Land (%)	Water/Land (%)	Land/Land (%)	LOL Cost (\$)	Gross Land Cost (\$)	Water/Land Cost (\$)	Land/Land Cost (\$)	License	Adjustment Tag	Associated Work Plan	Cost										Per Costs										Cost										Costs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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3000	North Corridor	3200	Rail Alignment	3210	Water Crossings	3211	Culverts	Cu-m	Culvert Removal	Cu-m	Site Works	Culvert Removal	Cv-27.5					12	m	0.3	2.2	26.1	21.7	50.0	4	26	313	261	600	0	0	100%	0%	100%	0%	600	0	600	0	600	0	600	0	Type A SAM-MEY1325	Added	P2	Direct	0	0	300	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Level 0 - Area Location	Level 1 - Description	Level 1 - Code	Level 2 - Family System	Level 2 - Description	ID CODE	Equipment Type	Price Code	Price Code Description	Qty Code	Area - QTY Code	QTY Code Description	Type	Description	Tag Number	QTY	Unit	Resources Per Unit						Total Materials	Total Labor	Total Equipment	Total Cost (\$)	Units Met	Total Vol (m)	LOI (%)	Crown Loss (%)	Wear/Laboury (%)	Lave Labouir (%)	OL Cost (\$)	Crown Land Cost (\$)	Wear/Laboury Cost (\$)	Land Utility Cost (\$)	License		Adjustment Tag	Associated Work Plan	Year of Costs	Cost										Fuel Costs										Other																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
																	Manhours per Unit	Unit Fuel Consumption	Unit Labour	Unit Equipment	Unit Rate	Year 0-1 %																				Year 1-1 %	Year 2-1 %	Year 3-1 %	Year 4-1 %	Year 5-1 %	Year 6-1 %	Year 7-1 %	Year 8-1 %	Year 9-1 Cost (\$)	Year 10-1 Cost (\$)	Year 11-1 Cost (\$)	Year 12-1 Cost (\$)	Year 13-1 Cost (\$)	Year 14-1 Cost (\$)	Year 15-1 Cost (\$)	Year 16-1 %	Year 17-1 %	Year 18-1 %	Year 19-1 Cost (\$)	Year 20-1 Cost (\$)	Year 21-1 Cost (\$)	Year 22-1 Cost (\$)	Year 23-1 Cost (\$)	Year 24-1 Cost (\$)	Year 25-1 Cost (\$)	Year 26-1 Cost (\$)	Year 27-1 Cost (\$)	Year 28-1 Cost (\$)	Year 29-1 Cost (\$)	Year 30-1 Cost (\$)	Year 31-1 Cost (\$)	Year 32-1 Cost (\$)	Year 33-1 Cost (\$)	Year 34-1 Cost (\$)	Year 35-1 Cost (\$)	Year 36-1 Cost (\$)	Year 37-1 Cost (\$)	Year 38-1 Cost (\$)	Year 39-1 Cost (\$)	Year 40-1 Cost (\$)	Year 41-1 Cost (\$)	Year 42-1 Cost (\$)	Year 43-1 Cost (\$)	Year 44-1 Cost (\$)	Year 45-1 Cost (\$)	Year 46-1 Cost (\$)	Year 47-1 Cost (\$)	Year 48-1 Cost (\$)	Year 49-1 Cost (\$)	Year 50-1 Cost (\$)	Year 51-1 Cost (\$)	Year 52-1 Cost (\$)	Year 53-1 Cost (\$)	Year 54-1 Cost (\$)	Year 55-1 Cost (\$)	Year 56-1 Cost (\$)	Year 57-1 Cost (\$)	Year 58-1 Cost (\$)	Year 59-1 Cost (\$)	Year 60-1 Cost (\$)	Year 61-1 Cost (\$)	Year 62-1 Cost (\$)	Year 63-1 Cost (\$)	Year 64-1 Cost (\$)	Year 65-1 Cost (\$)	Year 66-1 Cost (\$)	Year 67-1 Cost (\$)	Year 68-1 Cost (\$)	Year 69-1 Cost (\$)	Year 70-1 Cost (\$)	Year 71-1 Cost (\$)	Year 72-1 Cost (\$)	Year 73-1 Cost (\$)	Year 74-1 Cost (\$)	Year 75-1 Cost (\$)	Year 76-1 Cost (\$)	Year 77-1 Cost (\$)	Year 78-1 Cost (\$)	Year 79-1 Cost (\$)	Year 80-1 Cost (\$)	Year 81-1 Cost (\$)	Year 82-1 Cost (\$)	Year 83-1 Cost (\$)	Year 84-1 Cost (\$)	Year 85-1 Cost (\$)	Year 86-1 Cost (\$)	Year 87-1 Cost (\$)	Year 88-1 Cost (\$)	Year 89-1 Cost (\$)	Year 90-1 Cost (\$)	Year 91-1 Cost (\$)	Year 92-1 Cost (\$)	Year 93-1 Cost (\$)	Year 94-1 Cost (\$)	Year 95-1 Cost (\$)	Year 96-1 Cost (\$)	Year 97-1 Cost (\$)	Year 98-1 Cost (\$)	Year 99-1 Cost (\$)	Year 100-1 Cost (\$)	Year 101-1 Cost (\$)	Year 102-1 Cost (\$)	Year 103-1 Cost (\$)	Year 104-1 Cost (\$)	Year 105-1 Cost (\$)	Year 106-1 Cost (\$)	Year 107-1 Cost (\$)	Year 108-1 Cost (\$)	Year 109-1 Cost (\$)	Year 110-1 Cost (\$)	Year 111-1 Cost (\$)	Year 112-1 Cost (\$)	Year 113-1 Cost (\$)	Year 114-1 Cost (\$)	Year 115-1 Cost (\$)	Year 116-1 Cost (\$)	Year 117-1 Cost (\$)	Year 118-1 Cost (\$)	Year 119-1 Cost (\$)	Year 120-1 Cost (\$)	Year 121-1 Cost (\$)	Year 122-1 Cost (\$)	Year 123-1 Cost (\$)	Year 124-1 Cost (\$)	Year 125-1 Cost (\$)	Year 126-1 Cost (\$)	Year 127-1 Cost (\$)	Year 128-1 Cost (\$)	Year 129-1 Cost (\$)	Year 130-1 Cost (\$)	Year 131-1 Cost (\$)	Year 132-1 Cost (\$)	Year 133-1 Cost (\$)	Year 134-1 Cost (\$)	Year 135-1 Cost (\$)	Year 136-1 Cost (\$)	Year 137-1 Cost (\$)	Year 138-1 Cost (\$)	Year 139-1 Cost (\$)	Year 140-1 Cost (\$)	Year 141-1 Cost (\$)	Year 142-1 Cost (\$)	Year 143-1 Cost (\$)	Year 144-1 Cost (\$)	Year 145-1 Cost (\$)	Year 146-1 Cost (\$)	Year 147-1 Cost (\$)	Year 148-1 Cost (\$)	Year 149-1 Cost (\$)	Year 150-1 Cost (\$)	Year 151-1 Cost (\$)	Year 152-1 Cost (\$)	Year 153-1 Cost (\$)	Year 154-1 Cost (\$)	Year 155-1 Cost (\$)	Year 156-1 Cost (\$)	Year 157-1 Cost (\$)	Year 158-1 Cost (\$)	Year 159-1 Cost (\$)	Year 160-1 Cost (\$)	Year 161-1 Cost (\$)	Year 162-1 Cost (\$)	Year 163-1 Cost (\$)	Year 164-1 Cost (\$)	Year 165-1 Cost (\$)	Year 166-1 Cost (\$)	Year 167-1 Cost (\$)	Year 168-1 Cost (\$)	Year 169-1 Cost (\$)	Year 170-1 Cost (\$)	Year 171-1 Cost (\$)	Year 172-1 Cost (\$)	Year 173-1 Cost (\$)	Year 174-1 Cost (\$)	Year 175-1 Cost (\$)	Year 176-1 Cost (\$)	Year 177-1 Cost (\$)	Year 178-1 Cost (\$)	Year 179-1 Cost (\$)	Year 180-1 Cost (\$)	Year 181-1 Cost (\$)	Year 182-1 Cost (\$)	Year 183-1 Cost (\$)	Year 184-1 Cost (\$)	Year 185-1 Cost (\$)	Year 186-1 Cost (\$)	Year 187-1 Cost (\$)	Year 188-1 Cost (\$)	Year 189-1 Cost (\$)	Year 190-1 Cost (\$)	Year 191-1 Cost (\$)	Year 192-1 Cost (\$)	Year 193-1 Cost (\$)	Year 194-1 Cost (\$)	Year 195-1 Cost (\$)	Year 196-1 Cost (\$)	Year 197-1 Cost (\$)	Year 198-1 Cost (\$)	Year 199-1 Cost (\$)	Year 200-1 Cost (\$)	Year 201-1 Cost (\$)	Year 202-1 Cost (\$)	Year 203-1 Cost (\$)	Year 204-1 Cost (\$)	Year 205-1 Cost (\$)	Year 206-1 Cost (\$)	Year 207-1 Cost (\$)	Year 208-1 Cost (\$)	Year 209-1 Cost (\$)	Year 210-1 Cost (\$)	Year 211-1 Cost (\$)	Year 212-1 Cost (\$)	Year 213-1 Cost (\$)	Year 214-1 Cost (\$)	Year 215-1 Cost (\$)	Year 216-1 Cost (\$)	Year 217-1 Cost (\$)	Year 218-1 Cost (\$)	Year 219-1 Cost (\$)	Year 220-1 Cost (\$)	Year 221-1 Cost (\$)	Year 222-1 Cost (\$)	Year 223-1 Cost (\$)	Year 224-1 Cost (\$)	Year 225-1 Cost (\$)	Year 226-1 Cost (\$)	Year 227-1 Cost (\$)	Year 228-1 Cost (\$)	Year 229-1 Cost (\$)	Year 230-1 Cost (\$)	Year 231-1 Cost (\$)	Year 232-1 Cost (\$)	Year 233-1 Cost (\$)	Year 234-1 Cost (\$)	Year 235-1 Cost (\$)	Year 236-1 Cost (\$)	Year 237-1 Cost (\$)	Year 238-1 Cost (\$)	Year 239-1 Cost (\$)	Year 240-1 Cost (\$)	Year 241-1 Cost (\$)	Year 242-1 Cost (\$)	Year 243-1 Cost (\$)	Year 244-1 Cost (\$)	Year 245-1 Cost (\$)	Year 246-1 Cost (\$)	Year 247-1 Cost (\$)	Year 248-1 Cost (\$)	Year 249-1 Cost (\$)	Year 250-1 Cost (\$)	Year 251-1 Cost (\$)	Year 252-1 Cost (\$)	Year 253-1 Cost (\$)	Year 254-1 Cost (\$)	Year 255-1 Cost (\$)	Year 256-1 Cost (\$)	Year 257-1 Cost (\$)	Year 258-1 Cost (\$)	Year 259-1 Cost (\$)	Year 260-1 Cost (\$)	Year 261-1 Cost (\$)	Year 262-1 Cost (\$)	Year 263-1 Cost (\$)	Year 264-1 Cost (\$)	Year 265-1 Cost (\$)	Year 266-1 Cost (\$)	Year 267-1 Cost (\$)	Year 268-1 Cost (\$)	Year 269-1 Cost (\$)	Year 270-1 Cost (\$)	Year 271-1 Cost (\$)	Year 272-1 Cost (\$)	Year 273-1 Cost (\$)	Year 274-1 Cost (\$)	Year 275-1 Cost (\$)	Year 276-1 Cost (\$)	Year 277-1 Cost (\$)	Year 278-1 Cost (\$)	Year 279-1 Cost (\$)	Year 280-1 Cost (\$)	Year 281-1 Cost (\$)	Year 282-1 Cost (\$)	Year 283-1 Cost (\$)	Year 284-1 Cost (\$)	Year 285-1 Cost (\$)	Year 286-1 Cost (\$)	Year 287-1 Cost (\$)	Year 288-1 Cost (\$)	Year 289-1 Cost (\$)	Year 290-1 Cost (\$)	Year 291-1 Cost (\$)	Year 292-1 Cost (\$)	Year 293-1 Cost (\$)	Year 294-1 Cost (\$)	Year 295-1 Cost (\$)	Year 296-1 Cost (\$)	Year 297-1 Cost (\$)	Year 298-1 Cost (\$)	Year 299-1 Cost (\$)	Year 300-1 Cost (\$)	Year 301-1 Cost (\$)	Year 302-1 Cost (\$)	Year 303-1 Cost (\$)	Year 304-1 Cost (\$)	Year 305-1 Cost (\$)	Year 306-1 Cost (\$)	Year 307-1 Cost (\$)	Year 308-1 Cost (\$)	Year 309-1 Cost (\$)	Year 310-1 Cost (\$)	Year 311-1 Cost (\$)	Year 312-1 Cost (\$)	Year 313-1 Cost (\$)	Year 314-1 Cost (\$)	Year 315-1 Cost (\$)	Year 316-1 Cost (\$)	Year 317-1 Cost (\$)	Year 318-1 Cost (\$)	Year 319-1 Cost (\$)	Year 320-1 Cost (\$)	Year 321-1 Cost (\$)	Year 322-1 Cost (\$)	Year 323-1 Cost (\$)	Year 324-1 Cost (\$)	Year 325-1 Cost (\$)	Year 326-1 Cost (\$)	Year 327-1 Cost (\$)	Year 328-1 Cost (\$)	Year 329-1 Cost (\$)	Year 330-1 Cost (\$)	Year 331-1 Cost (\$)	Year 332-1 Cost (\$)	Year 333-1 Cost (\$)	Year 334-1 Cost (\$)	Year 335-1 Cost (\$)	Year 336-1 Cost 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384-1 Cost (\$)	Year 385-1 Cost (\$)	Year 386-1 Cost (\$)	Year 387-1 Cost (\$)	Year 388-1 Cost (\$)	Year 389-1 Cost (\$)	Year 390-1 Cost (\$)	Year 391-1 Cost (\$)	Year 392-1 Cost (\$)	Year 393-1 Cost (\$)	Year 394-1 Cost (\$)	Year 395-1 Cost (\$)	Year 396-1 Cost (\$)	Year 397-1 Cost (\$)	Year 398-1 Cost (\$)	Year 399-1 Cost (\$)	Year 400-1 Cost (\$)	Year 401-1 Cost (\$)	Year 402-1 Cost (\$)	Year 403-1 Cost (\$)	Year 404-1 Cost (\$)	Year 405-1 Cost (\$)	Year 406-1 Cost (\$)	Year 407-1 Cost (\$)	Year 408-1 Cost (\$)	Year 409-1 Cost (\$)	Year 410-1 Cost (\$)	Year 411-1 Cost (\$)	Year 412-1 Cost (\$)	Year 413-1 Cost (\$)	Year 414-1 Cost (\$)	Year 415-1 Cost (\$)	Year 416-1 Cost (\$)	Year 417-1 Cost (\$)	Year 418-1 Cost (\$)	Year 419-1 Cost (\$)	Year 420-1 Cost (\$)	Year 421-1 Cost (\$)	Year 422-1 Cost (\$)	Year 423-1 Cost (\$)	Year 424-1 Cost (\$)	Year 425-1 Cost (\$)	Year 426-1 Cost (\$)	Year 427-1 Cost (\$)	Year 428-1 Cost (\$)	Year 429-1 Cost (\$)	Year 430-1 Cost (\$)	Year 431-1 Cost (\$)	Year 432-1 Cost (\$)	Year 433-1 Cost (\$)	Year 434-1 Cost (\$)	Year 435-1 Cost (\$)	Year 436-1 Cost (\$)	Year 437-1 Cost (\$)	Year 438-1 Cost (\$)	Year 439-1 Cost (\$)	Year 440-1 Cost (\$)	Year 441-1 Cost (\$)	Year 442-1 Cost (\$)	Year 443-1 Cost (\$)	Year 444-1 Cost (\$)	Year 445-1 Cost (\$)	Year 446-1 Cost (\$)	Year 447-1 Cost (\$)	Year 448-1 Cost (\$)	Year 449-1 Cost (\$)	Year 450-1 Cost (\$)	Year 451-1 Cost (\$)	Year 452-1 Cost (\$)	Year 453-1 Cost (\$)	Year 454-1 Cost (\$)	Year 455-1 Cost (\$)	Year 456-1 Cost (\$)	Year 457-1 Cost (\$)	Year 458-1 Cost (\$)	Year 459-1 Cost (\$)	Year 460-1 Cost (\$)	Year 461-1 Cost (\$)	Year 462-1 Cost (\$)	Year 463-1 Cost (\$)	Year 464-1 Cost (\$)	Year 465-1 Cost (\$)	Year 466-1 Cost (\$)	Year 467-1 Cost (\$)	Year 468-1 Cost (\$)	Year 469-1 Cost (\$)	Year 470-1 Cost (\$)	Year 471-1 Cost (\$)	Year 472-1 Cost (\$)	Year 473-1 Cost (\$)	Year 474-1 Cost (\$)	Year 475-1 Cost (\$)	Year 476-1 Cost (\$)	Year 477-1 Cost (\$)	Year 478-1 Cost (\$)	Year 479-1 Cost (\$)	Year 480-1 Cost (\$)	Year 481-1 Cost (\$)	Year 482-1 Cost (\$)	Year 483-1 Cost (\$)	Year 484-1 Cost (\$)	Year 485-1 Cost (\$)	Year 486-1 Cost (\$)	Year 487-1 Cost (\$)	Year 488-1 Cost (\$)	Year 489-1 Cost (\$)	Year 490-1 Cost (\$)	Year 491-1 Cost (\$)	Year 492-1 Cost (\$)	Year 493-1 Cost (\$)	Year 494-1 Cost (\$)	Year 495-1 Cost (\$)	Year 496-1 Cost (\$)	Year 497-1 Cost (\$)	Year 498-1 Cost (\$)	Year 499-1 Cost (\$)	Year 500-1 Cost (\$)	Year 501-1 Cost (\$)	Year 502-1 Cost (\$)	Year 503-1 Cost (\$)	Year 504-1 Cost (\$)	Year 505-1 Cost (\$)	Year 506-1 Cost (\$)	Year 507-1 Cost (\$)	Year 508-1 Cost (\$)	Year 509-1 Cost (\$)	Year 510-1 Cost (\$)	Year 511-1 Cost (\$)	Year 512-1 Cost (\$)	Year 513-1 Cost (\$)	Year 514-1 Cost (\$)	Year 515-1 Cost (\$)	Year 516-1 Cost (\$)	Year 517-1 Cost (\$)	Year 518-1 Cost (\$)	Year 519-1 Cost (\$)	Year 520-1 Cost (\$)	Year 521-1 Cost (\$)	Year 522-1 Cost (\$)	Year 523-1 Cost (\$)	Year 524-1 Cost (\$)	Year 525-1 Cost (\$)	Year 526-1 Cost (\$)	Year 527-1 Cost (\$)	Year 528-1 Cost (\$)	Year 529-1 Cost (\$)	Year 530-1 Cost (\$)	Year 531-1 Cost (\$)	Year 532-1 Cost (\$)	Year 533-1 Cost (\$)	Year 534-1 Cost (\$)	Year 535-1 Cost (\$)	Year 536-1 Cost (\$)	Year 537-1 Cost (\$)	Year 538-1 Cost (\$)	Year 539-1 Cost (\$)	Year 540-1 Cost (\$)	Year 541-1 Cost (\$)	Year 542-1 Cost (\$)	Year 543-1 Cost (\$)	Year 544-1 Cost (\$)	Year 545-1 Cost (\$)	Year 546-1 Cost (\$)	Year 547-1 Cost (\$)	Year 548-1 Cost (\$)	Year 549-1 Cost (\$)	Year 550-1 Cost (\$)	Year 551-1 Cost (\$)	Year 552-1 Cost (\$)	Year 553-1 Cost (\$)	Year 554-1 Cost (\$)	Year 555-1 Cost (\$)	Year 556-1 Cost (\$)	Year 557-1 Cost (\$)	Year 558-1 Cost (\$)	Year 559-1 Cost (\$)	Year 560-1 Cost (\$)	Year 561-1 Cost (\$)	Year 562-1 Cost (\$)	Year 563-1 Cost (\$)	Year 564-1 Cost (\$)	Year 565-1 Cost (\$)	Year 566-1 Cost (\$)	Year 567-1 Cost (\$)	Year 568-1 Cost (\$)	Year 569-1 Cost (\$)	Year 570-1 Cost (\$)	Year 571-1 Cost (\$)	Year 572-1 Cost (\$)	Year 573-1 Cost (\$)	Year 574-1 Cost (\$)	Year 575-1 Cost (\$)	Year 576-1 Cost (\$)	Year 577-1 Cost (\$)	Year 578-1 Cost (\$)	Year 579-1 Cost (\$)	Year 580-1 Cost (\$)	Year 581-1 Cost (\$)	Year 582-1 Cost (\$)	Year 583-1 Cost (\$)	Year 584-1 Cost (\$)	Year 585-1 Cost (\$)	Year 586-1 Cost (\$)	Year 587-1 Cost (\$)	Year 588-1 Cost (\$)	Year 589-1 Cost (\$)	Year 590-1 Cost (\$)	Year 591-1 Cost (\$)	Year 592-1 Cost (\$)	Year 593-1 Cost (\$)	Year 594-1 Cost (\$)	Year 595-1 Cost (\$)	Year 596-1 Cost (\$)	Year 597-1 Cost (\$)	Year 598-1 Cost (\$)	Year 599-1 Cost (\$)	Year 600-1 Cost (\$)	Year 601-1 Cost (\$)	Year 602-1 Cost (\$)	Year 603-1 Cost (\$)	Year 604-1 Cost (\$)	Year 605-1 Cost (\$)	Year 606-1 Cost (\$)	Year 607-1 Cost (\$)	Year 608-1 Cost (\$)	Year 609-1 Cost (\$)	Year 610-1 Cost (\$)	Year 611-1 Cost (\$)	Year 612-1 Cost (\$)	Year 613-1 Cost (\$)	Year 614-1 Cost (\$)	Year 615-1 Cost (\$)	Year 616-1 Cost (\$)	Year 617-1 Cost (\$)	Year 618-1 Cost (\$)	Year 619-1 Cost (\$)	Year 620-1 Cost (\$)	Year 621-1 Cost (\$)	Year 622-1 Cost (\$)	Year 623-1 Cost (\$)	Year 624-1 Cost (\$)	Year 625-1 Cost (\$)	Year 626-1 Cost (\$)	Year 627-1 Cost (\$)	Year 628-1 Cost (\$)	Year 629-1 Cost (\$)	Year 630-1 Cost (\$)	Year 631-1 Cost (\$)	Year 632-1 Cost (\$)	Year 633-1 Cost (\$)	Year 634-1 Cost (\$)	Year 635-1 Cost (\$)	Year 636-1 Cost (\$)	Year 637-1 Cost (\$)	Year 638-1 Cost (\$)	Year 639-1 Cost (\$)	Year 640-1 Cost (\$)	Year 641-1 Cost (\$)	Year 642-1 Cost (\$)	Year 643-1 Cost (\$)	Year 644-1 Cost (\$)	Year 645-1 Cost (\$)	Year 646-1 Cost (\$)	Year 647-1 Cost (\$)	Year 648-1 Cost (\$)	Year 649-1 Cost (\$)	Year 650-1 Cost (\$)	Year 651-1 Cost (\$)	Year 652-1 Cost (\$)	Year 653-1 Cost (\$)	Year 654-1 Cost (\$)	Year 655-1 Cost (\$)	Year 656-1 Cost (\$)	Year 657-1 Cost (\$)	Year 658-1 Cost (\$)	Year 659-1 Cost (\$)	Year 660-1 Cost (\$)	Year 661-1 Cost (\$)	Year 662-1 Cost (\$)	Year 663-1 Cost (\$)	Year 664-1 Cost (\$)	Year 665-1 Cost (\$)	Year 666-1 Cost (\$)	Year 667-1 Cost (\$)	Year 668-1 Cost (\$)	Year 669-1 Cost (\$)	Year 670-1 Cost (\$)	Year 671-1 Cost (\$)	Year 672-1 Cost (\$)	Year 673-1 Cost (\$)	Year 674-1 Cost (\$)	Year 675-1 Cost (\$)	Year 676-1 Cost (\$)	Year 677-1 Cost (\$)	Year 678-1 Cost (\$)	Year 679-1 Cost (\$)	Year 680-1 Cost (\$)	Year 681-1 Cost (\$)	Year 682-1 Cost (\$)	Year 683-1 Cost (\$)	Year 684-1 Cost (\$)	Year 685-1 Cost (\$)	Year 686-1 Cost (\$)	Year 687-1 Cost (\$)	Year 688-1 Cost (\$)	Year 689-1 Cost (\$)	Year 690-1 Cost (\$)	Year 691-1 Cost (\$)	Year 692-1 Cost (\$)	Year 693-1 Cost (\$)	Year 694-1 Cost (\$)	Year 695-1 Cost (\$)	Year 696-1 Cost (\$)	Year 697-1 Cost (\$)	Year 698-1 Cost (\$)	Year 699-1 Cost (\$)	Year 700-1 Cost (\$)	Year 701-1 Cost (\$)	Year 702-1 Cost (\$)	Year 703-1 Cost (\$)	Year 704-1 Cost (\$)	Year 705-1

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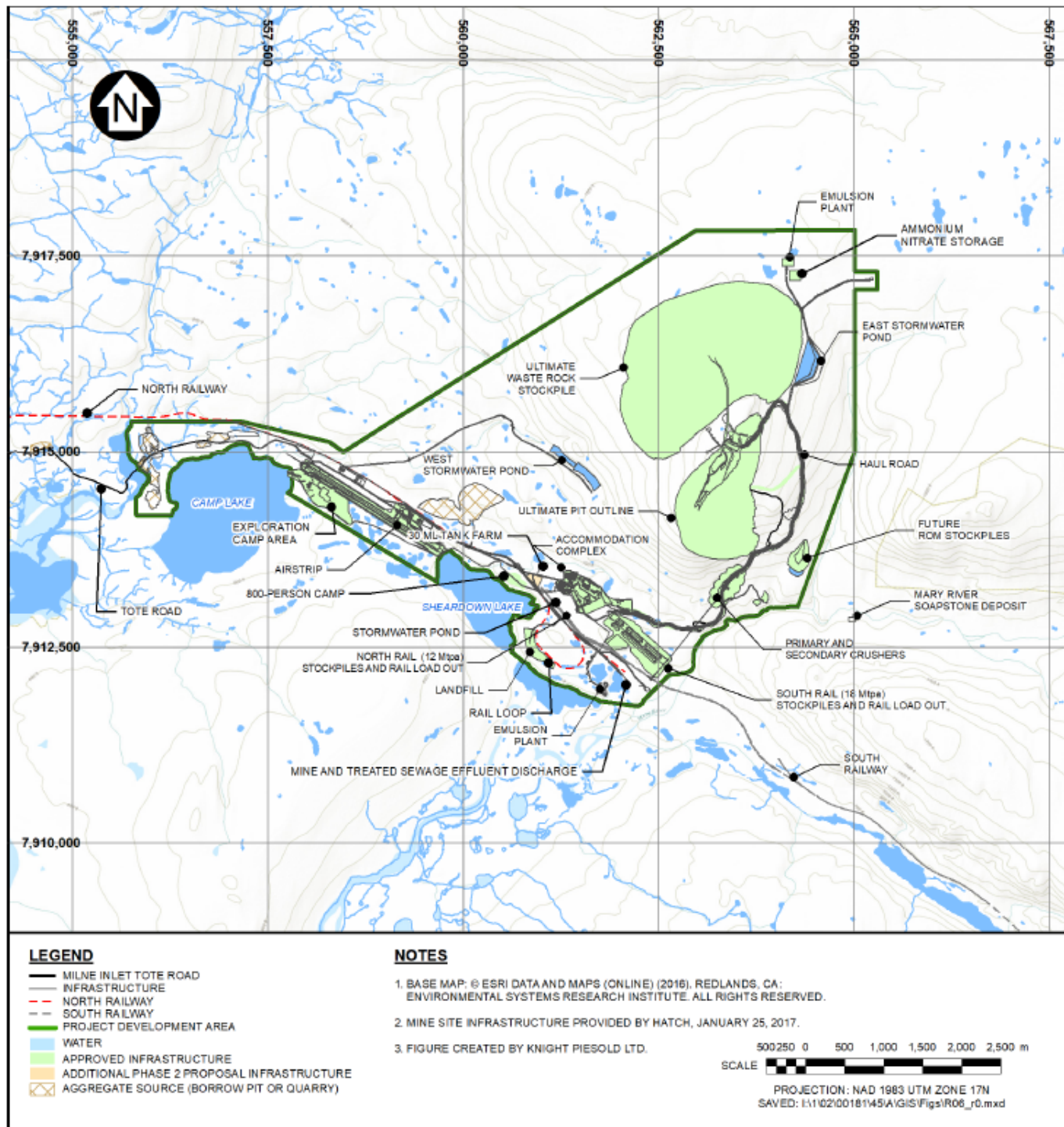
Appendix B

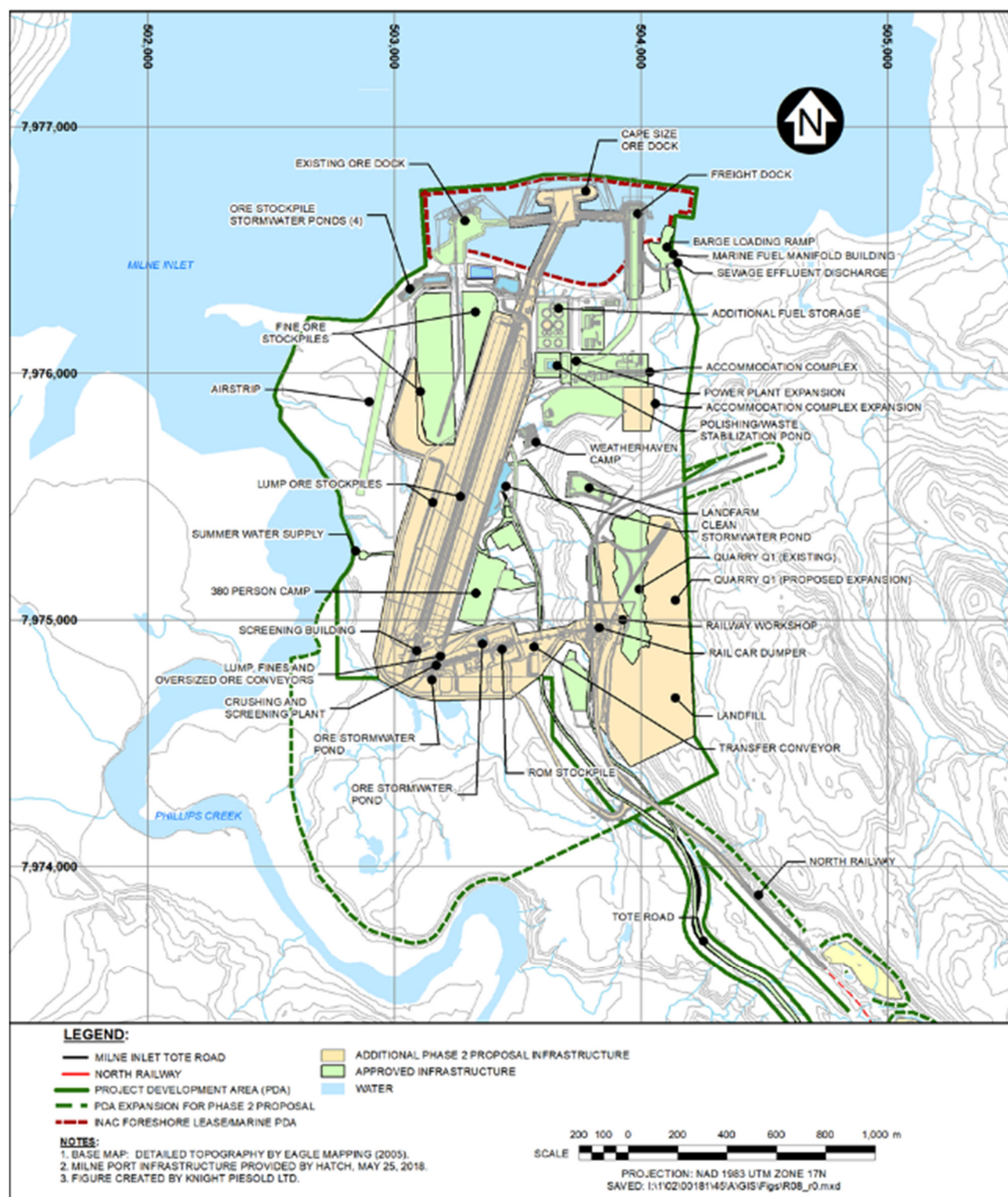
Updated Site Layouts

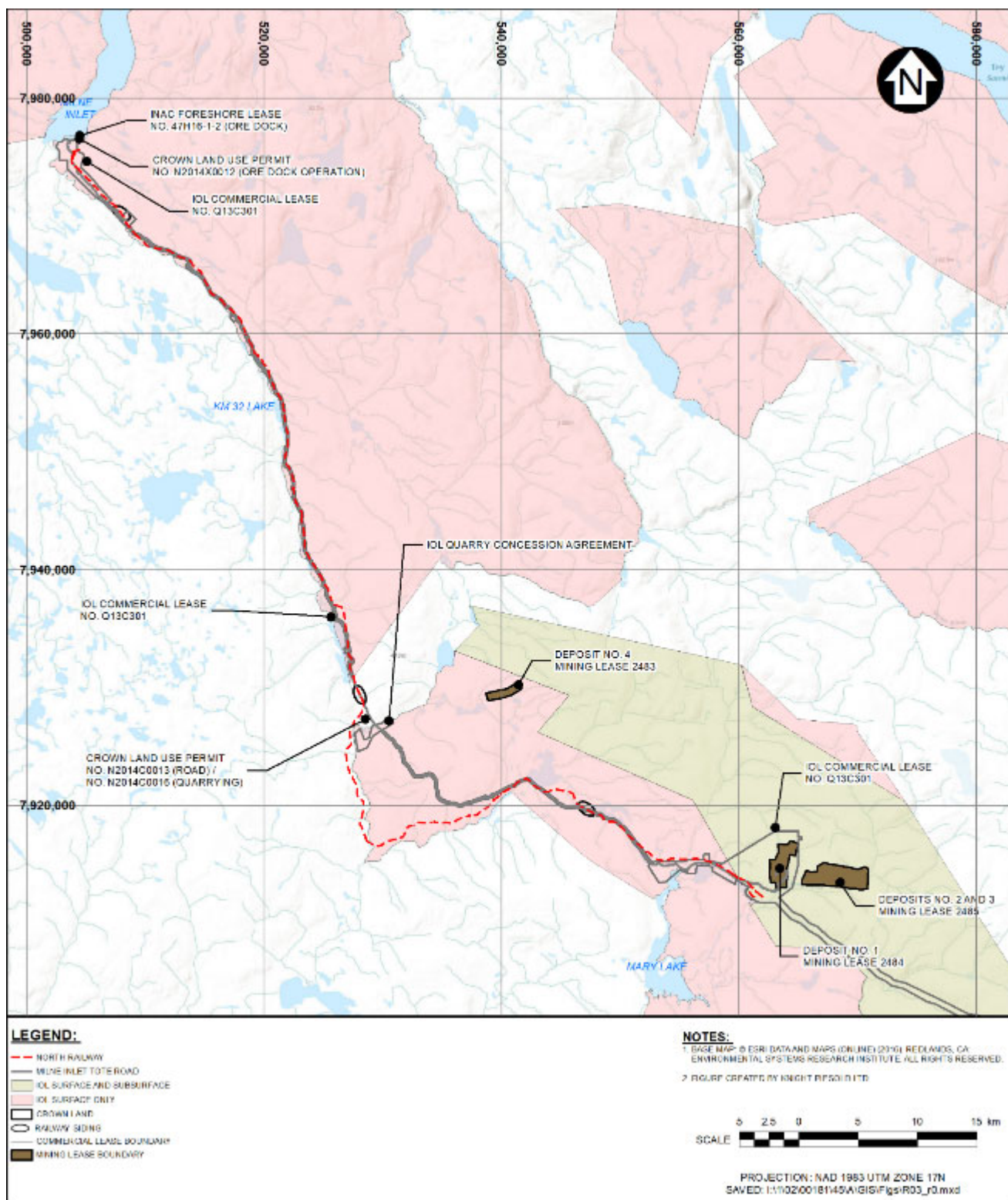
Phase 2 Mine Site Layout

Phase 2 Milne Port Layout

Phase 2 Northern Transportation Corridor





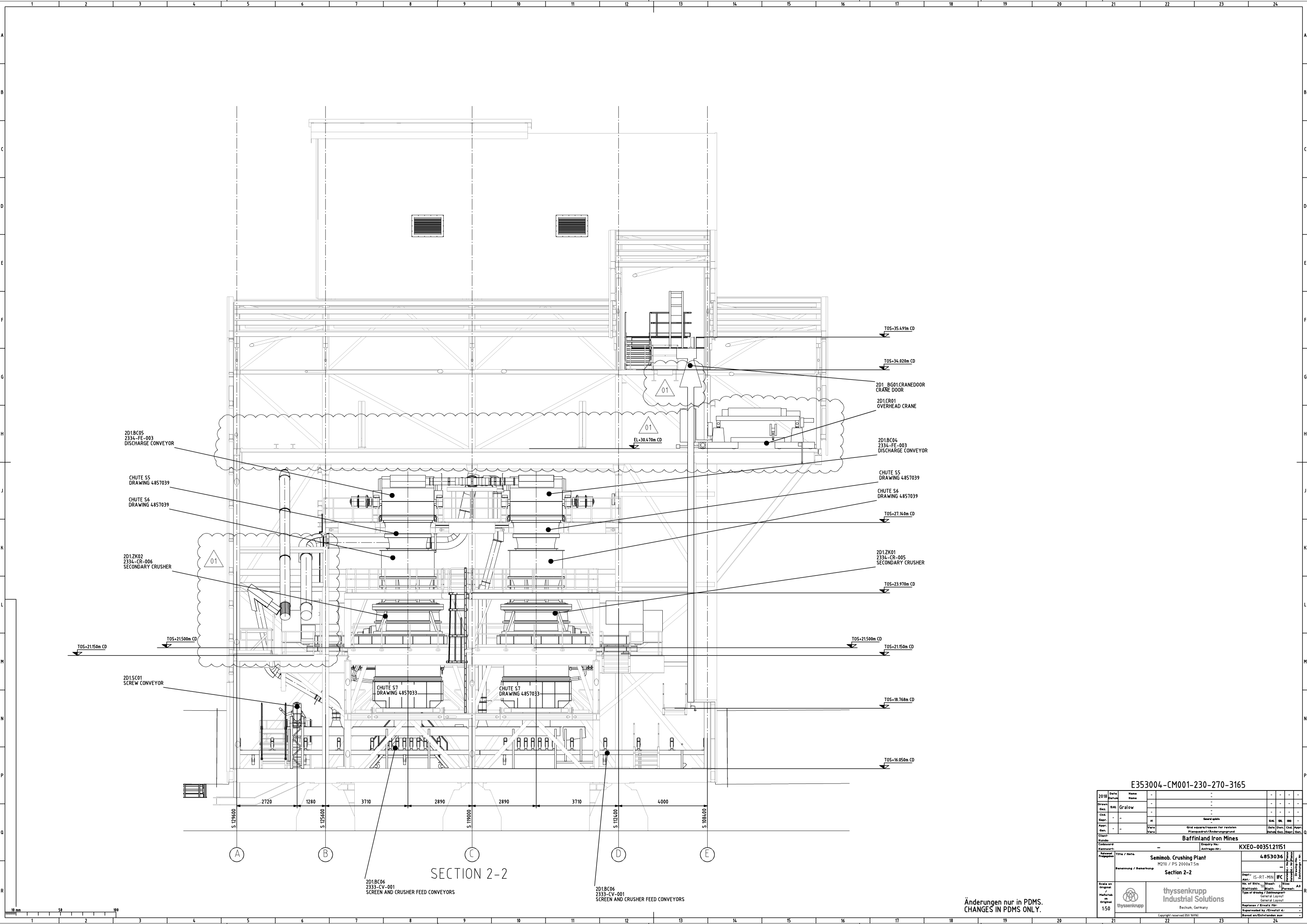


DRAFT

Appendix C

Supporting Documentation

Label	Type	Area (ha)	Easting	Northing
Q4	Quarry	0.77	507438.2941	7970517.803
Q6	Quarry	0.63	507804.114	7969987.837
Q10	Quarry	1.41	510638.1626	7967430.792
Q11	Quarry	0.40	513679.0933	7966223.482
Q13	Quarry	7.88	514294.886	7965313.931
Q16	Quarry	5.45	521838.3202	7952395.167
Q19	Quarry	2.81	523023.8647	7945185.603
Q21	Quarry	1.11	524356.0367	7940084.917
Q23	Quarry	0.40	525886.1608	7936585.887
Q24	Quarry	4.24	527062.9102	7934336.154
Q27	Quarry	9.07	527208.0488	7923193.417
Q42	Quarry	6.58	561673.1015	7912666.65
PQ5A	Quarry	18.56	525439.002	7938839.249
PQ4A	Quarry	11.10	523696.9379	7942900.617
PQ6A	Quarry	26.90	528552.096	7929762.854
PQ9A	Quarry	6.45	527378.4375	7920440.611
PQ9B	Quarry	2.18	527651.273	7920425.118
PQ10B	Quarry	9.66	531982.2251	7917635.007
PQ12A	Quarry	25.83	539072.4551	7921209.988
PQ13	Quarry	44.68	542676.2538	7923983.174
PQ14B	Quarry	9.45	550983.0824	7917457.6
PQ15A	Quarry	8.32	555853.2263	7915626.229
PQ15B	Quarry	6.14	555270.2492	7915585.828
PQ4B	Quarry	12.28	523650.8643	7941893.964
PQ5B	Quarry	47.23	526119.0313	7937802.056
PQ6B	Quarry	22.36	528993.2676	7928994.157
PQ10A	Quarry	13.47	531567.8168	7917522.408
PQ12B	Quarry	20.43	539898.1461	7921837.027
PQ14A	Quarry	4.58	550835.7095	7917828.697
PQ2B	Quarry	23.31	517664.1478	7961972.533
Rail Sand Pit	Quarry	7.95	528497.7375	7927789.752
LD-1	Laydown	3.43	504031.7205	7974597.534
LD-10	Laydown	1.22	524032.6564	7940558.284
LD-11	Laydown	0.96	527217.2405	7932785.764
LD-12	Laydown	2.50	528375.0108	7928223.09
LD-13	Laydown	1.96	540504.0646	7921426.459
LD-14	Laydown	0.33	543185.6927	7921430.623
LD-15	Laydown	1.74	547057.519	7919694.509
LD-16	Laydown	1.51	557978.2855	7914998.395
LD-17	Laydown	2.33	560009.8703	7913726.444
LD-18	Laydown	1.72	560829.4248	7913257.917
LD-19	Laydown	1.87	560909.1397	7913352.577
LD-2	Laydown	2.64	504048.7622	7974014.558
LD-3	Laydown	2.02	504491.5259	7973629.297
LD-4	Laydown	2.83	504974.8249	7972675.944
LD-5	Laydown	1.50	506327.9788	7971603.115
LD-6	Laydown	1.04	510799.1138	7967350.206
LD-7	Laydown	1.63	517314.0528	7961896.303
LD-8	Laydown	0.64	521690.9776	7953049.867
LD-9	Laydown	0.39	522987.3914	7945107.75



E353004-CM001-230-270-3165											
2018	Date Datum	Name Name	-	-	-	-	-	-	-	-	-
Drawn Gez.	BA	Gralow	-	-	-	-	-	-	-	-	-
Chk. Gepr.	-	-	-	-	-	-	-	-	-	-	-
Appr. Gepr.	-	-	-	-	-	-	-	-	-	-	-
Client Kunde	-	-	IT	General rights				UK	UK	UK	UK
Order Auftrag	-	-	Verz	Plans approved/assess for revision Plan genehmigt/Anforderungsgemäß				Drawn Gez.	Chk. Gepr.	Appr. Gepr.	0
Baffinland Iron Mines											
Contract Vertrag	-			Empiry No. Auftrags-Nr.			KXE0-00351.21151				
Released Freigegeben	-			-			4853036				
Title / Note Semimob. Crushing Plant						KXE0-00351.21151 4853036 Dept.: IS-RT-MIN EFC No. of Sheets: 1 Sheet No. of drawings: 2 drawings General Layout General Layout Replacement / Ersatzteil: - Superseded by / Ersetzt durch: - Revised and/oder neu: -					
Banennung / Bauzeichnung Section 2-2											
Scale on original Maßstab auf Blatt	1:50				thyssenkrupp Industrial Solutions Beckum, Germany		A				
1:50		thyssenkrupp									
21		22		23		24					

Änderungen nur in PDMS.
CHANGES IN PDMS ONLY.

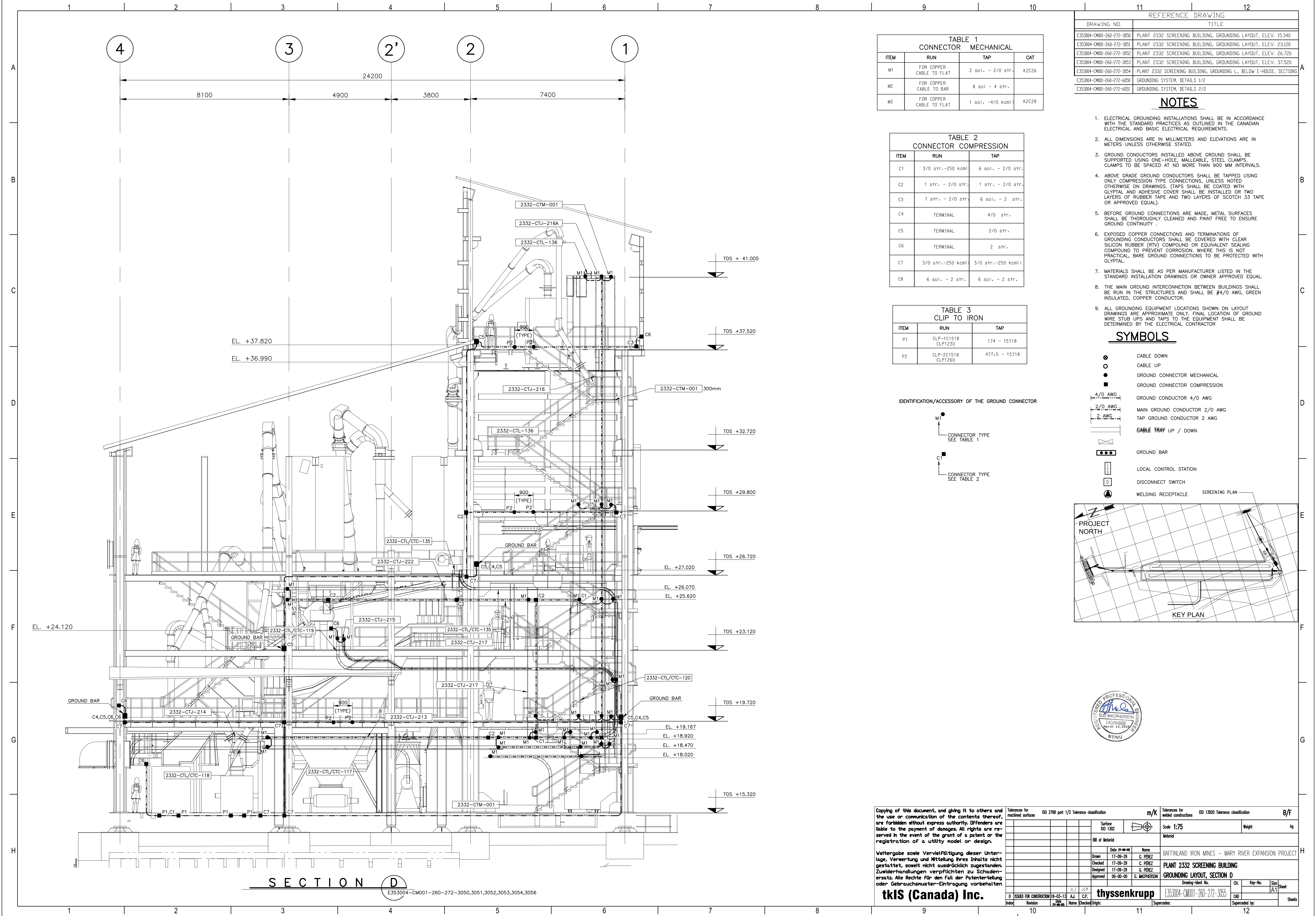
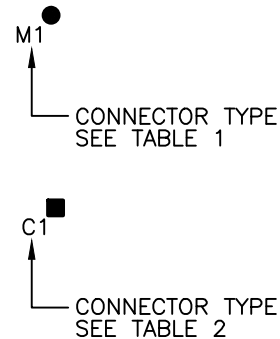


TABLE 1 CONNECTOR MECHANICAL			
ITEM	RUN	TAP	CAT
M1	FOR COPPER CABLE TO FLAT	2 sol. - 2/0 str.	K2C26
M2	FOR COPPER CABLE TO BAR	8 sol - 4 str.	
M3	FOR COPPER CABLE TO FLAT	1 sol. -4/0 kcmil	K2C28

TABLE 2 CONNECTOR COMPRESSION		
ITEM	RUN	TAP
C1	3/0 str.-250 kcmil	6 sol. - 2/0 str.
C2	1 str. - 2/0 str.	1 str. - 2/0 str.
C3	1 str. - 2/0 str.	6 sol. - 2 str.
C4	TERMINAL	4/0 str.
C5	TERMINAL	2/0 str.
C6	TERMINAL	2 str.
C7	3/0 str.-250 kcmil	3/0 str.-250 kcmil
C8	6 sol. - 2 str.	6 sol. - 2 str.

TABLE 3 CLIP TO IRON		
ITEM	RUN	TAP
P1	CLP-1C1518 CLP1230	124 - 15218
P2	CLP-2C1518 CLP1260	477.5 - 15218

IDENTIFICATION/ACCESSORY OF THE GROUND CONNECTOR



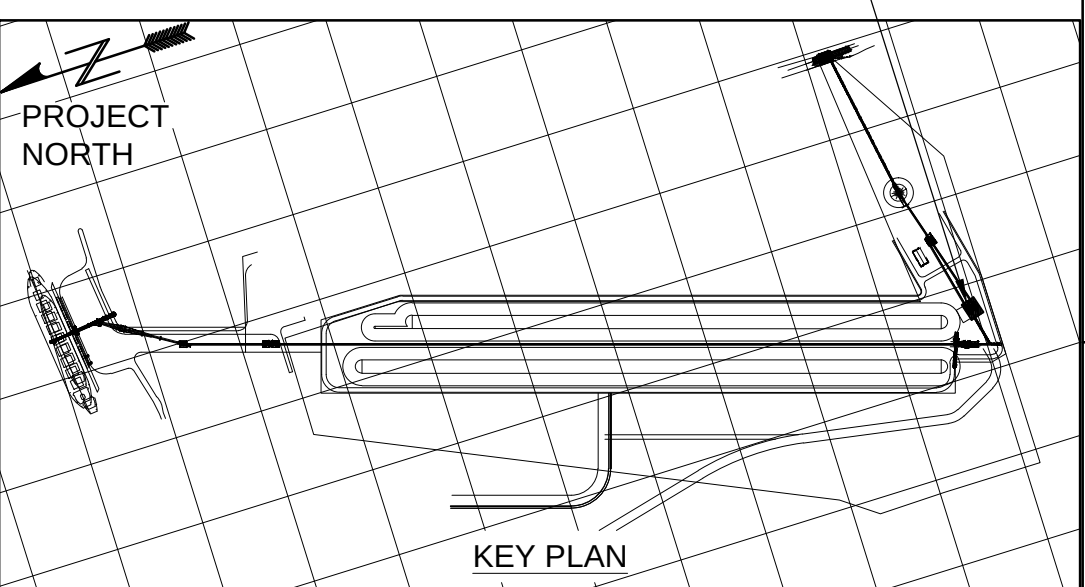
REFERENCE DRAWING	
DRAWING NO.	TITLE
E353004-CM001-260-272-3050	PLANT 2332 SCREENING BUILDING, GROUNDING LAYOUT, ELEV. 15.340
E353004-CM001-260-272-3051	PLANT 2332 SCREENING BUILDING, GROUNDING LAYOUT, ELEV. 23.120
E353004-CM001-260-272-3052	PLANT 2332 SCREENING BUILDING, GROUNDING LAYOUT, ELEV. 26.720
E353004-CM001-260-272-3053	PLANT 2332 SCREENING BUILDING, GROUNDING LAYOUT, ELEV. 37.520
E353004-CM001-260-272-3054	PLANT 2332 SCREENING BUILDING, GROUNDING L., BELOW E-HOUSE, SECTIONS
E353004-CM001-260-272-6050	GROUNDING SYSTEM, DETAILS 1/2
E353004-CM001-260-272-6051	GROUNDING SYSTEM, DETAILS 2/2

NOTES

- ELECTRICAL GROUNDING INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE STANDARD PRACTICES AS OUTLINED IN THE CANADIAN ELECTRICAL AND BASIC ELECTRICAL REQUIREMENTS.
- ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE STATED.
- GROUND CONDUCTORS INSTALLED ABOVE GROUND SHALL BE SUPPORTED USING ONE-HOLE, MALLEABLE, STEEL CLAMPS. CLAMPS TO BE SPACED AT NO MORE THAN 900 MM INTERVALS.
- ABOVE GRADE GROUND CONDUCTORS SHALL BE TAPPED USING ONLY COMPRESSION TYPE CONNECTIONS, UNLESS NOTED OTHERWISE ON DRAWINGS. (TAPS SHALL BE COATED WITH GLYPTAL AND ADHESIVE COVER SHALL BE INSTALLED OR TWO LAYERS OF RUBBER TAPE AND TWO LAYERS OF SCOTCH 33 TAPE OR APPROVED EQUAL).
- BEFORE GROUND CONNECTIONS ARE MADE, METAL SURFACES SHALL BE THOROUGHLY CLEANED AND PAINT FREE TO ENSURE GROUND CONTINUITY.
- EXPOSED COPPER CONNECTIONS AND TERMINATIONS OF GROUNDING CONDUCTORS SHALL BE COVERED WITH CLEAR SILICON RUBBER (RTV) COMPOUND OR EQUIVALENT SEALING COMPOUND TO PREVENT CORROSION, WHERE THIS IS NOT PRACTICAL, BARE GROUND CONNECTIONS TO BE PROTECTED WITH GLYPTAL.
- MATERIALS SHALL BE AS PER MANUFACTURER LISTED IN THE STANDARD INSTALLATION DRAWINGS OR OWNER APPROVED EQUAL.
- THE MAIN GROUND INTERCONNECTION BETWEEN BUILDINGS SHALL BE RUN IN THE STRUCTURES AND SHALL BE #4/0 AWG, GREEN INSULATED, COPPER CONDUCTOR.
- ALL GROUNDING EQUIPMENT LOCATIONS SHOWN ON LAYOUT DRAWINGS ARE APPROXIMATE ONLY. FINAL LOCATION OF GROUND WIRE STUB UPS AND TAPS TO THE EQUIPMENT SHALL BE DETERMINED BY THE ELECTRICAL CONTRACTOR

SYMBOLS

- CABLE DOWN
- CABLE UP
- GROUND CONNECTOR MECHANICAL
- GROUND CONNECTOR COMPRESSION
- GROUND CONDUCTOR 4/0 AWG
- MAIN GROUND CONDUCTOR 2/0 AWG
- TAP GROUND CONDUCTOR 2 AWG
- CABLE TRAY UP / DOWN
- GROUND BAR
- LOCAL CONTROL STATION
- DISCONNECT SWITCH
- WELDING RECEPTACLE



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tkIS (Canada) Inc.

Tolerances for machined surfaces				ISO 2768 part 1/2 Tolerance classification				m/K		Tolerances for welded constructions				ISO 13020 Tolerance classification				B/F	

