MHBL Response to:

Conformity Analysis of the Final Environmental Impact Statement (FEIS) for the Proposed Doris North Gold Project

prepared by:
Indian and Northern Affairs Canada

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1. Introduction

The Doris North review team was requested by Indian and Northern Affairs Canada (INAC) to conduct a conformity (or gap) analysis for the Doris North Gold Project. The scope of work involved comparing the Final Environmental Impact Statement (FEIS) prepared by Miramar Hope Bay Ltd. (Miramar or Proponent) to the NIRB Pre-hearing Decision (June 12, 2003). The review team was asked to comment on whether the FEIS is adequate and whether it complies with the NIRB requirements identified in the Pre-Hearing Decision. It was indicated to the review team that there will be an opportunity for a detailed technical review of the FEIS at a later stage in the environmental assessment (EA) process.

The Doris North Review Team includes:

- Gartner Lee Limited;
- BGC Engineering Inc.;
- Mehling Environmental Management Inc.;
- Northwest Hydraulics Consultants Ltd.;
- Brodie Consulting Ltd.; and
- INAC staff from the Lands, Waters, Environment and Economic Development Divisions.

This document is structured against the Pre-Hearing Decision requirements identified by NIRB. This conformity analysis addresses, in whole or in part, the following major issues outlined by NIRB:

- **NIRB Issue 1:** The incomplete nature of the statement of the Project's purpose or Project justification.
- **NIRB Issue 2:** The inadequacy of environmental baseline data, particularly site-specific data, and the absence of specific sectoral and supplemental surveys.
- **NIRB Issue 3:** The lack of detail contained in the general project description as well as in the description and analysis of specific plans and strategies.
- **NIRB Issue 4:** The adequacy of various components of the impact assessment, including the assessment of socio-economic impacts.
- **NIRB Issue 6:** Deficiencies in public consultation elements.
- **NIRB Issue 7:** The question of the anticipated life and scope of the project as it affects the project definition and the cumulative effects assessment.
- **NIRB Issue 8:** The inadequacy of the cumulative effects assessment.
- **NIRB Issue 9:** The lack of Project alternatives, particularly alternative tailings disposal methods.

2. Project Purpose or Project justification

NIRB Issue 1: The incomplete nature of the statement of the Project's purpose or Project justification.

a) The FEIS must include any economic analysis or feasibility studies, including economic models, to support the Project's viability.

This information is included in Supporting Document (SD) A6

b) The FEIS must justify the Proponent's stated view that the "Existence of an operating gold mine in this region will act as a catalyst for further investment in gold exploration and gold mine development in the region by other proponents" (Main Volume, 1.12.2).

This justification is included in SD A3, but only a weak argument presented. The nature of the geology immediately adjacent to the Doris North deposit (Doris Connector and Doris Central) suggests that these might be developed using the proposed infrastructure (camp, mill and tailings impoundment). The Proponent has acknowledged that the tailings impoundment is designed to accommodate future ore processing. The concern which arises out of this is "has the full probable project been proposed.?".

MHBL Comment:

Future Development

The issue of future development on the Hope Bay greenstone belt is a common theme in numerous comments from INAC and other interveners. It is addressed in general terms here and more specifically as it applies to specific issues, ie. tailings containment capacity.

The capacity and configuration of the Doris North Project is intended to process ores from Hope Bay belt gold deposits that will be developed for production after the known resources at Doris North are exhausted. The site at Doris North and the size of the proposed mill and tailings containment were all selected and proposed for development as the optimum size and location for incremental production from other deposits on the Hope Bay greenstone belt. At this time all other known gold deposits on the belt are prospects with development potential that are the subjects of additional and ongoing exploration effort. The status of each is summarized below:

- Doris Central and Doris Connector, immediately adjacent to Doris North but under Doris Lake are suitably drilled to establish 820,000 tonnes containing 280,000 ounces; however, at this time they can not be considered mineable because most of these resources lie within the minimum 100 m boundary interval from a lake bottom as set within the mining regulations. The remaining resources in Doris Connector and Central (outside the 100 m boundary interval) are too widely spaced to support any conceptual mining scenario and will require significant time and money to upgrade confidence levels.

- Madrid resources are considered a work in progress. Resource modeling and the incorporation of 2003 drilling results completed in January 2004 have dramatically changed the view of the Madrid deposits (primarily Naartok and Suluk) from higher grade selective deposits to lower grade bulk deposits. Insufficient data are available to discuss potential mining scenarios at this time.
- Boston has resources totalling 4.0 million tonnes containing 1.6 million ounces. An internal study has determined that 1.5 million tonnes containing 660,000 ounces are sufficiently drilled to define mining zones, the majority of which are accessible from the existing ramp. Additional drilling is required to upgrade confidence in the resource status of the remaining 2.5 million tonnes.

Exploration successes in 2003 point to Boston as the source of incremental production after Doris North ores are exhausted. MHBL is currently developing a critical path, subject to feasibility studies and permitting, that could facilitate mining at Boston in time to haul stockpiled ores to Doris North in January, February, and March 2008. Miramar strongly believes that an additional 4 to 5 years of economic operations at Doris North are readily available with a further 5 to 10 years depending upon continued exploration successes and resource conversions, and given the nature and history of similar greenstone hosted gold deposits. The critical path for development at Boston has MHBL submitting a Preliminary Project Description to KIA, the Nunavut Water Board, and NIRB in Q1 2005 while completing the previously initiated Boston development feasibility study. MHBL is confident that the scale of development at Doris North, especially the designed capacity of Tail Lake, is justified by the development potential on the Hope Bay greenstone belt.

3. Environmental Baseline Data

NIRB Issue 2: The inadequacy of environmental baseline data, particularly site-specific data, and the absence of specific sectoral and supplemental surveys.

a) The FEIS must include more detail on environmental baseline data in each of the following areas: climate/air quality, regional geology, permafrost conditions, geochemistry, ground water conditions, hydrology/water quality, sewage plans, archaeology, vegetation, wildlife, acid rock drainage and metal leaching, marine and fresh water organisms and habitat, bird life and habitat, bioaccumulation and biomagnification, waste handling, waste water management, and quarrying.

Climate Change

The Proponent does consider long term climate change implications for the project in SD A4, Section 2.3, and therefore fulfils NIRB's above noted requirement with respect to climate. However, INAC does not agree with Miramar's statement that the permafrost would necessarily remain continuous.

The site has a Mean Annual Air Temperature (MAAT) of –12.1^{o} C. Using the "Best Estimate" case for global warming[1], the Doris North Project would experience about 3.1^{O} C increase in the MAAT by 2100. Under a worst case scenario, the MAAT could increase by 5.4^{o} C. Therefore the "Best Case" MAAT is –9^{O} C and the "Worst Case" MAAT is –6.7^{o} C.

As a rule of thumb, the average ground temperature at the point of zero annual amplitude is about 3^{O} C warmer than the MAAT. This is confirmed by on-site thermistor data which shows ground temperatures in the range of –7 to –9 ^{o} C. Therefore under the "Best estimate" case, the predicted ground temperature would be –6^{o} C. For the "Worst Case" warming scenario, the average ground temperature would be –3.7^{o} C.

The boundary between discontinuous and continuous permafrost coincides closely with the –5^{o} C ground temperature isotherm. Therefore the site lies within the region where there is a potential for the continuous permafrost zone to disappear, depending on actual temperature conditions.

[1] Etkin, D., G. Paoli and D. Riseborough. 1998. Climate Change Impacts on Permafrost Engineering Design. Funding provided by Panel on Energy Research and Development (PERD).

MHBL comment:
The estimated MAAT for Hope Bay based on historical data is -12.1 °C but according to the predictions for climate change up to year 2100, the MAAT could eventually reach -9.0 °C for the “best estimate” scenario and -6.7 °C for the “worst case” scenario.

The literature indicates that the MAST is often 3 to 4 degrees warmer than the MAAT (Smith and Burgess, 2000), which is consistent with the ground temperature measurements at Hope Bay, where the MAST ranges approximately from -10 to -8 °C. The climate change could therefore raise the MAST to -5 °C under the “best estimate” scenario and -2.7 °C for the “worst case” scenario. The southern limit for continuous permafrost is often based on an arbitrary selection of the -5 °C isotherm measured at the depth of zero annual temperature amplitude (Andersland and Ladanyi, 2004). These authors also indicate that a MAST must be colder than -3 °C to support permafrost. Permafrost is, by definition, when the ground temperature remains below 0 °C over 2 consecutive years[2]. It would appear that the thermal regime could eventually approach marginal conditions at Hope Bay for supporting continuous permafrost. The permafrost could even become discontinuous if the warming trends exceeds the current predictions or remain in place well beyond the next few centuries. The ground temperature at depth will respond at a much lower rate and would likely take centuries before the ground reaches thermal equilibrium over the depth of the current permafrost. The impact of climate change can be seen as a trigger to a thermal reaction that will be initiated at the ground surface but will take a very long time to reach equilibrium over depth.

The impact of climate change can also be assessed by looking at the freezing index. The temperature increase would reduce the freezing index from the current 5135 °C-days to about 3500 °C-days for the “best estimate” scenario and 2300 °C-days for the “worst case” scenario. These freezing indexes were estimated by assuming that the predicted seasonal temperature increases applies at 100% for winter, 67% for spring and 33% for fall. Gerdel (1969)[3] suggested that the annual freezing index should be at least 3900 °C to maintain a continuous permafrost regime. This approach suggests that climate change will potentially trigger a thermal regime that will not support continuous permafrost. As mentioned previously, it will take a very long time for the thermal regime to equilibrate at depth, likely in order of centuries.

Climate change will begin by changing the thermal regime at the surface before it propagates into the ground. The nature of the cover over the ground surface will therefore become an important component or

[2] Brown, R.J.E., Kupsch, W.O. 1974. Permafrost Terminology. National Research Council Canada, Tech. Memo. 111.

[3] Gerdel, R.W. 1969. Characteristics of the Cold Regions. U.S. Army Cold Regions Research and Engineering Laboratory Monograph I-A.

the thermal regime. Studies reported in the literature (Brown, 1973[4]; Linell, 1973[5]) show, for instance, that vegetative or peat covers will maintain lower MAST than exposed mineral soils or bedrock.

It highlights the importance of minimising the areas that will be disturbed by the development of the mine development and operations at Hope Bay.

The overburden at Hope Bay consists in large part of an ice-rich marine deposit. The pore water in those deposits is saline and can have concentrations similar to seawater (~35 g per litre). Seawater will depress the freezing point to -2 °C. It is therefore important to recognise that portions of the pore water within the marine deposits could become completely unfrozen when the ground temperature reaches -2 °C instead of 0 °C. The pore water entrapped in the non-marine deposits and the bedrock appears to be non-saline and will need to reach temperatures close to 0 °C before it becomes fully unfrozen. The ice-rich marine deposit will likely "react" sooner to the climate change, essentially resulting in localised deeper active zones. It is therefore important that the natural slopes be properly assessed during the final design of the infrastructures and that the proper remedial measures are adopted.

Hydrology and Climate Data

There are no site specific climatic baseline data and a relatively small amount of hydrologic data (SD B1). The approach has been taken that Boston Camp site climatic data (located 50 km south of Doris Hinge Project site), combined with regional climatic and hydrologic data are sufficient to enable establishment of corresponding climatic and hydrologic factors/parameters at the Project site.

INAC noted on a site trip in 2003 that a meteorologic station had recently been installed and was operating. In the meantime, climate parameters presented in the EIS document have been based on Boston Camp and regional station data.

In Summary (preliminary analysis):

- Consistent operation of the newly installed (2003) meteorologic station at the Project site will in time enable correlation with Boston Camp records.
- Prediction of temperature regime at Project site using regionally extended Boston Camp record likely okay as spatial variability seems small.

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[4] Brown, R.J.E. 1973. Influence of climatic and terrain factors on ground temperatures at three locations I the permafrost region of Canada. Permafrost, Second International Conference (13-28 July 1973, Yakutsk, U.S.S.R.), North American contribution, National Academy of Sciences, Washington, D.C., pp. 27-34.

[5] Linell, K.A. 1973. Long-term effects of vegetative cover on permafrost stability in an area of discontinuous permafrost. Permafrost, Second International Conference (13-28 July 1973, Yakutsk, U.S.S.R.), North American contribution, National Academy of Sciences, Washington, D.C., pp. 27-34.

- Prediction of precipitation regime using extended Boston Camp record seems questionable at this time. Use of the predicted extreme 24-hour rainfall amounts for the Project site should be used with caution.
- Predicted extreme values of runoff for streams in the Project area have been based on regional correlations using relatively large streams compared to the sizes of Project impacted streams. Results should be used with considerable caution. If automatic recording stations have been maintained since 2000, then two or three years of additional data would greatly improve the ability to predict local, small basin flow regimes. There is a reasonable array and distribution of hydrometric gauges in the Project area, but unfortunately the first few years of data did not produce continuous water level records and information quality was somewhat sporadic.

MHBL comment:

Climate Data Collection:

A climate station was installed at Doris North in 2003. Power problems caused the station to collect data intermittently over the winter months but it was serviced in February 2004 and is currently operating. Miramar is committed to continued collection of baseline climate data at Doris North.

The ongoing baseline data collection program includes plans for snow course surveys at Doris North during the late winter of 2004. These surveys will include measurements of snow depth, density and snow water equivalent for sample plots representative of lake, flat upland, flat lowland and north, east, south and west aspect slopes.

There are currently no plans for installing instrumentation to measure pan evaporation at Doris North. These are difficult to operate and require skilled personnel to ensure that the data collected are of adequate quality. It would be possible to derive lake evaporation using the WREVAP program (Morton et al. 1985), based on temperature, insolation, humidity and altitude data. To do this effectively, it is recommended that sensors for measuring relative humidity and global solar radiation be added to the existing temperature and precipitation sensors at the Doris North climate station.

References

Morton, F.I., F. Ricard and S. Fogarisi. 1985. Operational Estimates of Areal Evapotranspiration and Lake Evaporation – Program WREVAP. Environment Canada, Inland Waters Directorate, National Hydrologic Research Institute, NHRI Paper No. 24, 15 p. + appendices.

Hydrology Data Collection:

Continuous water level monitors were operated in Doris Outflow, Roberts Outflow and Little Roberts Outflow during late June through early September, to provide a record of water levels and flows in these systems. Miramar intends to continue monitoring of levels in flows in these drainages in 2004 to provide additional information on the hydrologic regime for use during final design

Regional Geology

Regional geology is covered in the FEIS in Sections 3.1.3, 3.1.4, 3.1.5 and 3.1.6., as well as in SD A1, A4, A5 and A6. Thurber Engineering Limited conducted a site-specific surficial geology mapping for the Doris North Project in July 2003 (appended to SD A4 and A5). In general the data provides an overview of the regional geology[6]. No detailed bedrock or structural geology of the project area was presented, as part of the regional geology. Therefore, it is concluded that the Proponent has fully addressed the NIRB request with respect to regional geology.

Permafrost Conditions

Permafrost conditions are not well described in the FEIS, with a superficial description being given in Section 3.1.6. Ground temperatures are not mentioned in the FEIS. Although the supporting documents contain more site-specific information regarding permafrost from geotechnical investigations, there is still an overall lack of discussion on the regional aspects and recognition of the potential impacts of dealing with the ice-rich marine clays found at the site. These soils are the worst types of soils in terms of the potential environmental impacts associated with permafrost degradation.

As discussed later, the Proponent has failed to address the impacts of the tailings impoundment on the permafrost surrounding Tail Lake, which, in INAC's opinion, is a serious deficiency with respect to the overall FEIS. The Proponent has identified the need for constructing granular/rockfill pads (2.0- 2.5 m thick) to preserve the permafrost and the use of berms, not ditches to divert runoff. The Proponent has identified the presence of talik conditions under the tailings dam and the presence of saline porewater in the soil, resulting in a freezing point depression of -2^{o} C, therefore with respect to the dam design, there is sufficient information to assess potential impacts.

MHBL comment:
As indicated previously, the marine deposit could exhibit unfrozen behaviour when the ground temperature eventually reaches -2 °C instead of 0 °C. Once the pore water begins to thaw, the ice-rich content within the marine deposit will likely create an excess of pore water and reduce considerably the strength of the marine deposit.

The proponent will monitor the performance of the permafrost surrounding Tail Lake, and once the water level reaches the anticipated final closure water level, the Lake perimeter will be stabilized in areas of concern. This stabilization will be in the form of a rock cover, possibly overlying a suitable geotextile. The proponent would be prepared to stabilize the entire Lake perimeter; however, this would likely not be required. These slopes will continue to be monitored throughout the life of the project, and any areas that exhibit excessive movement will be suitably stabilized. Once the water level is lowered, permafrost is

[6] This baseline data indicates that some degradation is occurring within the ice-rich marine clays at several locations, due in part to previous human disturbance. The Proponent should be responsible for mitigating this damage as a licence condition under the site reclamation and restoration plan to ensure that further degradation is prevented

expected to re-establish, and since the slopes that will be re-exposed will have been stabilized, no further problems are expected. The potential impact of the drawdown would be minimized due to the potentially long time period over which this drawdown would occur.

An alternative method to mitigate this problem was considered, i.e. not allowing the water level to be drawn down. The dams have in actual fact been designed for this scenario, and would be totally functional under these conditions. It was however felt, that considering the perpetual nature of these dams, the prudent thing would be to limit any risk, albeit the dam risk is considered low.

Groundwater Conditions

With respect to the underground mine, groundwater is not an issue since the Doris Hinge Zone lies within the permafrost zone on land. Groundwater movement will only occur in the shallow active layer during the seasonal thaw period. SD B5 by SRK presents a preliminary analysis of groundwater inflow for the possible, future extension of the mine under Doris Lake; however no rock permeability testing has yet been done to confirm the assumptions made. Although this portion of the mine is not part of the current mine plan, exploration in to the area is planned and, therefore, additional site-specific information regarding possible groundwater inflows is required to assess impacts on the site water balance.

Thermal modelling was done in Appendix 10A of SD A5 describing the tailings impoundment design. The thermal modelling was done to assess the development of a talik between Tail Lake and Doris Lake.

In general, there is sufficient data presented on groundwater conditions to assess potential impacts.

MHBL comment:
SD B5 by SRK clearly states that the modeling was considered to be preliminary, and that all parameters were estimated from literature. The intent of this study was however to bracket the flow rages that could potentially be expected should mining under Doris Lake proceed. SRK presented a base case and sensitivity analysis, which confirmed that the primary factor affecting the potential volume of water flowing in the mine would be the rock permeability. The rock permeability used for the base case evaluation was based on the local lithology, and are therefore reasonable, and likely biased towards the conservative side. The primary use of this information was for the Tail Lake water balance, presented in SD A4, Section 7, and in the water balance SRK used a conservative approach by allowing for storage of the full base case underground flow into Tail Lake from the start of mining, even though whilst mining occurs at Doris North there will be no groundwater inflow into the mine. SRK also presented some sensitivity analysis considering the impact of this inflow on the dam height. In the event that development of Doris Central and Doris Connector proceed, and detailed site specific hydrogeological information is gathered to firm up the groundwater inflow numbers, the Tail Lake water will be re-evaluated; however, SRK believes there is sufficient conservatism built into these analysis to allow time for implementation of contingency measures if required.

SRK and Miramar acknowledge that the mine groundwater model would have to be refined by obtaining site specific hydrogeological information in this area, including rock permeability and thermal properties. It is the intent of Miramar to initiate this detailed hydrogeological study prior to proceeding with any plans to develop Doris Connector and Doris Central.

Water Quality

The FEIS summarizes water quality baseline sampling from 1995-2003 for onsite water bodies and 1996-1998 for Roberts Bay (RL&L/Golder, 2002). Aquatic sediments were sampled from inland waters and marine sediments (RL&L/Golder, 2002). Surveys and results are also described in SD C3 (1995-2000), SD C2 (2002) and SD C1 (2003). Bathymetry of Doris, Tail and other lakes is provided (SD C3).

Spatial, temporal and seasonal water quality sampling is adequate to describe the baseline. Sufficient sample numbers (~30 for ice free period in, ~4-8 for ice-cover) were reported to describe Doris Lake. Tail Lake was sampled at a lower intensity (25-50% of the effort) but this is sufficient, as it will be become a tailings storage area. The other six lakes were sampled at low intensities. No project activities are planned for these lakes but, if they are intended as reference lakes for the Environmental Effects Monitoring (EEM) program, then sampling should be intensified in the future.

While additional baseline information has been gathered, which may be acceptable for the conformity check, a preliminary assessment of the data indicates that there may be some fundamental technical issues that will need to be researched and resolved as part of the technical review for the Environmental Assessment.

The Doris outflow has not been sampled intensively and is proposed for a discharge site. Water quality for several key parameters (i.e. ammonia, phosphorus, Cu) is variable and this has implications for disposal of tailings water. The plan for discharging from the Tail Lake containment area is dependent on utilizing the dilution potential of Doris Lake outflow to meet CCME guidelines after mixing. Copper is stated to be the limiting contaminant. Baseline water quality data for Doris outflow, in particular, is therefore critical to assess the feasibility and impact of the Tail Lake decant strategy, and the Proponent should be cautioned that:

- The Tail Lake decant strategy is very sensitive to the actual (background) copper concentration in the Doris Lake outflow. Based on this strategy no decant from Tail Lake would be allowed if the Doris Lake outflow copper concentration exceeded the CCME guideline (2 μg/L);
- The accuracy of the Doris outflow copper baseline data is questionable because the reported values (1.5 – 2.3 μg/L) are very near to the published detection limit of 1 μg/L (Table A2.1; SD C3); and
- Not enough baseline data for the Doris Lake outflow has been obtained to confirm that background levels are below the CCME copper guideline of 2 μg/L during the periods of expected discharge/decant from Tail Lake (Table 3.12 in SD C3).

Sampling intensity may have to be increased here prior to mine development (i.e. 2004 field season) or prior to any discharge from tail lake. Other strategies for discharge limits may need to be examined (e.g., best-available technology - BAT).

For Roberts Bay, sampling for routine parameters is adequate (~25 samples) but is insufficient for trace metals (only 6 samples 1996-1998). INAC notes that the results shown in Table 3.19 of SD C3 clearly show sample contamination for Cd in Roberts Bay – the results show concentrations of 30 times the guideline and this is clearly wrong. This must be resolved.

MHBL comment:
Additional water quality sampling, including trace metals , in Roberts Bay, Roberts Outflow, Doris Lake and Doris outflow will be incorporated into the late winter and open water sampling program to be conducted in 2004 to provide additional baseline data prior to development. The additional sampling program will resolve the issue identified relating to cadmium concentrations in Roberts Bay.

These comments considered waste water management (as indicated in NIRB's request).

MHBL comment:
The observation that the Tail Lake decant strategy is sensitive to the actual background water quality of Doris Lake is correct and the understanding is that additional baseline monitoring (metals as well as nutrients) at a higher frequency would be undertaken to verify the background water quality estimates used in the water quality model. The discharge strategy will be revised to accommodate additional baseline data generated prior to development by incorporating these in the current water and load balance calculations. Furthermore, the understanding is that water quality monitoring of Tail Lake, Doris Lake outflow and downstream of the discharge point would be undertaken throughout operations to ensure that the CCME guidelines are not exceeded.

Geochemistry, Acid Rock Drainage and Metal Leaching

See part b) below.

Quarrying

Information on quarry sites is given in SD A1 and SD A4. Three quarries will be used. All are located in exposed bedrock outcrops, so no overburden stripping is involved. Rock samples from each quarry were tested to ensure that the rocks were not susceptible to acid rock drainage (ARD) and metals leaching.

There are no details presented regarding water management at the quarries other than a note that runoff and melt water will be diverted by constructing berms around the edges of the quarry excavation used for the landfill.

Of greater concern is the borrow areas for construction of the tailings dams. There is no information presented regarding the borrow areas used to provide the fine-grained impervious materials used in the core of the tailings dams. The Proponent plans to open a borrow pit and mine the ice-rich soils by seasonal stripping. This is a major technical concern in the dam design as it will not be possible to obtain the material due to the excess ice content and nature of the material. Considerable environmental damage may be caused as a result of permafrost melting associated with these borrow sites. The Proponent should be requested to review the type of dam section proposed.

Information on the investigations and management plans regarding the quarrying of granular material for dam construction is critical to the technical review of the Environmental Assessment and the absence of adequate information in this topic from the FEIS is a non-conformity issue, in our view.

MBHL comment:
After consulting a contractor with northern and winter construction experience, we refined the approach originally envisaged for the dam construction. The dams will use crushed rock from the quarry and fine grained material that will be excavated upstream of the North Dam. The construction of the dams will be in winter and the disturbance to the existing ground will be limited to within the footprint of Tail Lake once the water level reaches the closure operating level of 29.5 m. The proposed construction area will be located upstream of the North Dam. The proposed area will be layered out to accommodate for the borrow source for the fine grained soils, the stockpiles, a crusher and a building for the asphalt plant that will be used to prepare the backfill material prior to placement. Since the construction will occur in winter, the placement of gravel pads will be on frozen ground and could be removed upon completion of the construction of the dams.

The fine grained material intended for the central core of the dam will be excavated during winter. It will be excavated by drilling and blasting. The key trench will also require drilling and blasting. The excavation would practically be equivalent to a quarry operation but it will likely consume more explosives due to the presence of pore ice. The blasted material will be stockpiled adjacent to the excavated area. The fine grained soil will then be passed through a crusher and then through a dryer similar to an asphalt plant where the proper amount of water would be added. The moist mixture would then be transported by truck for placement and compaction. The excavated material from the key trenches will probably be used if it is suitable material. The waste material will likely be put back in the excavation of the borrow source. The excavated material will be stockpiled at the same location. The placement of the material will require that the stockpiled material be run through a crusher to break down the frozen lumps, run through a dryer (asphalt plant) where the proper dosage of water will be added for the proper water content, and then be placed. The asphalt plant and the addition of water will require a temporary heated building.

This proposed approach eliminates the risks associated with the disturbance of permafrost and the release of suspended solids. Additionally, the winter construction does not have to manage impacted water from suspended solids since the flow from Tail Lake is negligible or can be easily managed. It will however require that the dams are completed within one season, which is reasonable given the size of the dams.

b) The FEIS must include site-specific data for each of the following areas: climate, air quality, bioaccumulation and biomagnification, surficial geology and terrain, acid rock drainage, and permafrost conditions. If the Proponent chooses to extrapolate data from other sites, a demonstration of the accuracy of the data must be provided.

Climate

See Hydrology and Climate Data under part a) above.

Surficial Geology and Terrain

The Proponent has undertaken a program of drilling at each of the proposed structure sites. In general, the entire site is blanketed by ice-rich marine silts, clays and minor sands and gravels. Sampling of the ice rich soils was done using a core barrel and chilled brine to recover intact soils and has confirmed the presence of ice lenses. A total of 23 thermistors have been installed to measure ground temperatures at various sites including the dam foundations. In general the information provides sufficient data to assess impacts of proposed structure sites on permafrost.

There was no thermistor installed in the vicinity of the proposed underground mine development, so there is no site-specific data on ground temperatures at the depth of the mine workings. Details on the geology of the underground workings is also lacking. Insufficient information exists to assess impacts of the underground workings.

MHBL comment:
The deepest thermistor installed at Doris North is about 70m below ground surface while the Boston site has one thermistor string down to almost 250m. The "deep" thermistor string installed at Doris North is not deep enough to determine the general geothermal regime for the site. It can be expected that the thermal regime would be similar to the Boston site because the Doris North temperature data are consistent with the Boston measurements. Miramar should therefore include a deep thermistor at Doris North that would be at least 200m deep as part of their field program in prevision of the final design. The location should be located within the general area of the proposed mining facilities.

Geochemistry, Acid Rock Drainage and Metal Leaching

Site-specific environmental baseline data, with respect to geochemistry, acid rock drainage, and metal leaching, that was added to the FEIS included data from the 3 proposed construction quarry sites and the 2003 Doris North metallurgical program (FEIS, Section 3.1.7, SD B2, SD B4). Therefore, in comparison to the Draft EIS there has been additional geochemical characterization of:

- Quarry rock (Q1 = 7 samples, Q2 = 8 samples, Q3 = 7 samples). AMEC provided detailed mapping and sampling summaries of each quarry. The chip samples appear to be sufficiently representative of the quarry.
- 1 Ore (Head) sample = ABA, whole rock analysis (?), shake flask extraction
- 1 Flotation tailings sample = ABA
- 1 Cyanide leach residue sample (following cyanide detoxification) = ABA
- 1 Combined final mill tailings sample = ABA, ICP, whole rock analysis, XRD, shake flask extraction, humidity cell and LC-50 Rainbow Trout bioassay

Specific recommendations by various parties (submission reports on the Draft EIS) that were not addressed in the FEIS were:

- "Analysis to determine the effect of iron carbonates and overall determination of carbonate forms" (INAC)

MHBL comment:
When Fe and Mn carbonates weather, hydrolysis of the Fe and Mn creates acidity, so there is no net alkalinity generation. Also kinetic dissolution rates can be slow. The possible contribution of non-neutralizing Fe and Mn carbonate minerals, including commonly occurring minerals such as siderite and ankerite, must be checked when carbonate-NP is used. It is recognized that Fe and Mn carbonate minerals can distort Sobek NP measurements.

The dissolution of Fe and Mn bearing carbonates can have a significant impact on the validity of the Sobek measured bulk neutralization potential. For example siderite dissolution ($FeCO_3 + 2HCl \Rightarrow Fe^{2+} + 2Cl^- + H_2O + CO_2$) followed by oxidation of Fe^{2+} to Fe^{3+} and subsequent hydrolysis reactions ($4Fe^{2+} + O_2 + 4HCl \Rightarrow 4Fe^{3+} + 4Cl^- + 2H_2O$ and $Fe^{3+} + 3NaOH + 3Cl^- \Rightarrow Fe(OH)_3 + 3NaCl$) can result in no actual resultant neutralization potential.

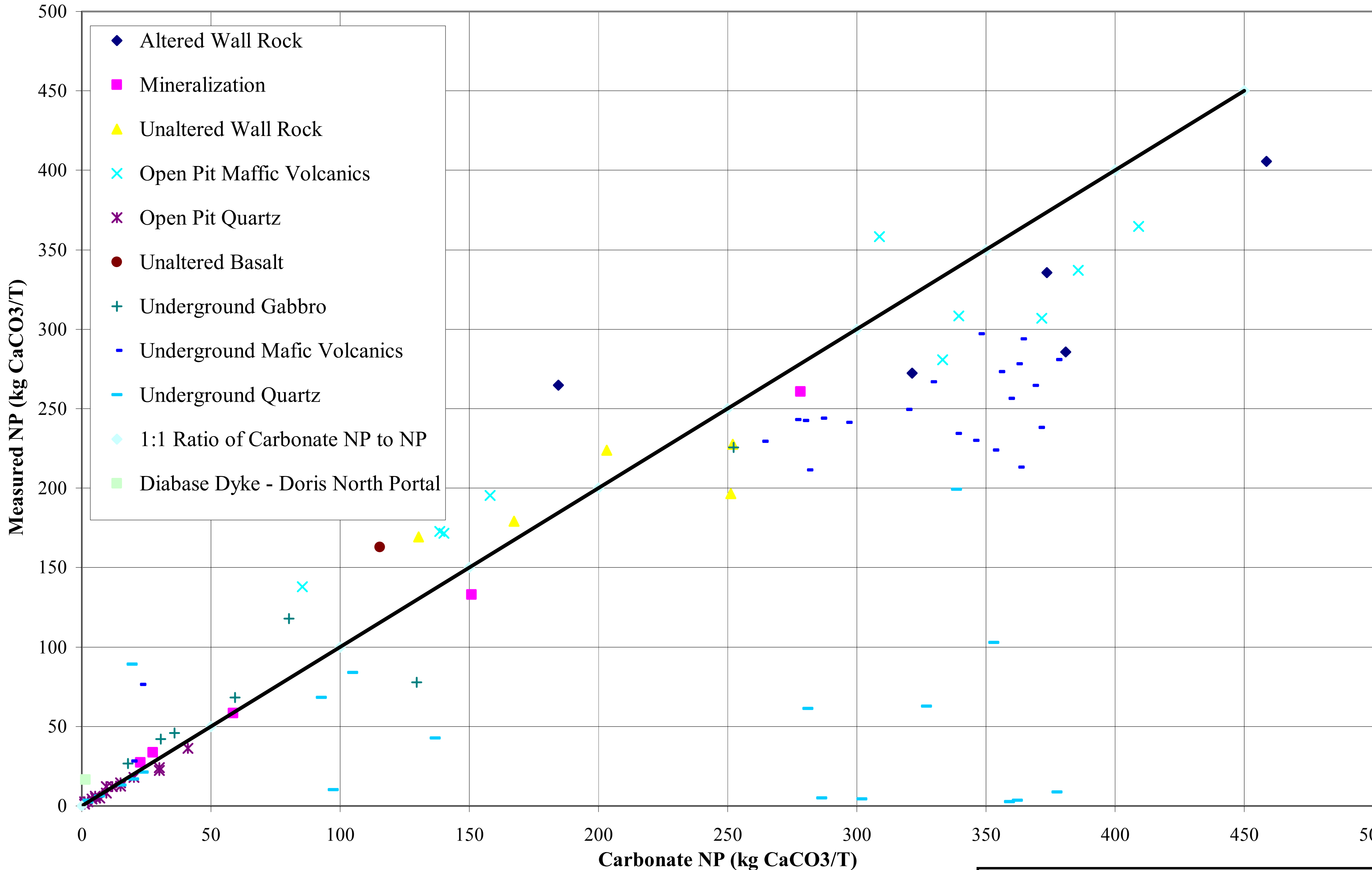
The Doris Lake deposit consists of a steeply dipping, over 3 km long quartz vein system in folded and metamorphosed pillow basalts and is situated on an inferred inflexion in the regional Hope Bay Break. At the north end, the veins are folded over to create a high-grade anticlinal hinge zone lying close to surface. This is the Doris North deposit. As part of the same vein system, 1.2 km to the south, an intersection of two structures creates a high-grade zone (the Doris Central). The Doris Connector zone spans approximately 500 m in strike extent, between the Doris Central and Doris North resource areas. Alteration is defined by iron carbonate, paragonite, pyrite and sericite. Gold is found at quartz vein and wall rock contacts and is associated with dark coloured tourmaline-pyrite septa or ribbons.

The Doris vein system is characterized by a series of north-south striking, sub-vertical, gold bearing, ductile-brittle structures, that commonly host wide, styrlitic, ribboned bull quartz veins. Host rocks are variably carbonate (dolomite) altered and deformed basalts with lesser gabbro. Within the veins, gold is commonly associated with narrow tourmaline-chlorite septa oriented parallel to and along the vein margins. Gold is also associated with disseminated sulphides at the margins of the quartz veins, or with sulphide clusters within the vein. Occasionally, gold is present within brecciated zones adjacent to the quartz veins. Sulphide mineralization consists of trace to 2% pyrite, trace chalcopyrite, rare sphalerite and pyrrhotite.

Consequently the predominant carbonate mineralization present at the Doris North deposit is the dolomite in the host rock. There are iron carbonates present within the alteration zones associated with the ore zones and the surrounding mineralization. Typically the iron carbonates will be associated with the rock extracted as ore and with the mineralized halo immediately adjacent to the ore. These are the materials that are targeted within the ARD management plan as requiring special attention and management.

A comparison of carbonate-NP and bulk Sobek NP values can provide useful information about potential NP sources and the NP capacity of the carbonate minerals. For example if carbonate-NP is greater than the Sobek-NP, a measurable portion of the inorganic carbon is not generating alkalinity or is nonreactive. This suggests the presence of iron or manganese rich carbonates or, if a total carbon assay was used, the presence of organic matter. More Sobek-NP than carbonate-NP in a sample indicates that there may be significant neutralization from non-carbonate minerals. Because of the potentially slow reaction rate and possibly multiple sources of aluminosilicate alkalinity, further work is required to determine the sources and their reactivity rate to the rate of acid generation, before it can be concluded that the laboratory measured, non-carbonate NP will provide effective field NP.

A total of 92 samples out of the 166 sample Doris North ABA data base were analyzed for both carbonate carbon neutralization potential and for the Sobek bulk neutralization potential. These results are compared in the attached Table A below. Of these 92 samples, two thirds had a carbonate-NP value that exceeded the measured Sobek-NP value. Figure 3.5 from Supporting Document B4 (copy attached) presents a plot of carbonate NP versus measured Sobek NP for these 92 samples. The 1:1 line shown on the graph indicates where carbonate NP is equal to the measured Sobek NP (i.e. where all of the measured NP is coming from carbonate mineral dissolution). A sample that plots above this line indicates that the measured NP is greater than the carbonate NP suggesting that NP is being contributed by both carbonates and other neutralizing minerals, such as fast weathering silicates. A sample that plots below the line indicates that the carbonate NP is higher than the measured Sobek NP indicating that there are carbonates in the sample that are not contributing net neutralization, such as Fe and Mn carbonates. Typical examples of these types of carbonates are siderite and ankerite (it should be noted that the text provided in Section 3.3.1.3 of Supporting Document B4 to the FEIS provided an incorrect analysis of the data presented in Figure 3.5) following



Rev 0 - Issued for Report

HOPE BAY JOINT VENTURE		
HOPE BAY PROJECT		
CORE ABA SAMPLES - DORIS MINERALIZED ZONE MEASURED NP vs CO2 NP		
Knight Piésold CONSULTING	PROJECT / ASSIGNMENT NO. VA101-7/1	NO. 1
	FIGURE 3.5	0

Table A: Comparison Of Carbonate Neutralization Potential Versus Measured Neutralization Potential										
Doris North Deposit - Combined ABA Database										
	Sample		Hole Interval			Paste	CO2	Carbonate-NP	Sobek-NP	Carbonate NP - Sobek NP
Rock Type	ID	Drill Hole	From	To	Source	pH	Inorg.			
		#	(m)	(m)			(Wt.%)	(Kg CaCO3/ Tonne)	(Kg CaCO3/ Tonne)	(Kg CaCO3/ Tonne)
Altered Wall Rock	23	TDD245	40.05	40.55	1	9.3	16.78	380.9	285.7	95.2
Altered Wall Rock	26	TDD223	118.50	119.00	1	9.3	14.16	321.4	272.4	49.0
Altered Wall Rock	28	TDD241	77.00	77.85	1	8.8	20.20	458.5	405.5	53.0
Altered Wall Rock	29	TDD231	75.29	75.72	1	9.4	16.46	373.6	335.8	37.8
Altered Wall Rock	31	TDD236	37.47	38.47	1	9.0	8.13	184.6	264.9	-80.3
Mineralization	5	TDD238	73.00	74.00	1	8.5	12.26	278.3	260.7	17.6
Mineralization	24	TDD230	73.74	74.74	1	8.7	2.58	58.6	58.5	0.1
Mineralization	25	TDD225	48.77	49.80	1	8.6	1.00	22.7	27.4	-4.7
Mineralization	27	TDD212	72.24	73.24	1	8.6	6.65	151.0	133.1	17.9
Mineralization	34	TDD216A	165.53	166.53	1	8.1	1.21	27.5	33.6	-6.1
Unaltered Wall Rock	4	TDD209	5.18	5.70	1	8.6	5.74	130.3	169.2	-38.9
Unaltered Wall Rock	30	TDD242	79.25	79.75	1	8.9	8.95	203.2	223.9	-20.7
Unaltered Wall Rock	32	TDD224	71.65	72.15	1	8.9	11.10	252.0	227.6	24.4
Unaltered Wall Rock	33	TDD222	28.60	28.95	1	8.3	7.37	167.3	179.1	-11.8
Unaltered Wall Rock	35	TDD215	1.67	41.35	1	8.7	11.07	251.3	196.5	54.8
Open Pit Maffic Volcanic					2	8.7	3.76	85.4	137.8	-52.4
Open Pit Maffic Volcanic					2	8.9	6.10	138.5	172.9	-34.4
Open Pit Maffic Volcanic					2	9.3	14.68	333.2	280.7	52.5
Open Pit Maffic Volcanic					2	9.1	14.95	339.4	308.3	31.1
Open Pit Maffic Volcanic					2	9.4	16.99	385.7	337.1	48.6
Open Pit Maffic Volcanic					2	9.0	6.96	158.0	195.5	-37.5
Open Pit Maffic Volcanic					2	9.0	16.37	371.6	307.0	64.6
Open Pit Maffic Volcanic					2	9.3	13.60	308.7	358.4	-49.7
Open Pit Maffic Volcanic					2	9.4	18.02	409.1	364.7	44.4
Open Pit Maffic Volcanic					2	9.1	6.17	140.1	171.7	-31.6
Open Pit Quartz					2	8.3	23.00	5.20	6.0	-0.8

Table A: Comparison Of Carbonate Neutralization Potential Versus Measured Neutralization Potential

Doris North Deposit - Combined ABA Database

	Sample		Hole Interval			Paste	CO2	Carbonate-NP	Sobek-NP	Carbonate NP - Sobek NP
Rock Type	ID	Drill Hole	From	To	Source	pH	Inorg.			
		#	(m)	(m)			(Wt.%)	(Kg CaCO3/ Tonne)	(Kg CaCO3/ Tonne)	(Kg CaCO3/ Tonne)
Open Pit Quartz					2	8.3	1.32	30.00	22.3	7.7
Open Pit Quartz					2	8.3	0.42	9.50	8.0	1.5
Open Pit Quartz					2	8.0	0.66	15.00	12.5	2.5
Open Pit Quartz					2	8.4	**0.05**	1.10	2.7	-1.6
Open Pit Quartz					2	8.3	0.42	9.50	12.3	-2.8
Open Pit Quartz					2	8.5	0.89	20.20	18.0	2.2
Open Pit Quartz					2	8.4	0.24	5.40	5.0	0.4
Open Pit Quartz					2	8.0	**0.05**	1.10	1.3	-0.2
Open Pit Quartz					2	8.7	1.32	30.00	24.1	5.9
Open Pit Quartz					2	8.4	0.10	2.30	2.5	-0.2
Open Pit Quartz					2	8.3	0.52	11.80	12.3	-0.5
Open Pit Quartz					2	8.1	0.66	15.00	14.5	0.5
Open Pit Quartz					2	8.3	1.81	41.10	36.3	4.8
Open Pit Quartz					2	8.2	0.31	7.00	5.0	2.0
Open Pit Quartz					2	8.1	0.17	3.90	4.3	-0.4
Unaltered Basalt					2	8.7	5.08	115.3	162.9	-47.6
Underground Gabbro					2	9.0	3.53	80.1	117.8	-37.7
Underground Gabbro					2	9.3	11.12	252.4	225.6	26.8
Underground Gabbro					2	9.1	0.79	17.9	26.7	-8.8
Underground Gabbro					2	9.1	1.35	30.6	42.1	-11.5
Underground Gabbro					2	8.3	5.71	129.6	77.8	51.8
Underground Gabbro					2	9.0	1.58	35.9	45.9	-10.0
Underground Gabbro					2	9.0	2.61	59.2	68.1	-8.9
Underground Maffic Volcanic					2	9.4	14.49	328.9	266.9	62.0
Underground Maffic Volcanic					2	9.2	12.18	276.5	243.1	33.4
Underground Maffic Volcanic					2	8.9	11.62	263.8	229.3	34.5
Underground Maffic Volcanic					2	9.1	0.86	19.5	28.2	-8.7

Table A: Comparison Of Carbonate Neutralization Potential Versus Measured Neutralization Potential										
Doris North Deposit - Combined ABA Database										
	Sample		**Hole Interval**			**Paste**	**CO2**	**Carbonate-NP**	**Sobek-NP**	**Carbonate NP - Sobek NP**
Rock Type	**ID**	**Drill Hole**	**From**	**To**	**Source**	**pH**	**Inorg.**			
		#	**(m)**	**(m)**			**(Wt.%)**	**(Kg CaCO3/ Tonne)**	**(Kg CaCO3/ Tonne)**	**(Kg CaCO3/ Tonne)**
Underground Maffic Volcanic					2	8.7	15.31	347.5	297.0	50.5
Underground Maffic Volcanic					2	8.9	14.07	319.4	249.4	70.0
Underground Maffic Volcanic					2	9.2	15.65	355.3	273.2	82.1
Underground Maffic Volcanic					2	9.4	16.23	368.4	264.4	104.0
Underground Maffic Volcanic					2	9.2	15.95	362.1	278.2	83.9
Underground Maffic Volcanic					2	9.3	16.33	370.7	238.1	132.6
Underground Maffic Volcanic					2	9.2	14.91	338.5	234.3	104.2
Underground Maffic Volcanic					2	8.9	16.63	377.5	280.7	96.8
Underground Maffic Volcanic					2	8.9	14.40	362.9	213.0	149.9
Underground Maffic Volcanic					2	8.7	12.31	279.4	242.5	36.9
Underground Maffic Volcanic					2	8.6	12.62	286.5	243.8	42.7
Underground Maffic Volcanic					2	9.2	1.01	22.9	76.3	-53.4
Underground Maffic Volcanic					2	8.9	16.02	363.7	293.8	69.9
Underground Maffic Volcanic					2	8.7	15.82	359.1	256.3	102.8
Underground Maffic Volcanic					2	8.8	15.55	353.0	223.8	129.2
Underground Maffic Volcanic					2	8.6	13.05	296.2	241.3	54.9
Underground Maffic Volcanic					2	8.8	15.21	345.3	230.0	115.3
Underground Maffic Volcanic					2	8.9	12.38	281.0	211.3	69.7
Underground Quartz					2	8.8	4.08	92.6	68.3	24.3
Underground Quartz					2	8.6	0.67	15.2	13.0	2.2
Underground Quartz					2	8.2	0.21	362.1	3.5	358.6
Underground Quartz					2	7.9	0.10	2.3	3.5	-1.2
Underground Quartz					2	8.5	9.54	338.5	199.2	139.3

Table A: Comparison Of Carbonate Neutralization Potential Versus Measured Neutralization Potential										
Doris North Deposit - Combined ABA Database										
	Sample		**Hole Interval**			**Paste**	**CO2**	**Carbonate-NP**	**Sobek-NP**	**Carbonate NP - Sobek NP**
Rock Type	**ID**	**Drill Hole**	**From**	**To**	**Source**	**pH**	**Inorg.**			
		#	**(m)**	**(m)**			**(Wt.%)**	**(Kg CaCO3/ Tonne)**	**(Kg CaCO3/ Tonne)**	**(Kg CaCO3/ Tonne)**
Underground Quartz					2	8.5	0.10	2.3	2.2	0.1
Underground Quartz					2	8.5	3.24	326.9	62.7	264.2
Underground Quartz					2	8.7	4.62	104.9	84.0	20.9
Underground Quartz					2	8.2	0.24	286.5	4.8	281.7
Underground Quartz					2	8.3	0.30	6.8	6.0	0.8
Underground Quartz					2	8.3	2.16	136.7	42.6	94.1
Underground Quartz					2	8.2	0.07	359.1	2.5	356.6
Underground Quartz					2	8.4	5.12	353.0	102.8	250.2
Underground Quartz					2	8.3	1.05	23.8	21.2	2.6
Underground Quartz					2	8.3	0.88	20.0	16.7	3.3
Underground Quartz					2	8.7	3.34	281.0	61.4	219.6
Underground Quartz					2	8.4	0.52	377.5	8.8	368.7
Underground Quartz					2	8.0	4.25	19.5	89.0	-69.5
Underground Quartz					2	8.4	0.17	301.9	4.3	297.6
Underground Quartz					2	8.4	0.56	97.3	10.3	87.0
Diabase Dyke - Doris North Portal		02TDD547			4	8.1	0.06	1.4	16.5	-15.1

Notes:

1. Source Code 1 = Preliminary ARD and Metal Leaching Assessment for the Doris and Naartok Mineralized Zones, Knight Piesold Ltd., Nov. 2001.
2. Source Code 2 = 2000 Supplemental Environmental Baseline Data Report Hope Bay Belt Project, Rescan Environmental Services Ltd., March 2001
3. Source Code 3= 1996 Environmental Baseline Report, Rescan Environmental Services Ltd., 1997
4. Source Code 4 = Sample tested in May 2002, not previously reported.
5. Numbers in bold represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

The following observations can be drawn from the data as presented in Figure 3.5:

- There is a large cluster of sample points that fall right on the 1:1 line, i.e., the measured carbonate NP is equal to the measured Sobek NP. Of particular interest is that for samples where the Sobek NP is typically under 50 kg $CaCO_3$ equivalent per tonne of sample, the corresponding measured carbonate NP measured is typically equivalent, with one exception (UG quartz vein material). In other words (with the exception of the UG quartz vein material) for samples with lower NP (<50 kg $CaCO_3$ equivalent per tonne of sample) the carbonate NP and bulk Sobek NP are typically equal and thus there appears to be no concern for over estimation of NP for materials that fall into this group;

- For UG quartz vein material, the carbonate NP is consistently higher than the corresponding Sobek NP values suggesting that for this material use of carbonate NP overestimates the measured NP quite significantly. This corresponds with the fact that iron carbonate mineralization is associated with the alteration associated with the mineralized quartz veins. For UG quartz vein material use of the Sobek NP will provide a more accurate measure of actual available NP than will carbonate NP. The data indicates that the iron carbonates present in this material are not contributing actual NP.

- Similarly in the samples of mafic volcanics (both UG and Open Pit) and in the altered wall rock, carbonate NP values are greater than the corresponding Sobek NP values suggesting that iron carbonate presence is resulting in an overestimation of the available NP in the carbonate NP determinations. Typically the difference between carbonate NP and Sobek NP were not as large for the mafic volcanics and altered wall rock as for the quartz vein material suggesting a lower presence of iron carbonate mineralization. This is consistent with the amount of alteration present in these materials. It is also important to note that typically the Sobek NP values associated with the mafic volcanic and altered wall rock are significantly greater than the Sobek NP values typically associated with the quartz vein materials.

In conclusion, presence of iron carbonate mineralization in the quartz vein, mafic volcanic and altered wall rock results in overestimation of NP using the carbonate NP over the Sobek NP. It should be noted that for the ARD characterization of the Doris North deposit presented in the Final EIS, only Sobek NP values were used to calculate the reported Neutralizing Potential Ratios (NPRs) and Net Neutralization Potentials (NNPs).

- "In addition to ABA, static testing should be further evaluated on the basis of kinetic test results" (INAC)

MHBL comment:
MHBL staff are currently working on the preparation of three representative cross section views across the Doris North deposit to provide a tool to assist in understanding the spatial relationship of the lithologic units across the deposit and surrounding host rock, the planned underground mine workings and the spatial trace of the diamond drill hole intervals that were used to obtain the samples for ABA testing. The location of the diamond drill hole traces for the four kinetic cell tests will be similarly added to these sections to facilitate a better understanding of where these samples came from, what relationship the materials have in relation to the planned mine workings and thereby an understanding of the representivity of these materials in relation to their being classified as ore grade materials or waste rock.

Unfortunately no static testing was completed on the four samples taken from the Doris North deposit that were subsequently used in the humidity cell work conducted between December 2000 and October 2001, so it is difficult to directly correlate the static testing with the kinetic testing for these specific samples. None of the samples showed the onset of acid generation during the 40 week test duration. Three of the samples were predicted to be net acid generating with the fourth being a possible source of net acid generation in time. The projected time to onset of net acid generation was predicted to be between 68 and 182 years.

MHBL will endeavour to compare the kinetic test samples against static test samples collected from comparable lithologic settings and to show these together with the sections and cross sections currently under preparation for review at the technical session March 29 – 2 April.

- SD B4, the author made a number of recommendations for additional testing, that were not done in the 2003 program – See page IX of X in SD B4

MHBL comment:
A number of these recommendations were acted upon, however not all of them have been acted on at this time. Specifically:

- ➢ Recommendation 1 – Column testing to further address the issue of aluminium and arsenic leaching under alkaline pH conditions. The column testing referred to in this recommendation has not been conducted. As the project engineering evolved, it was recognized that the primary source of rock that will be used in the construction of roads, the airstrip, laydown areas and building pads will be from the three proposed quarry sites. Consequently the issue of metal leaching from these potential quarry rock sources was given priority and was addressed in the supplementary work carried out in 2003. The results of these investigations are reported in Supporting Document B2 to the final EIS. In all cases Al was flagged as a potential concern. The carbonate content of the rocks within each of the three quarry sites results in elevated pH from the BC MEM shake flask extraction procedures. In turn the elevated pH results in the leaching of elevated levels of Al. However this test procedure involves a water wash of a pulverized sample of the rock sample. Typically in the presence of carbonate mineralization this procedure will result in elevated pH and Al values that are not necessarily representative of what will happen in the field with a quarried sample where the carbonate mineralization is not pulverized. The BC MEM shake flask extraction leachate concentrations for Al were notably high when compared to CCME guidelines for protection of aquatic life, moderately elevated when compared to the BC Pollution Control Objectives and below the CCME guidelines for protection of livestock. Experience from other sites suggests that typically in the presence of carbonate mineralization, the smearing action of pulverizing the sample raises pH in this test procedure above levels expected from quarried rock where the release of alkalinity from the carbonates will be significantly slower. In turn this smearing action coupled with the high ph typically results in elevated Al concentrations from the dissolution of Al bearing clay minerals. Elevated As levels were not noted from any of the quarry site samples tested. The potential for elevated pH and Al from these quarry sources was flagged and warrants additional monitoring as the project moves forward.

- Recommendation #2 - Additional ABA testing to address areas of uncertainty. It was recommended that additional ABA testing be undertaken once underground development commenced at Doris North to allow for areas of current uncertainty in the understanding of the ARD characterization of the materials in close proximity to the mineralized quartz veins be undertaken. This work was planned to commence with the development of the underground mine.

- Recommendation #3 – Additional ABA testing on potential portal adit. This additional characterization work would commence with the start of the development of the underground mine. The initial characterization work on the adit portal rock was completed in 2002 on samples taken from a drill hole placed into the planned path of the mine adit.

- Recommendation #4 – Characterization of Mill Tailings. This work was completed in 2003 and reported on in Supporting Document B2 to the FEIS. The static testing completed on the composite metallurgical samples indicated that the ore, the flotation tailings, the cyanide leach residue and the combined mill tailing solids will likely be non-acid generating and unlikely to be a source of significant metal release. A kinetic test on the same sample of combined mill tailings solids is currently underway (test has run for approximately 22 weeks as of March 01, 2004).

- Recommendation #5 – Characterization of Overburden Materials. No overburden is expected to be disturbed or removed by the development of the Doris North Project. The plan calls for construction of roads and building pads on top of the current ground to preserve permafrost conditions. Consequently no characterization work on overburden has been undertaken.

- Recommendation #6 – Additional ABA testing on Naartok Rock. The Naartok deposit remains an exploration target and does not form part of the Doris North Project under current review.

- "Clearly link the mafic volcanic samples used in the humidity cell tests to the subgroups described in the ARD testing and describe any implications that this has on the results or provide a clear reference to where this information is located in the EIS documentation" (INAC)

MHBL comment:
Please see the response under bullet #2 above. MHBL will provide information at the technical sessions to help tie the humidity cell mafic volcanic sample to other mafic volcanic samples within the ABA data base. The locations of the various samples will be shown on cross sections through the

deposit in relation to the known lithologic units. These can be used to select appropriate similar ABA samples to compare against the humidity cell test results.

- "Provide a more detailed assessment of the test results to propose criteria to identify material with potential pH neutral metal release in addition to acid generation potential" (DSD) (in particular arsenic)

MHBL comment:
The test work conducted to date on the samples of rock taken from the Doris North deposit has not indicated a potential metal release problem in relation to elevated pH nor arsenic (see Section 3.4 of Supporting Document B4). There was an issue of elevated pH and Al concentrations discussed previously in relation to the three potential quarry sites. Using the available information metal release from rock stored on surface is not expected to be an issue, however as indicated in the FEIS all drainage from the proposed mine site infrastructure will be collected, monitored and only released if it meets acceptable discharge criteria. If acceptable criteria are not met then this drainage will be transferred via the tailings pipeline to the tailings impoundment.

It is not clear to MHBL what is being requested in this comment. Perhaps further discussion can take place on this issue so that all parties are in a position to review this issue at the planned technical sessions.

- "Provide documentation of the spatial relationship of the samples, rock types, and proposed mine workings" (DSD)

MHBL comment:
MHBL staff are currently working to prepare a series of cross sections through the Doris North deposit from the existing geologic data base to present reviewers of the FEIS with a tool to better understand the spatial relationship between the various lithologic units across the deposit, the planned underground mine workings and the exploration drill hole intervals that were used to obtain the samples analyzed by acid base accounting analyses to create the existing ABA data base. The information will be available for review at these planned technical sessions. MHBL will endeavour to distribute copies of the sections to appropriate review groups ahead of the technical session.

- "Provide a more detailed geologic assessment with a consistent nomenclature that defines the rock types and rock-type associations to each other and the proposed mine workings" (SDS)

MHBL comment:
Please see the response for the previous bullet. We will provide a clearer picture of the lithologic units that make up the Doris North deposit in the cross sections being prepared for the Technical Sessions.

- "Recalculate the CaNP values from the ABA database and reassess the implications on acid generating potential of the discrepancy between NP and CaNP" (DSD)

MHBL comment:
Please see the response under the first bullet in this section.

- "The data summary and assessment should include non-parametric parameters such as median values to provide a better estimation of the central tendency of the various sample sets" (DSD) (i.e. averages could provide misleading results)

MHBL comment:
Agree with comment. Data have been revised as Table B following to include median values as well as average values where appropriate.

Table B: Doris North Deposit - Combined ABA Database Average & Median ABA Results By Rock Type

	Paste	Total	Maximum Potential	Neutralization	Net Neutralization	
Rock Type	**pH**	**Sulphur**	**Acidity****	**Potential**	**Potential**	**NPR**
		(Wt.%)	**(Kg CaCO3/Tonne)**	**(Kg CaCO3/Tonne)**	**(Kg CaCO3/Tonne)**	**NP/MPA**
Altered Wall Rock (2001 Program)						
Average	9.2	1.21	37.7	312.9	275.2	75.2
Median	9.3	0.17	5.3	285.7	269.0	53.8
Minimum	8.8	0.05	1.6	264.9	237.7	2.4
Maximum	9.4	5.37	167.8	405.5	334.2	214.9
Standard Deviation	0.3	2.33	72.8	58.7	36.7	83.3
Count	5	5	5	5	5	5
Mineralization (2001 Program)						
Average	8.5	0.77	24.1	102.7	78.5	12.3
Median	8.6	0.75	23.4	58.5	35.1	2.8
Minimum	8.1	0.16	5.0	27.4	-3.3	0.9
Maximum	8.7	1.50	46.9	260.7	255.7	52.1
Standard Deviation	0.2	0.58	18.0	97.8	104.4	22.3
Count	5	5	5	5	5	5
Unaltered Wall Rock (2001 Program)						
Average	8.7	0.38	11.8	199.3	187.5	52.3
Median	8.7	0.12	3.8	196.5	182.0	59.7
Minimum	8.3	0.07	2.2	169.2	164.5	5.0
Maximum	8.9	1.46	45.6	227.6	220.2	81.9
Standard Deviation	0.2	0.61	19.0	26.1	21.1	32.1
Count	5	5	5	5	5	5
Mafic Volcanic						
Average	8.9	0.9	26.8	203.7	176.9	47.2
Median	8.9	0.2	4.7	223.8	178.8	36.8
Minimum	8.1	0.01	31.4	1.0	-99.1	0.1
Maximum	9.6	6.6	31.7	405.5	354.4	276.6

Table B: Doris North Deposit - Combined ABA Database Average & Median ABA Results By Rock Type

Rock Type	Paste pH	Total Sulphur (Wt.%)	Maximum Potential Acidity** (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	NPR NP/MPA
Standard Deviation	0.3	1.5	29.1	106.1	100.1	52.4
Count	77.0	77.0	28.8	78.0	78.0	78.0
Open Pit Maffic Volcanic						
Average	9.1	0.66	20.5	263.4	242.9	49.2
Median	9.1	0.56	17.3	293.9	260.9	16.8
Minimum	8.7	0.02	0.6	137.8	131.2	6.4
Maximum	9.4	1.68	52.5	364.7	354.4	276.6
Standard Deviation	0.2	0.59	18.5	85.6	73.3	82.4
Count	10	10	10	10	10	10
Underground Maffic Volcanic						
Average	9.0	1.61	50.4	232.5	182.1	39.0
Median	8.9	0.29	9.1	242.8	212.9	13.6
Minimum	8.6	0.04	1.3	28.2	22.9	1.1
Maximum	9.4	6.57	205.3	297.0	291.9	211.5
Standard Deviation	0.3	2.05	64.1	63.5	86.1	55.4
Count	22	22	22	22	22	22
Mafic Volcanic - H (stong hematite staining, trace - 1% magnetite)						
Average	8.9	0.01	0.3	35.0	34.7	112.0
Minimum	8.9	0.01	0.3	35.0	34.7	112.0
Maximum	8.9	0.01	0.3	35.0	34.7	112.0
Standard Deviation						
Count	1	1	1	1	1	1
Mafic Volcanic - D1 (strong dolomite/sericite alteration <1% disseminated pyrite from wallrock to Lakeshore vein)						
Average	9.5	0.17	5.2	312.7	307.5	71.1
Median	9.5	0.14	4.4	320.0	315.9	66.0
Minimum	9.4	0.10	3.1	247.0	242.9	30.8
Maximum	9.6	0.36	11.3	347.0	342.9	110.7
Standard Deviation	0.1	0.10	3.0	37.4	36.4	27.6
Count	6	6	6	6	6	6
Mafic Volcanic - D2 (strong dolomit/sericite alteration, >1-2% pyrite, taken from Lakeshore Veing and Central Vein)						
Average	9.0	3.21	100.2	299.7	199.5	3.1
Median	8.9	3.26	101.9	309.0	193.9	3.1
Minimum	8.7	2.47	77.2	253.0	175.8	2.4
Maximum	9.3	4.20	131.3	327.0	228.3	3.8
Standard Deviation	0.2	0.63	19.6	25.9	23.7	0.5
Count	6	6	6	6	6	6
Mafic Volcanic - F (moderately to weakly foliated, >1% disseminated magnetite)						
Average	8.8	0.09	2.9	79.1	76.2	43.0
Median	8.8	0.07	2.2	86.0	81.0	41.6
Minimum	8.7	0.02	0.6	40.0	34.4	6.2
Maximum	8.9	0.21	6.6	123.0	120.2	105.6
Standard Deviation	0.1	0.06	1.9	26.9	27.1	30.1

Table B: Doris North Deposit - Combined ABA Database Average & Median ABA Results By Rock Type

Rock Type	Paste pH	Total Sulphur (Wt.%)	Maximum Potential Acidity** (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	NPR NP/MPA
Count	11	11	11	11	11	11
Mafic Volcanic - L (finely banded to laminated, possible a pyroclastic, 1% pervassive calcite)						
Average	8.6	0.08	2.6	166.5	163.9	79.1
Median	8.5	0.10	3.1	158.0	154.3	67.8
Minimum	8.5	0.03	0.9	124.0	123.1	41.9
Maximum	9.0	0.15	4.7	233.0	229.6	132.3
Standard Deviation	0.2	0.04	1.3	33.3	32.4	35.7
Count	11	11	11	11	11	11
Mafic Volcanic - P (Pillow flow, trace - <1% pyrite)						
Average	8.7	0.17	5.4	152.6	147.1	38.3
Median	8.6	0.14	4.2	165.0	157.2	25.0
Minimum	8.1	0.03	0.9	16.5	15.6	4.3
Maximum	9.5	0.37	11.6	319.0	316.5	127.6
Standard Deviation	0.4	0.11	3.4	97.6	97.8	37.7
Count	10	10	10	10	10	10
Quartz						
Average	8.4	0.83	25.9	29.7	3.8	3.4
Median	8.4	0.33	10.2	13.0	3.6	2.2
Minimum	7.4	0.02	0.6	1.0	-99.1	-59.9
Maximum	8.9	6.02	188.1	199.2	88.6	20.0
Standard Deviation	0.3	1.21	38.0	36.6	28.4	4.1
Count	60	60	60	60	60	60
Open Pit Quartz						
Average	8.3	0.54	16.9	11.7	-5.2	5.0
Median	8.3	0.08	2.5	10.2	2.4	2.2
Minimum	8.0	0.02	0.6	1.3	-59.9	0.2
Maximum	8.7	2.98	93.1	36.3	15.5	20.0
Standard Deviation	0.2	0.92	28.6	9.6	22.4	6.4
Count	16	16	16	16	16	16
Underground Quartz						
Average	8.4	1.2	37.0	40.3	3.3	2.6
Median	8.4	0.2	4.7	14.9	3.7	2.5
Minimum	7.9	0.0	0.6	2.2	-99.1	0.5
Maximum	8.8	6.0	188.1	199.2	67.2	6.7
Standard Deviation	0.2	1.7	52.1	50.3	31.7	1.8
Count	20	20	20	20	20	20
Quartz Vein -Q1 (>1% pyrite, >5% tourmaline, taken from Lakeshore Vein)						
Average	8.4	1.0	32.0	36.0	4.0	1.2
Median	8.5	0.9	29.5	30.0	-2.4	0.9
Minimum	8.0	0.3	9.7	7.0	-27.6	0.2
Maximum	8.8	1.9	58.1	76.0	52.6	3.2
Standard Deviation	0.3	0.6	19.1	30.7	26.4	1.1

Table B: Doris North Deposit - Combined ABA Database Average & Median ABA Results By Rock Type

	Paste	Total	Maximum Potential	Neutralization	Net Neutralization	
Rock Type	**pH**	**Sulphur**	**Acidity****	**Potential**	**Potential**	**NPR**
		(Wt.%)	**(Kg CaCO3/Tonne)**	**(Kg CaCO3/Tonne)**	**(Kg CaCO3/Tonne)**	**NP/MPA**
Count	6	6	6	6	6	6
Quartz Vein -Q2 (<1%-rare pyrite, >1% tourmaline, taken from Lakeshore Vein)						
Average	8.2	0.4	11.5	17.2	5.7	3.2
Median	8.3	0.3	7.8	6.5	2.8	1.4
Minimum	7.4	0.1	1.6	1.0	-10.3	0.1
Maximum	8.8	1.2	38.1	63.0	24.9	12.8
Standard Deviation	0.5	0.4	13.7	23.3	13.5	4.8
Count	6	6	6	6	6	6
Quartz Vein -Q3 (<1%-rare pyrite, >3-5% tourmaline, taken from Central Vein)						
Average	8.6	0.3	8.0	35.8	27.8	5.7
Median	8.6	0.2	7.5	42.0	29.7	5.4
Minimum	8.4	0.1	1.9	13.0	11.1	3.1
Maximum	8.8	0.5	15.0	55.0	43.7	9.2
Standard Deviation	0.2	0.2	5.9	18.2	13.8	2.5
Count	6	6	6	6	6	6

Table B: Doris North Deposit - Combined ABA Database Average & Median ABA Results By Rock Type

Rock Type	Paste pH	Total Sulphur (Wt.%)	Maximum Potential Acidity** (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	NPR NP/MPA
Quartz Vein -Q4 (>1% pyrite, >5% tourmaline, taken from Central Vein)						
Average	8.5	1.3	39.4	42.8	3.4	1.6
Median	8.4	0.8	25.8	25.0	-14.5	0.6
Minimum	8.2	0.2	5.9	1.0	-35.5	0.2
Maximum	8.9	4.1	127.5	108.0	88.6	5.6
Standard Deviation	0.3	1.4	44.9	46.1	46.6	2.2
Count	6	6	6	6	6	6
Unaltered Basalt						
Average	8.7	0.11	3.4	162.9	159.5	47.4
Minimum	8.7	0.11	3.4	162.9	159.5	47.4
Maximum	8.7	0.11	3.4	162.9	159.5	47.4
Standard Deviation						
Count	1	1	1	1	1	1
Gabbro						
Average	9.2	0.22	6.9	95.7	88.8	34.3
Median	9.3	0.10	3.1	68.0	57.8	23.0
Minimum	8.3	0.03	0.9	26.7	20.0	1.3
Maximum	9.8	1.85	57.8	322.0	319.2	114.5
Standard Deviation	0.4	0.49	15.3	85.7	87.7	30.1
Count	13	13	13	13	13	13
Underground Gabbro						
Average	9.0	0.3	10.4	86.3	75.8	29.9
Median	9.0	0.1	3.1	68.1	42.8	19.8
Minimum	8.3	0.0	0.9	26.7	20.0	1.3
Maximum	9.3	1.9	57.8	225.6	222.2	65.6
Standard Deviation	0.3	0.7	20.9	68.2	72.1	24.8
Count	7	7	7	7	7	7
Gabbro - Massive, Coarse grained						
Average	9.6	0.1	2.8	106.7	103.9	39.4
Median	9.6	0.1	3.0	64.0	61.3	25.2
Minimum	9.3	0.0	0.9	31.0	30.1	16.3
Maximum	9.8	0.2	4.7	322.0	319.2	114.5
Standard Deviation	0.2	0.0	1.2	108.5	108.2	37.2
Count	6	6	6	6	6	6
Diabase Dyke - Doris North (Potential Adit Portal)						
Average	8.1	0.03	0.9	16.5	15.6	17.6
Minimum	8.1	0.03	0.9	16.5	15.6	17.6
Maximum	8.1	0.03	0.9	16.5	15.6	17.6
Standard Deviation						
Count	1	1	1	1	1	1

- "Better diagrams and maps to show the layout and configuration of the deposit. Three dimensional figures may be useful for this purpose." (INAC)

MBHL comment:
Please see response for the earlier bullet regarding preparation of sections of the Doris North deposit for presentation at the planned technical sessions.

- "A discussion of the rock type relationship is necessary to provide context for ARD/metal leaching assessment. Provide clarification as to the relationship between the various Mafic Volcanic units (i.e. D1, D2, F, P, etc.) Quartz veins (i.e. Q1, Q2, etc.) and units such as the "unaltered wall rock" and "mineralization". Indicate which rock types will comprise the ore. (DSD)

MBHL comment:
These various rock type designations were assigned by the geologists involved in the initial exploration drilling at the Doris North project site (BHP). They were an attempt to break down the various lithological groups into sub-categories to help differentiate between the degrees of alteration, such as the degree of alteration within the mafic volcanics and quartz veining. Later other geologists labelled the samples as being U/G or Open Pit to represent other sub-groups amongst the various lithologies, such as UG and open pit mafic volcanics in an attempt to differentiate rock types based on whether they were likely to be mined by UG or open pit mining method. These various categories do tend to confuse, however we were stuck with them based on the designations assigned by these earlier geologists who collected and labelled the various samples.

As discussed previously MHBL staff will prepare cross sections of the deposit for the planned technical sessions that will show the lithologic units, the planned mine workings and the locations of the various diamond drill hole traces used to provide the samples within the ABA database. It is hoped that this tool will help reviewers better understand the relationships between the various lithologic units.

- "A mineralogic assessment will assist in the interpretation of the ARD test results." (DSD)

MBHL comment:
Information on the mineralogical makeup of the Doris North deposit was presented in Supporting Document B4. No additional mineralogical studies have been undertaken in relation to the ARD characterization work. MHBL geological staff has been asked whether there is additional mineralogical assessment work that can be provided to aid in interpreting the ARD test data.

It will be difficult to conduct a review on the reports because there is no ability to determine the representativeness of the samples due to the lack of documentation on nomenclature and on the spatial relationship of the samples, rock types, and proposed mine workings. Geology sections provided in the FEIS are very general. Additionally, commentary on neutralization potential does not appear to take into account the mineralogy of the sample. Specifically, carbonate NP and NP do not appear to consider the presence of ankerite, which is an iron carbonate that does not provide effective buffering under neutral conditions, in the tailings. There also appears to be a gap in the link between ore and host rock types as it influences ore feed through mine dilution (a gap in the variation of head grade i.e. the change between ore being potential acid generating (PAG) in the Integrated ARD Characterization report (SD B4), to ore/head grade being non-PAG in the metallurgical test program (SD B2 - ARD and Metal Leaching Characterization Studies in 2003)). The absence of this information is considered to represent a conformity issue because it will prevent an adequate technical review for the Environmental Assessment.

c) The FEIS must include the 2002 supplemental surveys concerning wildlife, raptors, hydrology, water quality and fisheries.

Supplementary water quality and fisheries data are provided in SD C1 (2002) and SD C2 (2003). Hydrological information collected in 2002 by Miramar is presented in SD B1. Miramar's consultants conducted a site reconnaissance in August 2002 to observe hydrologic conditions, watershed characteristics, and the location and design of the data collection stations as a basis for interpreting the reported data.

d) The FEIS must include the missing sectoral studies including:

- ***Hope Bay Doris North Project Surface Infrastructure Feasibility Study Inputs, Nunavut, Canada*. SRK Consulting. December 2002.**
- ***Hope Bay Doris North Project - Tail Lake Dam Site - Geotechnical Investigations and Conceptual Design Report*. SRK Consulting. December 2002.**
- **Feasibility study referred to on page A-2, which was scheduled to be completed in January 2003.**

These studies were provided respectively as SD A4, SD A5, and SD A6.

4. Project Description, Plans and Strategies

NIRB Issue 3: The lack of detail contained in the general project description as well as in the description and analysis of specific plans and strategies.

4.1 Project Description

a) The FEIS must include a greater level of detail in the project description.

Overall, the level of detail in the project description as presented in SD A1 appears to be adequate.

b) The FEIS must include a mining plan that addresses: groundwater inflow; preservation of permafrost in the mine; presence of permafrost above exploration declines below lakes; seasonal variations in operating conditions and constraints and major future developments and exploration.

There are several information deficiencies regarding the mine plan that will prevent an adequate technical review for the Environmental Assessment per the comments below.

Mine Plan

The proposed mine plan involves mining only the Doris Hinge Zone, located entirely on land and within the permafrost (although no thermistor data is provided that covers the actual underground workings). The mine will be at a relatively shallow depth, extending no deeper than 80 m vertically. There are no details presented regarding the actual mine plan other than to note that the development ramp will go to a depth of 36.5 m. Details of the deposit geology and structure with respect to the mine openings is lacking. There is no information provided regarding the thickness of the crown pillar. Figure 6.2 in the Technical feasibility report (A6) shows the anticlinal structure of the orebody coming close to the surface. There is no information on how close the proposed underground workings will come to the talik under Doris Lake.

MHBL comment:
SRK and Miramar acknowledge that the extent of the talik under Doris Lake is currently not adequately defined for the purpose of understanding the impacts of developing Doris Connector and Doris Central. Site specific information will have to be obtained, and it is the intent of Miramar to initiate this detailed study prior to proceeding with any plans to develop Doris Connector and Doris Central. Insofar as the uncertainty associated with this development impacted the existing Doris North project, it would only impact the tailings impoundment size, since it has been assumed that any potential underground mine water would be contaminated and would be pumped to and contained in Tail Lake. A discussion of this

issue has been presented in Section 3(a) – "Groundwater Conditions" of this document and will not be repeated here.

Groundwater Inflow

Groundwater flow is not expected to be an issue according to the Proponent, assuming all mining to take place within the permafrost. SD B5 provides an estimate of potential groundwater inflows associated with mining of the Doris Central Zone, under the lake; however it is not based on any site-specific testing of the rock in this zone. The Proponent does intend to explore the ore zone under the lake during the 2 year mining program, so it is important to determine the potential inflows as they may affect the overall mine water balance and treatment requirements.

MHBL comment:
Please refer to Section 3(a) – "Groundwater Conditions" and Section 4.1(b) – "Mine Plan" for a discussion of this issue.

Permafrost

There was no information provided regarding the need to preserve the permafrost in the underground mine. For example, at the Teck Cominco Polaris Mine in Nunavut, the mine operators undertook special measures to control (chill) the ventilation system during the summer to prevent permafrost degradation. The Proponent has not explained what impacts mining will have on the permafrost around the mine or what impacts permafrost has on the mining. No thermal modelling has been done of the proposed underground mine development. Since the underground openings will be relatively close to the surface, this information will be critical to assessing the potential for subsidence and permafrost degradation, keeping in mind the potential for the influence of the adjacent Doris Lake talik. This talik is likely to grow with global warming and the potential loss of continuous permafrost conditions in the region.

MHBL comment:
It is expected that the underground operations will be operated with an air temperature of -10 °C, which is similar to the current ground temperature. It can be expected that the mining activities, in particular the machinery, will generate some heat locally but this amount of heat could easily be "evacuated" by ventilation normally present in underground workings. If water sources are encountered, in particular towards Doris Lake, the incoming groundwater will become a heat source and is therefore important that the proper dewatering system is in place before approaching the talik underneath Doris Lake.

Future Development

The Proponent's intent to explore under the lake is implied in the present mine plan but not explicitly stated. Miramar should clearly state their intentions regarding exploratory work in the Central Zone in the mine plan – INAC assumes that this exploratory work would not be authorized unless it is part of

Miramar's mine plan. Future development of the mine under Doris Lake may have significant impact on the overall site water balance if large groundwater inflows are encountered.

MHBL comment:
Please see discussion on Future Development in Section 2.b above; please also refer to Section 3(a) – "Groundwater Conditions" and Section 4.1(b) – "Mine Plan" for a discussion of water balance issues.

4.2 Tailings Management Plan

a) The Proponent must provide a detailed description of the design and operation of the tailings impoundment.

A description of the proposed Tail Lake tailings impoundment facility design and operation are provided in SD A5, and SD A1, Section 2.4. However, as elaborated on below, INAC feels that the overall impact of the potential for large-scale permafrost degradation around Tail Lake due to the increased water level is of great concern as is the details of the dam design. The Proponent has not adequately considered alternatives to the wet cover requiring water retention dams to raise the water level, in our opinion.

There are two major technical concerns with the proposed tailings impoundment design that INAC feels is warranted to bring to the attention of NIRB and the Proponent at this time. The concerns are related to the use of the wet cover, and the design of the dams themselves, and are described in detail below.

Use of Wet Cover:

Tail Lake is currently at elevation 28.3 m. A talik exists under the lake, with permafrost occurring roughly along the edges of the current shoreline. During the two years of operations, the level of Tail Lake may be raised to a maximum full supply level of 33.5 m. Upon closure, the water quality in Tail Lake will be assessed and releases will occur to gradually lower the water so that it is a minimum of 3 m over the tailings (29.5 m). During this time period, the permafrost along the shoreline may have degraded in response to the increased water level in Tail Lake. The amount of degradation will depend on the length of time the water remains impounded. This degradation may affect the water quality of Tail Lake by introducing suspended sediment associated with the melting out of the ice rich marine clays. Depending on the severity of this degradation, the suspended sediment content of the lake may be such as to prevent any discharge from Tail Lake indefinitely. If the water level is lowered to elevation 29.5, as proposed for long term closure, the previously degraded (flooded) shoreline will become re-exposed and the permafrost will become re-established; however the upper soils in the active zone may have become so damaged and eroded that they will continue to generate suspended sediment. Continued erosion of the active layer soils will expose more permafrost to thawing and the degradation process will continue. Since the final water level is 1.2 m above the original lake level, there is a long term issue with the progressive degradation of the permafrost around the lakeshore.

The degradation of the lakeshore may lead to increased frequency of flow slides and potential for a large scale degradation of the slopes surrounding Tail Lake. Flow slides have been associated with the Panda Diversion channel at the Ekati Mine, where ice rich glacio-lacustrine materials were exposed in the channel cut. The quantity of sediment released into the channel vastly exceeded the amount expected from surface erosion alone, due to permafrost degradation considerable distance away from the bank. The Proponent has not addressed these impacts or mitigation in the FEIS. The cost allowance for post closure maintenance included the closure cost estimate will not be sufficient to cover this magnitude of degradation.

It is recommended that the Proponent review the wet cover tailings disposal plan and consider alternatives to avoid raising the level of Tail Lake above its natural level (see also comments under 4.8(f)).

MHBL comment:
Raising Tail Lake will eventually cause the talik to expand up to that footprint of the lake. The proposed Tailings Management plan will raise the lake elevation to 33.5 m when the full supply level is reached by the end of year 10. The lake level would then be lowered to elevation 29.5 m over a period of about 22 years. The flooded shoreline will probably become part of the talik of the lake and could trigger some deterioration of the slope because of the newly thawed zone. As mentioned previously, the ice-rich marine deposits will likely exhibit low shear strength during the thawing process, which could cause the adjacent slope to become unstable. It is therefore important the slopes along the shoreline of Tail Lake be thoroughly investigated in regards to potential instability caused by the raising of Tail Lake.

The remedial measures would probably involve the placement of granular material to act as a buttress or simply to provide thermal insulation for the natural frozen ground. The granular material could be placed in critical areas prior to raising the lake and could be added as needed as the lake level is raised or lowered.

Please also refer to Section 3 – "permafrost conditions" of this document for more discussion on this topic.

Dam Design and Construction:

A detailed description is provided in SD A5. The Proponent proposes to construct dams at each end of Tail Lake. Various options were considered. The dams selected by the Proponent will be an earth and rockfill structure with a central impervious core constructed using the ice-rich marine clays found at the site. Geotechnical investigations have identified a talik within the sand under the North Dam. Also the porewater in the marine soils is saline, resulting in a freezing point depression of -2^{o} C. The Proponent intends on obtaining the core material by stripping off the thawed layer during the summer/fall, stockpiling the material, then placing the material in a frozen state during the winter.

MHBL comment:
A talik was reported to exist in the sandy deposit under the North Dam in one of our reports (SRK 2002)[7]. The zone in question had very poor sample recovery and ground temperature was not available at the time the initial report was prepared. As a precautionary measure, it was decided to assign that zone as a potential talik until further information was obtained. Additional holes were later drilled in that zone and instrumented to measure the ground temperature. The results show that the ground temperature in that zone is well below freezing and is similar to ground temperatures measured elsewhere on site. The assumed talik was consequently "rejected". It is for those reasons that our report "Tailings Impoundment Preliminary Report' states that "Ground temperature measurements along this dam alignment *(North Dam)* indicate that permafrost is present over the entire length of the dam (see Section 5.4.1)."

There are several technical concerns associated with this design:

- The water content of the soils used for the core generally is equal to or greater than the liquid limit of the soil. In addition, there are massive ice lenses present within the soil. In the borrow area, the ice-rich marine clay soils will melt out as a slurry due to the excess water content in the form of ice. To obtain the required soil volumes to construct the dams from the stripping of the thawed soils in one season will require the excavation over a large area of these soils. Once the active zone melts, it will be difficult to control the stability of the adjacent soil slopes, which may become susceptible to flow sliding due to the low shear strength of these materials in a thawed state. The location of the borrow area has not been specified, other than it is located "in the vicinity of Tail Lake" (SD A5, Section 11.2). The borrow area will require settling ponds and a water management plan to prevent sediment laden runoff and meltwater from entering the environment. None of these provisions have been included in the FEIS. An example of the potential types of problems that may be encountered is at the Discovery Mine, north of Yellowknife. Sedimentation problems are occurring in response to permafrost degradation associated with a borrow pit in fine-grained glaciolacustrine sediments.
- Assuming that soil is removed from the borrow area, it must be hauled and placed into a stockpile area. The location of the stockpile area has not been defined. Due to the high moisture content, the stockpiled materials will flow to very flat slopes in the stockpile. To contain this material would require some type of bermed containment area. The excess water would be in the form of a slurry containing a high proportion of suspended sediment which cannot be released to the environment. Settling ponds and a water management plan will be required to contain runoff from the stockpile area. No provisions have been included in the design for this issue.
- Construction of the dams will require some stripping and excavation of the foundation soils within the footprints of the dams. There is no information provided regarding where this waste overburden will be placed. The Proponent discusses the options of summer versus winter dam construction (A5, Section 11.3) If this excavation is done during the summer/fall season, the sides of the excavation will collapse or flow due to the melting of the excess ice. The drawings show

[7] SRK Consulting Inc. 2002b. Hope Bay Doris North Project – Surface Infrastructure Feasibility Study Inputs, Nunavut, Canada. Report submitted to Miramar Hope Bay Limited, December 2002.

side slopes of 1:1. These slopes are too steep for this kind of material, unless they are excavated in a frozen condition. For summer construction, the required excavation volumes will be greater due to the flatter side slopes required. For this reason, it is recommended that the Proponent review the proposed dam construction schedule and methodology.

- In the winter, the stockpiled soils will become frozen again. To place the soils in the dam will require breaking up the frozen soils, and placing into the core of the dam. Moisture control and compaction of these materials will be impossible under winter conditions. The frozen lumps may contain ice lenses and will be difficult to handle, place and compact. The consistency of the dam core materials will be difficult to control and may be of suspect quality.
- The clay borrow areas will be subject to ongoing permafrost degradation once exposed. The thawed marine clays are subject to flow slides and the meltwater will be in the form of a slurry containing a percentage of suspended sediment. No provisions have been made to mitigate the potential impacts of the clay borrow area.

MHBL comment:
See previous response on quarry and the construction sequence of the dams (Section 3 – "quarrying" of this document).

b) The Proponent must address the potential expansion of mining operations in the vicinity.

In SD A5, the Proponent acknowledges that the tailings disposal area can handle all the waste from future potential developments of adjacent orebodies, without an increase in the present footprint. The underground operations may expand to include the Doris Central deposit under the lake. SD B5 estimates potential groundwater inflows associated with such a development (see comments section 4.1 (b)). Further investigations will be required to assess this expansion, including delineation drilling to confirm the mineable reserves. This would need to be presented as a new mine plan, when and if the decision is made to expand. No details can be provided at this time with respect to the infrastructure requirements associated with more distant deposits that may involve, for example, extending the site haul roads.

c) The Proponent must provide a description of the hydrogeology of the Tail Lake tailings containment area.

Miramar addresses this request adequately in SD A5 and Appendix 10A.

d) The Proponent must undertake water quality modelling to predict metal levels for the Tail Lake Tailings Containment Area and Doris Lake Outlet Stream using metals data from the optimized tailings slurry treatment process.

A predictive water quality model is provided in SD F8. With respect to predicting metal levels, it would have been helpful if a sensitivity analysis had been provided. This is particularly important given uncertainties associated with background copper levels in the Doris Lake outflow (see Section 3, part a of this document). As an example: the model calculated maximum Tail Lake decant rates assuming Doris Lake outflow Cu concentration of 1.6 µg/L. If 1.8 µg/L had been used instead (for the Doris Lake outflow Cu concentration), the calculated allowable decant rates would be approximately 50% lower. This has possible implications for dam design and definite implications for post-closure water management.

SD F8 does not include any contribution to water quality from sewage sludge which is to be disposed of in Tail Lake. This represents a non-conformity issue.

Section 5.2.5 of the FEIS, and SD A1, Section 2.4.4 also provide relevant information.

MHBL comment:
The observation that the volume of discharge is directly proportional to the background water quality in Doris Lake outflow is correct. A sensitivity analysis with the background water quality set at 1.4 µg/L and 1.8 µg/L will be prepared and submitted by the end of March.

The water quality model includes the typical effluent quality that would be expected from the water treatment system. Sludge disposal would be required intermittently only, and would be co-disposed (intermingled) with the tailings. As such the particulate matter would be expected to be taken up in (or 'entrapped' within) the tailings pore space. Any suspended matter that may remain will settle and it too would be covered by tailings as tailings deposition continues. Therefore, apart from the treatment plant effluent, no other contribution is indicated.

e) The Proponent must conduct an analysis of the impact of ammonia and nitrogen compounds on the water quality of Tail Lake and the receiving environment in the area of the mine from sources such as, but not limited to, the tailings slurry, sewage treatment plant effluent, runoff from the ore storage area, waste rock, quarry rock, and mine water.

The modelling (noted in part d) above) appears adequate to predict ultimate ammonia, cyanide, and cyanate levels in Tail Lake. However, the modelling neglects to predict changes in Tail Lake nitrite or nitrate levels resulting from the following mechanisms:

- Ammonia nitrification;
- Nitrite oxidation to nitrate;

This has implications for the impact assessment since predicted nitrite concentrations in Tail Lake from loading alone (0.76 mg/L; Table 3.3 SD F8) are well above CCME guideline levels and are potentially acutely toxic to fish.

The water quality model also does not consider resuspension of nutrients or metals from sewage sludge. The FEIS states that the sewage sludge will be deposited into Tail Lake. The Proponent should either modify the model to account for this or provide a rationale for excluding this source.

MHBL comment:
Ammonia nitrification (i.e. oxidation of ammonia to nitrate) may occur. This typically occurs in a two step process. Ammonia is first to nitrite, which is then rapidly oxidised to nitrate under oxidizing conditions. For the conditions expected in Tail Lake, (i.e. anticipated concentrations and biological activity), it is anticipated that only a small proportion of the ammonia would be oxidized to nitrate (less than 30 percent based on experience elsewhere). Concurrently in the hypolimnion and during winter freeze-up when anoxic conditions are expected to occur, the nitrate would be reduced and converted to nitrogen gas (N_2) which removes nitrate from the water body. The nitrogen gas would then be released to the atmosphere and the overall nitrogen content of the Tail Lake would be lowered. Because these mechanisms are secondary and in general would lead to lower nitrogen estimates in the water column they were disregarded.

The CCME Guideline for Nitrite is 60 µg/L. Since nitrite is expected to be oxidised to nitrate it will not persist in the water column. Nonetheless, while it may exceed CCME guidelines in Tail Lake, this will not occur in Doris Lake outflow for the proposed discharge strategy. The concentration in Doris Lake outflow is predicted to be less than 25 µg/L. The CCME guideline for nitrate is 2930 µg/L and also will not be exceeded in the Doris Lake outflow for the proposed discharge strategy.

As noted in the response to Comment (d) above, the sewage sludge is not likely to contribute to nutrient loadings and modification of the water quality model is not required.

f) The Proponent must present a fully substantiated and robust water balance that demonstrates that the infrastructure as planned will be able to accommodate the full range of flows that may be experienced. The rationale for assuming a seepage rate of 0 m^3 per year, as specified in the water balance, must be included.

A comprehensive water balance model using monthly time steps was developed: results for a 10-year modelled period are presented in SD A5 (Vol. 2). The model is considered to include all necessary inflow and outflow elements.

However, some technical issues arise with respect to selection of coefficients and input quantities. The model does volumetrically account for accumulation of slurry sediments within Tail Lake over a six year mine life and the option has been included that up to 240,000 m^3 of decanted water could be released annually downstream of the facility in a way that mimics the natural hydrograph pattern of Doris Lake outflow. Establishment of dam height has been determined on the basis that there would be no release of decant water over the mine life and the emergency spillway level was established assuming a 500-year storm rainfall event. However, INAC could not find any reference to dam height versus freeboard and potential maximum wave heights.

INAC notes that Tail Lake has a number of physical characteristics which do not appear to have been considered in the design of the dams. Tail Lake is a long, narrow body of water affording the wind a 3 kilometer fetch. This, coupled with it's relatively shallow depth (1- 5 m) and the possible added venturi effect imparted on the wind by the high relief on the east and west sides of the lake, could – under conditions where the wind is blowing at gale force out of the north or south – contribute to the development of unusually large, short period, violent waves. These, in turn, could threaten the integrity of the dams; particularly the south dam in the event of a northerly gale. The potential impact of winds on Tail Lake dams should be assessed.

MHBL comment:
The design freeboard height for both the North and South Dams has been set at 3.5m height (See SD A5). This height has been established based on a requirement for allowance of settlement of 1.0m along the frozen core, and an allowance of 2.5m for thermal insulation. This freeboard height exceeded the hydraulic freeboard requirement for the Dams due to wave run-up as a result of wind induced waves of 1.7m. The maximum wave was calculated resulting from a 160km/hr wind with a fetch of 3.2km. This would result in a wave height of 1.13m, which requires a 1.7m vertical freeboard height. Since the actual freeboard height is dominated by the thermal requirements, the dam can withstand waves as high as 1.67m, which far exceeds the design requirement.

It has been assumed that seepage from Tail Lake beneath both dams would be collected and pumped back into the lake. Given the extreme temperature conditions, this will be difficult and alternatives should be considered by the Proponent.

MHBL comment:
In the event that seepage is observed downstream of either of the Dams, a purpose built well/sump will be constructed to allow for collection and pumping of the seepage back to Tail Lake. If the seepage is diffuse, it will be directed to the sump via collection berms. The pump will be a submersible pump, and would likely be housed in wood shack. It is unlikely that seepage will occur during the winter months; however in the event that it does, it would imply that the water is flowing and therefore the collection and pumping arrangement would operate without difficulty. This is a practice that is adopted at other mines in the arctic, and therefore is a proven method of operation.

The water quality modeling presented in SD F8 uses the conservative assumption that there is continuous seepage from Tail Lake at a rate of 1,550m^3/month, and that this water is not intercepted and pumped back to Tail Lake. The water quality model illustrates how this impacts the water quality downstream of Doris Lake, and illustrates the sensitivity of intercepting and pumping back all seepage.

The proponent suggests that adoption of a zero seepage rate in the water balance model provides a conservative approach. However, it is also indicated that seepage would be collected and pumped back to Tail Lake, so the net volume in the water balance would then be zero.

MHBL comment:
The proponent has adopted the most conservative case for both sizing the tailings impoundment, and predicting water quality impacts. In doing so apparently contradicting statements have been made; however these were intentional. In SD A5 the tailings impoundment water balance is presented. This water balance is used to size the dams, such that the impoundment can act as a full containment facility. Our conservative approach to this was to minimize the losses from Tail Lake, and in order to do this, we have assumed that if any seepage does occur, it would be intercepted and pumped back, thus not becoming a loss to the system. In contrast, in SD F8 we presented a predictive water quality model to simulate the potential decant rates from Tail Lake. The conservative approach here was to assume that seepage did occur, and that we could not capture it all and pump it back. This scenario would be the most conservative, since it would reduce the amount of decant water that would be allowed from Tail Lake, since the receiving water would have a higher load to start with.

g) The Proponent must conduct an analysis of the sedimentation of the tailings in Tail Lake and the potential impact on the receiving environment downstream of Tail Lake. AND

h) The Proponent must identify and assess sediment contaminant pathways.

The Tail Lake water balance model does involve a monthly accounting of slurry deposition, along with a corresponding decrease in lake storage capacity. However, deposition patterns will likely be quite complex, non-uniform and unbalanced. There should be acknowledgement of this and a need to address in a quantitative way the anticipated deposition rates and pattern in the presence of ice, or open water/wind/wave conditions. As well, might it be possible that in some conditions deposited material could become exposed to the air and wind-driven transport.

MHBL comment:
The reviewers correctly point out that subaqueous deposition of tailings in Tail Lake will be complex, and will be non-uniform and potentially unbalanced. This will have to be balanced by ensuring that the tailings discharge point is relocated regularly, such that the "deposition cones" do not become too big and be exposed above the lake water level. A detailed bathymetric survey of the basin should be conducted annually during the open water season, and if necessary dredging of the basin should be carried out to ensure a level spread of tailings. By managing the tailings level in this way, the potential for exposed tailings will be minimized. A detailed deposition plan will be developed during the final detailed design stage; however this deposition plan will be reviewed annually based on the results of the annual bathymetric survey.

SD A5 provides an analysis of sedimentation rate for tailings in Tail Lake and concludes that there will be a high rate of sedimentation, based on a coarse tailings product. It does not address the existence or fate of any fines placed in Tail Lake.

MHBL comment:
The tailings are expected to be coarse with 56% passing the #200 sieve (0.075mm) and approximately 11% being classified as clay, being smaller than 0.002mm. It could however be expected that as the water level in Tail Lake rises, the submerged permafrost on the Lake perimeter would thaw. These natural soils are generally classified as sand and silt, however some minor pockets of clay exist, with the finest sample tested having 95.5% passing the #200 sieve. It could thus be expected that as these soils thaw, fines will be releases into Tail Lake, which may be dispersed through wind and wave action. Given the relatively small volume of this type of sedimentation as opposed to the daily tailings volume, this sedimentation is not expected to cause concern. There is certainly no risk of this sedimentation impacting the containment of water in Tail Lake for the first 10 years of operation, since the impoundment has been designed to contain this volume of water without allowing any discharge. The proponent will however be monitoring the sedimentation in Tail Lake closely, and implement contingency measures if any problems does arise.

SD F8 does not account for transport of sediments downstream of Tail Lake – the impact assessment is based on CCME Water Quality Guidelines, with no reference to particulates. It therefore (by implication) assumes no sediments will be entrained in the decant. Furthermore, the sedimentation efficiency within Tail Lake will decrease in relation to loss of storage capacity, so there may be a need to provide treatment of decanted outflow.

As a conformity issue, the Proponent should provide a rationale and substantiate why the impact assessment does not include discharge of sediments from Tail Lake. The rationale should consider the full spectrum of particle sizes discharged to Tail Lake.

i) The Proponent must address concerns regarding the capacity for metal or nutrient loading in the Lake and surrounding water bodies.

The FEIS (Section 5.2.5) and SD F8 include analysis of nutrient levels in the discharge from Tail Lake but no assessment of the implications to all downstream receivers. Implications to the Doris Outflow and Little Roberts Lake are rated as positive (i.e. increased production). The analysis needs substantiation in the form of quantitative predictions. An analysis of nitrogen loading to the marine environment at Roberts Bay is warranted, as nitrogen limits production in the marine environment.

The FEIS and SD F8 include mass balances for metal loadings to Tail Lake for each year of mine life and predict impacts of these loadings to water quality in the Doris Outflow during periods of discharge. The implications of metal loadings to water quality are assessed by this approach. The proponent has also addressed the potential implications of metal loading to body burdens in aquatic life (but not for marine life).

j) The Proponent must assess the potential for, and consequences of, Hg bioaccumulation in the food chain.

The Proponent completed a risk assessment for the Tail Lake facility and discharge (SD F2). Hg was not identified as a Contaminant of Concern in the risk assessment. Review of SD F8 shows that predicted Hg levels were below CCME Guidelines in the Tail Lake discharge. Although this rationale is not provided explicitly in the FEIS or in SD F2, it is sufficient to conclude that Hg bioaccumulation need not be considered (assuming the Tail Lake predictive model is accurate).

k) The Proponent must present an assessment of the effectiveness of the proposed cyanide destruction circuit.

An assessment of the effectiveness of the proposed cyanide destruction unit is presented and detailed in the following sources:

- SD A2, Sections 4 and 5
- SD A1, Section 2.3.1.2, Section 2.4.4
- FEIS, Section 5.2.5
- SD F8, Tables 2.4 and 2.5

l) The Proponent must provide a worst-case scenario plan for the emergency tailings dump pond, including a discussion of contingencies in the event of a breech of, or seepage from, the Tail Lake Dam. Provide an assessment of potential seepage pathways.

The Proponent has provided a worst-case scenario for the emergency tailings dump pond. The dump ponds are sized to hold two successive dumps, with a freeboard of 0.5 m within a lined holding pond.

The Proponent has done a seepage analysis for the North and South Dams (SD A5, Section 10.8) for the proposed frozen dam, assuming thawed conditions (worst-case). Note that potential seepage pathways from the dam will depend on the final design of the dam. See comments given under part a) above.

The Proponent intends on operating the Tail Lake tailings disposal facility as a “zero discharge” containment. No releases will occur unless they meet MMER requirements. If seepage occurs, the Proponent intends to monitor the seepage flow by means of a hydrological station downstream of the dams (SD A5, Section 11.7). The Proponent has assumed that a Surveillance Network Program (SNP) will be established as part of the water licence for the project (SD G1, Section 8.1.1). SD F8 has assessed the impacts of contaminant loadings due to seepage losses from Tail Lake. No impacts were predicted, so no specific mitigation measures were provided..

Water levels in Tail Lake will be controlled by a spillway. The operating plan is to retain all the water in Tail Lake until it meets MMER requirements. The spillway will prevent a breech scenario from developing.

The information provided by the Proponent has addressed the NIRB request, keeping in mind that details of specific contingencies can be addressed at the water licensing stage.

4.3 Water Management and Sewage Treatment Plan

a) The FEIS must fully describe the proposed sewage treatment technology, including proposed methods of removing and disposing of sludge.

Few details are provided regarding sewage treatment and management and the details that are provided are contradictory. Practices described in the FEIS and supporting documents are as follows:

- FEIS (extended aeration bioreactors; discharge to Tail Lake; no discussion of solids mgmt)
- SDA1 (Rotating Biological Contact treatment; discharge to Tail Lake; no discussion of solids mgmt)
- SDA5 (no discussion of treatment technology; states that treated effluent and sludge will be discharged to Tail Lake);
- SDF6 (extended aeration bioreactors; discharge to Tail Lake; some solids combusted, some landfilled, some applied to land in Tail L. watershed).

The lack of clear residuals management procedures precludes an assessment of solids-related impacts. The lack of information related to the treatment technology includes the following areas:

- Treatment process not clearly defined;
- No information related to BOD/TSS removal;
- No justification for prediction of very high nitrite levels in treated effluent (30 mg/L; Table 2.10 SD F8)

MHBL comment:
The sewage treatment facility planned for the Doris North project will be a rotary biological contactor as described in Section 3.8 of Supporting Document A1, dated November 2003. The sewage treatment facility will be a modular pre-packaged RBC treatment facility purchased from a qualified supplier of this type of equipment. Both the treated effluent and the sludge from this facility will be transferred to the combined final mill tailings pump box within the processing plant, mixed with the mill tailings and then pumped to the tailings containment area. Reference to other possible sewage treatment process technology is incorrect as is the reference to possible combustion of the solids from the sewage treatment plant.

Preliminary design information on such a facility was obtained by MHBL. The initial design was for a smaller unit based on a smaller accommodation facility at the Doris North Project. The sizing information was pro-rated on a basis of persons in camp to obtain the information used in the final EIS for predictive water quality modeling.

b) The FEIS must describe how the emergency catch basins will be drained so as not to reduce their capacity to receive tailings in the event of an accident.

The issue of emptying catch basins is addressed briefly in Section 9.2.2, in SD A5. The plan would be to excavate and haul in winter, or pump in summer.

4.4 Overburden and Waste Rock Disposal

a) The FEIS must identify the procedure to be used to recover the temporary surface waste rock pile.

Miramar identified the procedure to be used to recover the temporary surface waste rock pile. The temporary waste rock pile is intended to store PAG rock from the underground development. The designated area is the ore stockpile area next to the mill. When the underground mining takes place, this material will be relocated into the mined openings as backfill, so it will only be on the surface for a short time.

b) The FEIS must describe the transportation and placement of waste rock.

Miramar describes in sufficient detail the transportation and placement of waste rock in SD A1 (Sections 2.2.2 and 2.2.3).

In general the waste rock will be used continuously to backfill mined out underground openings. The Proponent has stated that some waste rock may be stored on the tundra adjacent to the ore stockpile if there is an excess during operations.

Preliminary assessment identifies potential concerns regarding:

- Reliance on visual identification of sulphides to segregate construction vs. PAG rock
- Lack of clarity, at this point, as to why 0.3% sulphur is considered an appropriate cut-off

c) The FEIS must include a contingency plan (including location and type of storage; monitoring of runoff treatment of runoff) if sulphide-bearing waste rock is encountered.

Miramar addresses this request in SD A1, Section 2.2.3 and 2.5.2. See also part a) above.

Miramar notes that pre-development characterization of the rock types expected to be encountered during mine development suggest that very little material is likely to be classified as PAG rock. Runoff from the temporary PAG waste rock stockpile will be directed towards and collected in a sump and pumped to the mill. From the mill, the runoff will be added to the Tailings Feed line and deposited with the tailings in the Tail Lake tailings containment area.

d) The FEIS must provide an overburden storage area and plan.

Most construction will be on pads constructed on top of the natural tundra surface. The only structures where there may be significant overburden removal is the dams, and these remain to be defined better. So far there is no identified area for stockpiling of the stripped and excavated overburden from the dam construction. This is a conformity issue and the deficiency needs to be addressed

MHBL comment:
Please see response on quarry and dam construction above (Section 3 – "quarrying").

e) The FEIS must identify the criteria that will be used to determine whether rock on the surface is acceptable for permanent disposal on the surface and provide a contingency plan for rock that is considered to be unacceptable for surface disposal.

SD A1 (Section 2.2.3) and SD F6 (Section 3.1.2) provide information on the above noted request. However, the information contained in SD F6 was noted to be weak. Also see part b above.

A preliminary technical assessment of the information identifies potential concerns regarding:

- Reliance on visual identification of sulphides to segregate construction vs. PAG rock
- Lack of clarity, at this point, as to why 0.3% sulphur is considered an appropriate cut-off

f) The FEIS must state whether encapsulation in permafrost is a primary intent for waste disposal in the mine and, if so, provide information on ground temperatures in the mine in support of this strategy.

The Proponent has not clearly stated whether permafrost encapsulation is a primary intent for waste disposal in the mine. In Supporting Document G1, Section 6.1.2, the Proponent expects that the ground in the mine will remain in a frozen condition, thereby preventing the movement of groundwater, sulphide mineral oxidation and transport of contaminants. In the next paragraph, the Proponent states that in the event of loss of permafrost conditions around the mine due to global warming, the underground workings will become flooded to a level, likely equalizing with the level of Doris Lake.

In general, there is limited information provided regarding the permafrost conditions in the mine or how this will be addressed in the design, operations and closure phases. In the technical feasibility report (SD A6, Section 17.2.1) the geological characteristics relevant to mine design are described. A rock temperature of $-10\,^{o}$C is given, but the source of the information is not clear. Also, it is acknowledged that the permafrost will enhance the stability of an already competent rock mass. More information is required to assess the impacts of mining on the permafrost and how it will be mitigated. No information on ground temperature was found for mine workings (see also Section 3 part b) of this document).

The Proponent has not satisfied the NIRB request in this regard.

MHBL comment:
Provided that the underground operations are operated at an ambient air temperature of -10 °C, the material stored underground will eventually freeze. If the material contains significant amounts of water, the freezing process will be longer because of the latent heat that will be released.

If the mine workings become flooded, the presence of water will act as a heat source and the freezing process will be very slow because of the large quantity of latent heat present in the water. The freezing process would probably be difficult to predict but it may prudent to accept the assumption that the permafrost will not be present if flooding occurs.

4.5 Waste Management

a) The FEIS must provide more detail relating to whether encapsulation in the permafrost is anticipated, bearing in mind the possibility of long-term climate change.

The landfills are intended to store inert, non-hazardous waste without liquids. In the project description (SD A1, Section 2.6), the landfill will be located within a mined-out rock quarry. Ultimately a cover cap will be placed (see Figure 5.20 in SD A4). Although not explicitly stated, the site conditions will cause permafrost aggradation to occur within the landfill if an appropriate closure cover is constructed that takes into account climate change. The NIRB request has been answered, although the technical details need to be worked out at the design/permitting stage.

MHBL comment:
We agree that the permafrost will be impacted by the exploitation of the quarry. The reason for placing waste at the quarry is simply to use an already disturbed area for the purpose of the mine operations. The concept is not to depend on permafrost to encapsulate the waste, which would not have fluids nor toxic waste. Depending on the sequence of placement, the waste could potentially promote the permafrost condition since it will be less conductive to heat than the bedrock mass. We also agree that the "technical details need to be worked out at the design/permitting stage".

b) The FEIS must provide more detail relating to plans to monitor for and mitigate seepage during or after the life of the mine.

Seepage monitoring has been included as part of the design for the tailings dams. Upon closure, the water level in the tailings impoundment would be lowered if water quality improves to meet environmental discharge criteria. The South Dam would no longer hold water, so there would be no need to carry out seepage monitoring there. The North Dam would remain, but would be breached with a spillway to allow free flow of water around the dam from Tail Lake after closure. Annual inspections and water quality monitoring would be carried out in the post-closure period of the water in the creek downstream of the North Dam.

This issue seems to be adequately addressed for the purposes of this conformity analysis.

4.6 Environmental Management and Mitigation Plan

a) **The FEIS must contain a Spill Contingency Plan that: addresses the handing of reagents, including the details of their storage; demonstrates how ARD will be monitored and, if appropriate, treated; addresses a tailings spill from the mill that exceeds the one-hour upset (~50 m^3); describes the method of secondary spill containment that will be employed for fuel, chemical, waste chemical storage, and fuel piping and valves at the mine and barge off-loading facility.**

Section F.6 of the supporting documentation outlines spill response for any spills that occur on site. The spill plan cannot be adequately assessed due to the following deficiencies:

- The document provides names and phone numbers of persons in charge, however, none of these seem to indicate which one, specifically, is the 24 hour contact. It is of the utmost importance to have the name of the individual who can immediately effect a spill plan and make decisions in the event of a major spill.

- While the geographic location and size of the facility is provided in the general information package, it is not provided in the body of the spill plan. This information should be included in the spill plan. It should be kept in mind that in many cases, the spill plan becomes a separate document; particularly with respect to first response/regulatory agencies.

- A list of hazardous materials stored on site are provided, however the proponent should also provide the quantities of each. It should be noted that tailings and sewage are considered contaminants for purposes of preparing a spill plan.

- The proponent should provide a detailed site map of the area, identifying the location of structures, contaminants storage areas, likely pathways of contaminant flow (in the event of a spill) potentially sensitive areas, such as water bodies, and general topography. The site map should be included as in integral part of the spill plan. If necessary, a series of site maps can be employed for this purpose.

- The plan does not indicate what type of spill response training, if any, the mine personnel have undergone. This information is required in order to assess the ability of the proponent to deal with any spill emergency, including a sudden failure of tailings containment areas.

- The proponent lists several external sources of spill response equipment but does not indicate how long it would take for this equipment to be landed on site in the event of a major spill.

- The proponent is vague about the final disposition of recovered materials – such as free product and contaminated snow, soil and water. The proponent should provide a detailed plan on how they intend to manage these materials post cleanup phase.

Appendix B.1 of section F.6 of the supporting documentation lists the areas where spill kits are to be located. The jetty in Roberts Bay is not listed as an area a spill kit is located. As the jetty is the offloading site for all materials that are to be utilized for the project, a spill kit needs to be located at the jetty. Appendix B.1 of section F.6 of the supporting documentation also lists the contents of each spill kit. CCG and EC should confirm whether or not the contents of the spill kit are adequate to contain a spill that may occur when offloading supplies at the jetty.

MHBL comment:
These comments are constructive, helpful, and appreciated. The Environmental Management System as presented in supporting document F6 is a "work in progress". The details on overall "errors and omissions" indicated above will be addressed as the specific elements are finalized for submission during the permitting phase (as required by the Nunavut Water Board for example), or in the negotiations for leases with KIA, or GN-DSD on a wildlife mitigation and monitoring protocol.

b) The FEIS must contain a detailed ARD/Metal Leaching Management Plan that includes a strategy for the on-site classification of waste rock according to its ARD/ML characteristics. This plan must describe the methods of handling that will be implemented, with particular attention to the mafic volcanic rock group.

SD A1, Section 2.2.3 outlines a waste rock management plan, which includes a strategy for on-site classification of waste rock and handling methods. However, particular attention to the mafic volcanic group has not been addressed in the management plan. The plan discusses PAG rock vs. non-PAG rock, no particular rock types/subgroups have been singled out.

Also, preliminary assessment identifies potential concerns regarding:

- Reliance on visual identification of sulphides to segregate construction vs. PAG rock
- Lack of clarity, at this point, as to why 0.3% sulphur is considered an appropriate cut-off

MHBL comment:
Section 3.2.3 entitled "Waste Rock Management" in Supporting Document A1 provides a description of how potentially acid-generating rock from the underground mine will be identified by mine staff before it is removed from the mine workings and the actions that will be taken to ensure that such rock is appropriately segregated and managed to prevent release of contaminants to the surrounding environment.

The plan relies on a visual inspection of the faces of all development rounds prior to blasting to allow the geologist to identify the lithology of the material to be mined in that round. Typically the geologist will have an expectation of the rock type that the heading is going to be in from the geological modelling of the various lithologies that has been derived from the prior exploratory drilling. Through these visual inspections the geologist will be in a position to confirm that the actual lithology matches the expectations based on the lithologic modelling. These inspections will allow the geologist to confirm that the heading is in either unaltered wall rock (unaltered basalt), gabbro, mafic volcanic, diabase dyke or in area of quartz veining or in transition from one zone to the other.

The acid base accounting characterization work conducted on the Doris North deposit indicates that the rock types that are potentially acid generating are associated with the mineralized materials which are typically quartz veins with increasing amounts of pyrite mineralization. These are highly visible and easily differentiated by visual inspection from the basalt, gabbro, diabase dyke and/or mafic volcanic rock types.

Surrounding the mineralized zones there typically is some altered basalt and mafic volcanic rock that contains increased pyrite mineralization. ABA testing suggests that when the pyrite increases above 1% to 2% there is some risk that this material may become net acid generating. This rock is typically located in a halo adjacent to the mineralized zones (the ore) and can be identified by visual observation of the sulphide content.

The reliance on visual identification of the lithology and presence of sulphide mineralization as an initial screening tool is viable at the Doris North deposit due to the following factors:

- Potentially acid generating rock is limited to the mineralized ore zones (typically quartz veining) and to a small halo surrounding some of the mineralized zones where the pyrite content of the mafic volcanic rock noticeably increases;
- The rock types away from the ore zones, unaltered wall rock (unaltered basalt), massive gabbro and diabase dyke material are unlikely to be net acid generating; and
- It is quite easy for a geologist to visually distinguish the mineralized zones from the surrounding country rock.

The proposed ARD management program calls on the geologist to first make an assessment of rock type and then to assess the presence of visible sulphide mineralization. Based on rock type the geologist will be able to predict the likelihood of the material being either within the mineralized zone or within the mafic volcanic halo from the visual identification of lithology. However the proposed ARD management program requires that despite this initial identification, if sulphide mineralization is present at a relative amount in excess of 0.30 wt% then the material should be considered potentially acid generating and segregated and managed accordingly until it can be demonstrated that the material is not potentially acid generating through use of conventional acid base accounting analyses. The criteria of 0.30 wt% was arbitrarily selected as being representative of a conservative criterion that is typically used in assessing ABA data.

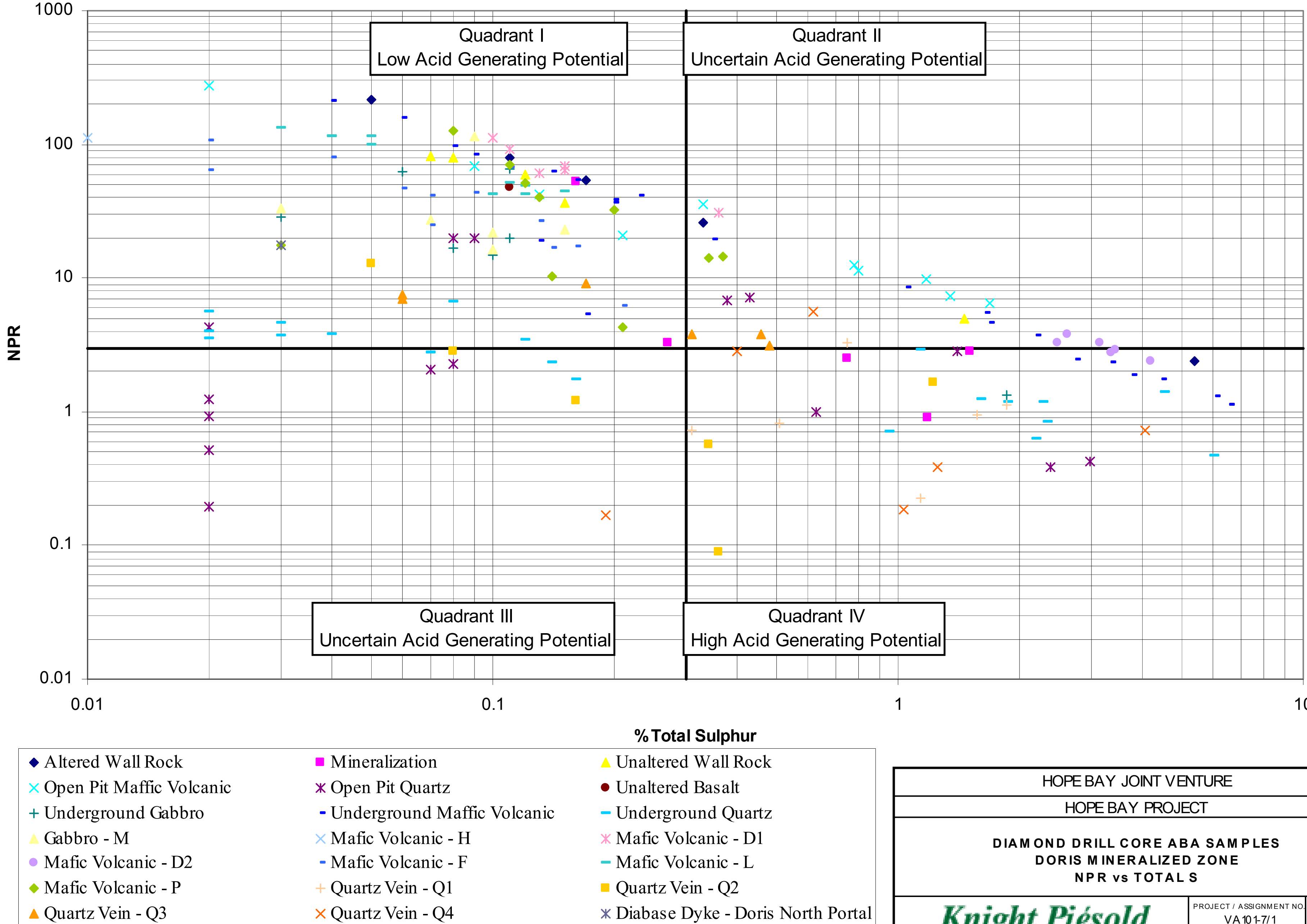
Figure 3.7 in Supporting Document B4 (copy below) shows a plot of Neutralization Potential Ratio (NP) against wt% Total S for all 166 samples in the Doris North ABA database. The plot indicates that a total of 62 samples from that database had an NPR less than 3 (i.e. could be classified as being potentially acid generating). Of these 62 values only 12 had a Total S content of less than 0.30 wt% and all of these represented quartz vein rock type material. The other 50 samples all had Total S contents in excess of 0.30 wt%, the majority having well above 1 wt% Total S content. The plot also indicates that out of the 166 samples in the database, a total of 99 had a Total Sulphur content of less than 0.30 wt%, however a total of 87 of these samples had an NPR greater than 3 indicating that they are non-acid generating.

An alternative way of looking at this same data is shown in Figure A (attached) which plots NPR versus Total wt% S where the NPR values are plotted on a logarithmic scale versus the wt% S that is on a non-logarithmic scale. The plot demonstrates the small number of samples within the data base that have NPR values under 3 (potentially acid generating) and have a wt% Total S concentration under 0.30 wt%. All of these samples were of quartz vein material where the neutralization potential is relatively low due to the absence of carbonate mineralization.

In other words the ABA data base for the Doris North deposit suggests that for all rock types, other than the mineralized quartz veining, if the wt% Total S is below 0.30 wt% then the material is unlikely to be classified as being potentially acid generating. The quartz vein material typically only occurs within the mineralized ore zones and is thus unlikely to be extracted as waste rock.

On this basis the proposed ARD management plan called for all rock that had a visual presence of greater than 0.30 wt% Total Sulphur to be classified as being potentially acid generating and thus segregated and managed accordingly unless ABA testing demonstrates that this material in non-acid generating. For practical purposes this criterion is likely to mean that if sulphide mineralization is noted in the development heading by the geologist, the material is likely to be labelled as potentially acid generating and thus segregated until it can be demonstrated by ABA testing that the material is non-acid generating. For consistency this criterion could be extended to include all quartz veining material encountered along with material with a visible Total S content in excess of 0.30 wt% .

This proposed ARD assessment program will be refined as underground development mining commences. Periodic submission of development muck samples for conventional ABA testing will allow the mine geological staff to improve their ability to distinguish potentially acid generating rock and with experience likely allow the volume of segregated material to be reduced.



Rev 0- Issued for Report

HOPE BAY JOINT VENTURE

HOPE BAY PROJECT

DIAMOND DRILL CORE ABA SAMPLES
DORIS MINERALIZED ZONE
NPR vs TOTAL S

Knight Piésold CONSULTING

PROJECT / ASSIGNMENT NO.	REF NO.	REV
VA101-7/1	1	0

FIGURE 3.7

4.7 Closure and Reclamation Plan

a) The Proponent must state unambiguously the ultimate objectives of the reclamation plan and identify any alternative objectives in terms of differing end land uses.

SD G1 contains the Mine Closure and Reclamation Plan. Ultimate objectives of the reclamation plan on a mine component basis were not provided. However, generic objectives are provided and specific objectives can be inferred from the description of reclamation measures.

b) The Proponent must clearly state what facilities are proposed to remain on site for ongoing operations after reclamation, but design a plan that deals with the final characteristics of the site once all infrastructure is abandoned, rather than assuming continued use of at least some of the infrastructure for mining.

The closure plan (SD G1) has stated which facilities will remain after closure and after all facilities have been removed.

Page 5.36 of the FEIS states that the jetty will remain in place after decommissioning. No information is given in the FEIS or closure and reclamation plan (G 1 in supporting documents) on why this option was chosen and no alternatives to leaving it in place were discussed. Further information on why the option of leaving the jetty in place needs to be provided.

MHBL comment:
Removing the jetty from Roberts Bay after the mine closes would require excavation of the rockfill placed in to create this structure. This would require the use of an excavator to retrieve the quarried rock that was placed onto the floor of Roberts Bay. The rockfill will have penetrated the underlying bay sediments and spread laterally at an angle of repose to create the structure. Removal of this structure will require removal of the rockfill and underlying sediments that will then have to be hauled onto the mine site to an appropriate disposal point (likely the tailings impoundment). This activity would likely create the following additional potential impacts:

- Disturbance of the underlying sediments on the bottom of Roberts Bay both from under and adjacent to the jetty structure;
- Release of sediment into the surrounding waters in Roberts Bay during the excavation activity;
- Release of sediment from hauling a wet slurried material to an appropriate permanent disposal site;
- Release of sediment from the deposition of the removed jetty material at the permanent disposal site such as the tailings impoundment.

In reviewing this activity, MHBL felt that leaving the rockfill jetty in place would result in less potential environmental impact that removal, consequently the decision was taken to propose within the closure plan that the rockfill jetty be left in place at the end of the mine life.

The proponent indicates that the jetty will include infrastructure such as bollards and mooring chains anchored in to the jetty. The closure and reclamation plan does not indicate what they plan to do with this additional infrastructure at closure. The proponent needs to confirm their plans for this.

MHBL comment:
The intent is to remove all of the bollards, mooring chains and other components from the rockfill jetty during the mine decommissioning and reclamation period. The intention is to only leave the rockfill structure in place once reclamation is complete.

c) **The Proponent must design the plan in accordance with the *Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories* (1990).**

The reclamation plan recognizes the above noted guidelines (SD G1). The adequacy of the plan's compliance with the guidelines has not been assessed.

d) **The Proponent must address the potential for ongoing ARD.**

Miramar states the following, indicating it has considered the potential for ongoing ARD:

> "Potential acid rock drainage (ARD) and metal leaching (ML) will be minimized through the placement of all potentially acid generating waste rock into the underground mine where it will remain in a frozen state due to the presence of permafrost (or underwater should future global warming trends cause permanent thawing of the permafrost and subsequent flooding of the closed mine workings at some point in the future). All mill tailings will be permanently stored under a minimum 3-meter deep water cover in the reclaimed tailings containment area. These actions will retard the rate of ongoing sulphide mineral oxidation and prevent the future release of contaminants into groundwater and surface water from these materials due to oxidation/weathering. Consequently no-long term water treatment requirements are envisioned once reclamation has been completed. The successful implementation of this strategy will minimize requirements for long-term post-closure surface water and groundwater monitoring."

e) **The Proponent must justify the proposed 1 metre water cover for tailings in Tail Lake.**

The Proponent has stated that the minimum cover over the tailings will be 3 m. The depth of water was increased to prevent excess turbidity due to wave action and ice plucking. There is however, a discrepancy regarding how the tailings will be placed that must be clarified, and this is discussed below.

SD A5 provides the details on the tailings management plan. The Proponent intends on placing the tailings into the deepest part of the lake first, then filling the lake basin so that the tailings are placed horizontally to the lowest possible elevation. Upon closure, the elevation of the tailings will be surveyed to establish the elevation of the lake surface so that the 3 m minimum water cover is obtained. This scenario implies that there will be water against the upstream face of the dam, as the top of the tailings is predicted to be at elevation 26.5 m. The current lake level is at elevation 28.3 m. Clearly this implies that there will be no tailings placed against either the North or South Dams. In any case, the dam stability and seepage analyses have not included the presence of tailings on the upstream face of the dams.

SD G1, the closure plan, in Section 4.7.2 states that "Inherent in the design is the fact that water stored behind the dam will be pushed away from the upstream face of the dam by the placement of a thick beach of tailings solids spiggotted along the upstream face of the dam." Clearly, under this scenario there will be an exposed tailings beach and a zone of tailings with less than 3 m of water cover. Further, upon closure, the extent of exposed tailings will increase as the water level in Tail Lake is lowered. There is no provision in the closure plan to address the mitigation of the exposed tailings beach around Tail Lake, if this is indeed the case. In addition the presence of the tailings on the dam face has not been considered in the overall design presented to SD A5.

MBHL comment:
It is not the intention of the proposed Tailings Management plan to deposit tailings above elevation 26.5 m nor against both dams. The tailings would have to be removed and placed in the lake where it would remain below elevation 26.5 m.

4.8 Monitoring and Follow-up Strategies

a) The FEIS must indicate the timeframes anticipated for post-closure monitoring and the timelines for dismantling any facilities and infrastructure that may remain for ongoing use after reclamation of the remainder of the facilities.

Post closure monitoring timeframes and dismantling timelines are included in reclamation schedules in the mine closure and reclamation plan (SD G1).

b) The FEIS must provide a description of: monitoring methodologies, standards, objectives and a corresponding data-collection schedule; the frequency of data-collection and analysis; the geographic extent of monitoring, with particular reference to the Doris Lake outflow stream and Little Roberts Lake; the subjects and parameters to be monitored, and the criteria used in their selection; and the logistics for carrying out both on-site and off-site monitoring activities.

With respect to water quality, draft monitoring commitments and protocols have been provided by the Proponent that are appropriate to this stage of the project.

The proponent has provided a detailed EEM procedure in SD F3 which draws heavily on the Federal Government MMER requirements. This demonstrates the necessary commitment to the EEM process and details can be added as part of the Water Licence requirements.

c) The FEIS must identify intended socio-economic monitoring strategies including ongoing consultation and provide a description of community involvement in monitoring.

The proponent has not provided a monitoring strategy for the project. They have indicated their intentions are to develop a socio-economic monitoring committee; however, the approach fails to provide any detail beyond the proponent's interest in mandating this group to monitor socio-economic impacts. The proponent also indicates that the Nunavut Planning Commission has developed a number of indicators that could be used to assist in monitoring the project's impacts, unfortunately the value in using the these indicators is unclear as they do not appear to be linked to all of the VSECs, the potential impacts or impact effects, any should it be required, nor are their any links to potential residual impacts.

While the committee would serve as a mechanism in addressing community and stakeholder engagement as it relates to the project, the absence of a cohesive strategy (or monitoring methodology) linking the relevant aspects of the assessment to mitigation and the respective elements that are to be monitored as part of a strategy should be seen as a point of non-conformity with the guidelines.

Discussions on this particular topic should also address issues related to the projects potential impact as identified in the assessment, and the appropriateness of a passive monitoring approach.

Additionally it will be important to ensure that the strategy provides a balanced assessment of both beneficial and adverse impacts.

MHBL comment:

The Community Socio-Economic Monitoring Committee in conjunction with any management committee set up under the IIBA will be charged with reviewing Miramar's performance concerning the provision of employment, training and business opportunities and the impacts of the project on the communities. The Committee will make recommendations to the company and the territorial and community governments to enhance the benefits of the project and reduce the negative impacts. As the project will take place over a maximum of four years, one for construction, two for mining and one for restoration, figures provided to the Committee will most probably come from the company and the community governments. Figures of use to the Committee would include:

- Percentage of workers on the property from the Kitikmeot Region;
- Percent of contract dollars going to Kitikmeot firms;
- Training courses held and proposed;
- Total wages going to each community;
- Crime statistics for each community;

- Data concerning local residents who leave the project; and
- Availability of country food; and

The Committee members representing the communities would be charged with reporting on impacts from the project on their community and the Committee would hold public meetings in each community at least once per year.

The appropriate body at the next meeting of the Committee must respond to recommendations made by the Committee.

Communities with members on the Committee would be Kugluktuk, Cambridge Bay, Gjoa Haven and Taloyoak.

d) The FEIS must address internal and external reporting and response mechanisms and structures, including procedures to be followed in the event that monitored results deviate significantly from predicted results.

MHBL has committed to an environmental management system (EMS) that has accountability as a key element, as well as to using ISO 14001 protocols to guide the audit of project performance (it is unclear whether the proponent is, or intends to become, compliant with ISO 14001) and demonstrate continuous improvement during the operating period (FEIS, pgs. 7-1, 7-3). However, the level of detail required to conform is lacking. It is recommended the proponent demonstrate how this will be implemented, for instance, by providing details including who will be responsible for collecting information, reviewing information, and making and implementing decisions to change the EMS, what information will be collected for this review, when will it be collected, reviewed, and reported, and how often the EMS will be audited.

MHBL comment:
MHBL is not committing to have the Doris North Project ISO 14001 certified, however, some of the fundamental ISO 14001 strategies like continuous improvement through review and corrective actions will be important elements of the EMS implementation plan.

In terms of socio-economic follow-up and monitoring, there is a need to clearly define the mechanism by which the project's monitoring for socio-economic impacts will ensure that appropriate steps are taken to address identified adverse impacts should they deviate from predicted results.

MHBL comment:
Please see c) above.

e) The FEIS must present plans for environmental effects monitoring studies and acute lethality testing of mine effluent in regards to requirements outlined by the MMER.

The Proponent has provided a detailed EEM procedure in SD F3 which draws heavily on the Federal Government MMER requirements. It includes plans for effluent lethality testing. This demonstrates the necessary commitment to the EEM process and details can be added as part of the Water Licence requirements.

f) The FEIS must present the framework for a comprehensive long-term monitoring program for the impacts of the Project on wildlife, including the fish habitat compensation plan and permafrost degradation.

Permafrost Degradation

The Proponent did not consider long-term permafrost degradation to be an issue in the monitoring program presented in SD G1, Section 8 and consequently a comprehensive long term monitoring program for permafrost degradation has not been provided.

The Proponent fails to consider the potential long-term and large-scale permafrost degradation of the ice-rich marine clay soils around the shoreline of Tail Lake associated with raising the natural lake level by 5.2 m during operations and then maintaining a minimum 3 m of water cover on the tailings in the post-closure phase. As a result, the Proponent's closure plan addresses only minor erosion repairs in the vicinity of the North Dam and fails to provide for any mitigation and monitoring of larger-scale degradation that may occur along the margin of Tail Lake.

The Proponent has not satisfied the NIRB request for a monitoring program that addresses long-term permafrost degradation.

MHBL comment:
We agree that "a comprehensive long term monitoring program for permafrost degradation has not been provided." See previous responses on the issue on thawing ice-rich marine deposit along the shoreline of Tail Lake.

g) The FEIS must provide a statement of who will finance the monitoring programmes

Financing for monitoring of environmental effects is addressed in the closure plan (SD G1).

The proponent has not provided a statement which identifies the financing of their proposed socio-economic monitoring instrument, nor the implementation of a socio-economic monitoring strategy (programme) should one be developed. The proponent does mention the potential for it to be included as part of the IIBA negotiations. For greater certainty, the identification of an alternative funding commitment should be identified if the resources fail to be incorporated into the IIBA for the implementation and monitoring of potential socio-economic impacts and the ongoing effectiveness of an approved management strategy.

MHBL comment:

Miramar will be responsible for the expenses incurred by the community representatives on the Socio-Economic Monitoring Committee.

5. Impact Assessment

NIRB Issue 4: The inadequacy of various components of the impact assessment, including the assessment of socio-economic impacts.

5.1 General Impact Assessment

a) The FEIS must include a more complete analysis of impacts in each of the following areas: <u>climate/global warming</u>, noise, <u>terrain</u>, <u>permafrost</u>, <u>hydrology/water quality</u>, wastewater treatment, <u>acid rock drainage and metal leaching</u>, <u>aquatic organisms and habitat</u>, wildlife, bird life and habitat, vegetation, and accidents and malfunctions.

Climate Change

Please see Section 3, part a) of this document.

Permafrost &Terrain

Please see Section 3, parts a) and b) of this document

Hydrology

Surface water impacts have been separated into three areas: impact on Doris Lake water levels, Tail Lake sedimentation pond facility, and infrastructure drainage. Analysis of impact on Doris Lake levels is reasonably complete. Tail Lake will be permanently impacted, so the primary mitigation effort will be in making certain that downstream releases have adequate levels of quality. Assessment of sedimentation efficiency needs further work as noted earlier (see Section 4.2 of this document). Infrastructure impacts on surface water have been described conceptually - there is a need to address the risk of a slurry pipeline breakage up-line of the Doris Lake outlet channel.

MHBL comment:
The proponent plans to place the tailings slurry pipeline in a half-round pipe culvert from the emergency tailings dump catch basin on the east end of the Doris Lake bridge crossing, all the way across the bridge to a distance 50m west of the bridge. This would prevent uncontrolled spillage of tailings slurry into the Doris Lake outlet in the event of a pipeline break-up in this area.

In conclusion:

- A reasonably complete analysis of impact on Doris Lake water levels has been undertaken – consideration of assumptions in the water balance model will be addressed later.

- A reasonably comprehensive Tail Lake water balance model has been developed – details will be reviewed later.
- Infrastructure drainage – Primarily conceptual, but considered adequate at this time

Technical issues noted based on preliminary analysis:

- Impact on outlet channel below Tail Lake North dam (outflow regime) is anticipated to be much different during mine operation.
- Impact on circulation and sediment transport arising from construction of barge landing jetty was not addressed.

MHBL comment:

The proponent has reconsidered the jetty design and is reviewing a possible alternative design that may reduce potential impacts on the bay, by reducing the volume of rockfill that would obstruct natural flow of water. The alternative design consists of one, two or three 30.5m long clear span bridge decks. These bridge decks would be supported by rockfill buttresses. Consideration was given to making use of piles; however this was not given further consideration due to the prohibitive cost of providing specialized piling equipment for construction. A detailed drawing of this proposed alternative Jetty design will be presented at the Technical Meetings scheduled for the week of March 29 – April 2, 2004. The final jetty configuration will be confirmed during the detailed engineering phase.

Shoreline Processes:

The main potential impact of the jetty on the shoreline of Roberts Bay is the interruption of longshore sediment movement. Where there is no predominant direction of longshore transport, jetties may have little to no effect. At sites where the longshore sediment transport is large, the amount of sediment available to downdrift shores can be reduced; at least until a new equilibrium shoreline is formed at the jetties. Where longshore transport predominates in one direction, an accretionary fillet will occur on the updrift side of the jetty and erosion will occur on the downdrift side.

Sediment transport in the foreshore zone in Roberts Bay is most likely due to wind waves and tidal processes. Wave-generated currents tend to dominate water movement in the nearshore zone and are the most important natural force in the movement of sediment. When waves break with their crests at an angle to the shoreline, a current is generated parallel to the shoreline that is able to move sediment alongshore. In the vicinity of structures, diffraction may produce substantial changes in breaking wave height.

The information currently available at the jetty location includes:

- Bathymetry contours;
- Sediment samples, and
- Photographs

The jetty site, located at the south end of Roberts Bay, appears to be located on a shoreline which has a low net longshore sediment movement (due to shoreline orientation, fetch and the nature of the shoreline sediments). However to confirm this hypothesis the following tasks will be undertaken prior to the Technical Sessions to be held at the end of March:

- Review existing site information – Review of the sediment data collected at the project area is important to establish the baseline condition and site characteristics.
- Review of historical aerial photos – Available aerial photos can be used to assess the long term evolution of the shoreline.
- Wind wave hindcasting – A wave hindcasting analysis to establish the wave conditions at Roberts Bay.
- Wave refraction/diffraction analysis – The construction of the jetty may alter the nearshore wave conditions due to diffraction and refraction processes. The diffraction and refraction modeling will provide the nearshore wave conditions at the site.

This information, along with the design and cost analyses of the alternate jetty designs (e.g., rockfill with open span sections) will provide a basis for discussion at the Technical Sessions**.**

- Perhaps some consideration of water balance in Tail Lake should groundwater volumes become significant at a Stage 2 or 3 of mine development.

MHBL comment:
Please refer to Section 3(a) – "Groundwater Conditions" and Section 4.1(b) – "Mine Plan" for a discussion of this issue.

Water Quality/Aquatics Organisms

The FEIS presents an analysis of impact to water quality and fisheries in Section 5. The previously requested items by INAC (water quality predictions and ammonia model) have been addressed and supporting documents provided (SD F5 and SD F8). The impact assessment was also improved through SD F2 (Tailings Risk Assessment).

However,

- increases in nitrate levels resulting from cyanate and ammonia degradation in Tail Lake were not modelled;

MBHL comment:
Please see response to Section 4.2 (e)

- effects due to sediment release from Tail Lake have not been addressed;

MBHL comment:
Only clean water with low solids content would be decanted, therefore sedimentation is not likely to be an issue.

and

- the Final EIS does not provide an assessment of seepage failure. The Pre-Hearing Decision of the NIRB required an assessment of impacts to water quality related to seepage from the Tail Lake Dam.

MBHL comment:
The water quality model allows for a limited amount of seepage. At increased seepage levels, annual decant volume would be reduced as lower decant rates would be required. In the event that the seepage exceeds the maximum allowable decant rate, a contingency such as a collection ditch together with a pump-back system would need to be implemented.

ARD and Metal Leaching

The Proponent provides an assessment of impacts related to ARD and Metal Leaching, which INAC is satisfied with. The assessment is found in the following sources:

- FEIS, Section 5.2.5, Water Quality, pages 5-21 to 5-28
- FEIS, Section 5.2.6, Regional Geology/Geochemistry/Acid Rock Drainage, pages 5-28 to 5-29
- SD F8, Predictive Water Quality Monitoring Report, SRK, 2003
- SD B2, ARD and Metal Leaching Characterization Studies in 2003, AMEC, 2003
- SD B4, Integrated ARD Characterization, AMEC, 2002
- SD A2, Investigation into the Use of Caro's Acid for Cyanide Destruction, BML, 2003

b) The FEIS must include a discussion of the effects of the causeway on physical dynamics and shoreline processes as a basis for identifying any potential related environmental effects. In particular, the EIS must demonstrate that the causeway, if left in place, will remain useable and will not constitute an ongoing source of adverse effects as a result of its disintegration.

The FEIS (p. 5-37) describes the assessment of the jetty. Impacts discussed do not include alteration of currents and these are not discussed in SD A4 (surface infrastructure). The closure plan (SD G1) does not make explicit reference to the jetty, but does commit to removal of all surface infrastructure. The FEIS (p. 5-36), however, indicates the jetty will remain in place.

Proponent should provide analysis of shoreline processes and closure plans for the jetty.

MHBL comment:
Please see discussion of analyses of shoreline process described above.

c) The FEIS must include the identification of appropriate mitigation measures for each impact.

In general, appropriate mitigation measures were put forward by the Proponent; however, because there are deficiencies in the Proponent's impact analysis, mitigation measures will still need to be developed in some cases.

Water Quality

Water quality mitigation has been built into the project design and operations for routine discharges and some failure scenarios (i.e. dam design for stability and extreme precipitation events). Mitigation for other scenarios (pipeline failures) is provided in design characteristics as well.

However, the impacts resulting from reduced allowable decant rates from Tail Lake (if less dilution is available from Doris Lake outflow; see earlier discussion of background copper levels) was not identified. In turn, mitigation measures to address the impacts (i.e., treatment of Tail Lake decant water) were not identified or described.

MHBL comment:
As stated in the FEIS, the primary mitigation available, in the event that adequate mixing is not available to meet the downstream CCME guidelines for copper or other metals, would be to contain the water in Tail Lake and not discharge until such time as the discharge would meet MMER guidelines, and upon mixing with Doris Outflow water (at the falls) meet CCME guidelines. If, through monitoring Tail Lake waters near the outlet point, it is apparent that the concentration of some contaminant (e.g., copper) is at a level that the decant upon mixing with Doris Outflow water would likely not meet CCME guidelines within the available period and/or holding capacity of the tailings impoundment, then treatment of the decant water would be undertaken prior to release into the receiving environment in order to attain the guidelines.

Hydrology

The information provided by the proponent with respect to hydrological mitigation measures is sufficient to conform to the NIRB request at this stage; however several comments are offered below.

Mitigation of potential impacts on:

- Doris Lake levels and outflow – Miramar has used a reasonable amount of detailed analysis to show that these impacts will be minimal.
- Tail Lake outflow regime - this could be substantially affected if in fact runoff into the lake is stored for three years. Without flow in the short length of channel between the dam and the Doris Lake outflow channel for this period of time, it is likely that there would be an environmental consequence.

MHBL comment:
Page 5-33 of the FEIS states: Water balance modelling predicted the combined effects of water withdrawal from Doris Lake and the dewatering of Tail Outflow on the water levels of Doris Lake, as well as the changes in flow in Doris Outflow. The water balance simulation predicted that under mean conditions; mean monthly lake drawdown from natural conditions will vary from 5 mm to 70 mm (inlcudes Tail Outflow and project water withdrawal requirements). The most extreme monthly lake draw downs from natural conditions calculated by the model varied from 5 mm to 76 mm over the course of the year (Supporting Document F4). These values are small compared to the 500 mm natural annual variations in lake water level. The model also predicted the effects of disrupting Tail Outflow on Doris Outflow. Predictions ranged from a 3.3% reduction during spring flood flows (June) to a 0.3% reduction during the low base flow period (October). Based on the water balance modelling, the disruption of Tail Outflow is not expected to impact fish habitat in Doris Lake or in Doris Outflow below the controlled discharge point from Tail Lake. Potential fish habitat would be lost within the short section of Tail Outflow that would be dewatered, and this has been addressed in the fisheries No-Net-Loss Plan.

- It is not clear how Miramar will mitigate unacceptable water quality in the lake - poor sedimentation efficiency may require treatment, not to mention the level of dissolved material in the water.

MHBL comment:
As stated above, the water in the tailings impoundment would he held and not discharged if it would not meet applicable MMER guidelines. If, through monitoring of Tail Lake waters near the outlet point, it is apparent that the concentration of some contaminant (including total suspended sediment or metals) is high enough that the decant upon mixing with Doris Outflow water would likely not meet CCME guidelines within the period of holding capacity of the tailings impoundment, then treatment of the decant water would be undertaken prior to release into the receiving environment in order to attain the guidelines. Please also refer to Section 4.2(h) above for a discussion of this issue.

- Miramar will need to address in greater detail the potential risk of a slurry line break upstream of the Doris Lake outflow channel and how this risk is to be mitigated.

MHBL comment:
Please refer to Section 5.1(a) – "Hydrology" for a discussion of this issue.

5.2 Socio-economic Impact Assessment

a) The FEIS must include additional detail concerning the nature of negative and positive socio-economic impacts of the Project.

The FEIS does not conform to this requirement because it lacks an assessment of both the positive and negative socio-economic impacts. It relies heavily on monitoring impacts. This may not be acceptable, given the irreversible nature of certain impacts. (e.g. early childhood impacts during their formative years, which might result from parental absence. This was commented on in the proponent's traditional knowledge study but not clearly integrated).

MHBL comment:
Both positive and negative impacts are assessed in SD E3.

Further information such as the employed methodology, assumptions, calculations, a list of variables that were use to establish the baselines for the VSECs employed in the assessment of potential impacts, and details on the DIAVIK model that was employed would contribute to the proponent's ability to clearly demonstrate their understanding on the nature of socio-economic impacts and how this was addressed in their assessment.

The VSECs were selected as a result of a review of the notes from the community meetings held by Miramar Hope Bay Ltd., by Tahera Corporation and by Diavik Diamond Mines Inc. and after consultation with the consultant's regional advisor.

The following is an extract from the Diavik Environmental Assessment (Diavik, 1998) which describes the economic model used in that assessment. The figures included in this study are proportional to the figures calculated for the Diavik project.

"The economic impacts of the proposed Project were analyzed for both the construction and operating phases of the project. Four variables were measured to determine the impacts for each phase. These variables include: (1) Gross Domestic Product, (2) employment, (3) labour income and, (4) government revenues. Economic impacts were not estimated for either the closure or post-closure phases of the proposed Project as the economic impacts for these phases would be minimal or zero.

Total estimated impacts include the direct impact associated with the onsite construction and operation of the proposed Project and the impacts generated by the "spin-off" from this activity. The spin-off economic impacts are referred to as "indirect" and "induced" impacts and they are the result of the multiplier impacts on the NWT and Canadian economies.

Economic multipliers trace the impacts of a change in output or demand for a good or service. For example, an increase in demand for a commodity will produce three effects that are described by economic multipliers.

The first is the impact on industries (firms) which expand production to satisfy increased demand. These effects are termed direct impacts. In this case of the building or operating of a mine they are the impacts associated with the on site construction contractors or mine operating employees.

Secondly, there is a ripple effect as these firms purchase additional required inputs from other firms. These effects are termed the indirect impacts. In this case these are the firms that supply goods and services to the construction contractors or the operating mine such as expeditors located in Yellowknife and possibly other communities in the NWT.

Lastly, as all these firms expand production they hire more staff and pay out wages, thereby increasing the income received by households. After withdrawing a certain portion for taxes and savings, households spend the income, which in turn increases demand for other commodities. These impacts are termed induced effects.

Estimates of economic impacts generated were determined from simulations using actual project data on employment and expenditures supplied by Diavik.

The NWT simulations were done using an economic impact (input-output) model that was developed for this project. This model is identical to that used by the NWT Bureau of Statistics and the tables, which are used by the model, were developed using a combination of the latest data sources. The model is highly desegregated covering a potential of 162 industries and 485 commodities (although less than a third of these are represented in the local study area). The model may be used to simulate directly both indirect and induced impacts and the industry and commodity structure can be updated and adjusted to make it more descriptive of changing economic conditions.

The simulations for the provinces and the Yukon were done using the Statistics Canada 1990 Interprovincial Open Input-Output Model. Since this is an "open" model, and it does not produce estimates of "induced" activity, the model was run twice. The first run was to estimate the direct and indirect impacts and to calculate the household income earned from this activity. After an amount for savings and taxes was withdrawn from the household income earned in the first run, the remainder was spread over the relevant provincial consumer expenditure pattern and run through the model a second time. This second run provided an estimate of the "induced" impacts.

All dollar values presented in this analysis are measured in constant 1997 dollars. All employment or jobs are expressed in "person-years". It is important to note that the results of economic models should only be viewed as estimates and not absolutes."

b) The FEIS must include a discussion of the "boom and bust" impacts of a short-term project, as well as the socio-economic implications of a longer-term project.

At present any discussion related to this portion of the project assessment seems to be buried in the document. There is a definite need to clearly outline the existing impacts of a project of this nature to clearly assess whether this project, as it has been proposed is of a national and regional interest.

MHBL comment:
Extract from SD E3
"The jobs offered by Miramar Hope Bay Ltd. are all, under the assumptions used in this EIS, for less than three years; indeed some will be for only four months. This project can be compared to a dam construction program in southern Canada or to recent seismic surveys in the Mackenzie Delta that took place at a frenzied pace during the winters of 2000-2001 and 2001-2002 but have since declined to a few a year. In the latter example, the consultants personally observed that the communities of the Delta felt stressed during the period of high activity but missed it when it disappeared (R. Hornal, Pers. Comm.)."

The project will generate 400 person years of employment over three years and spend approximately $30 million per year. These jobs and this income are regionally significant as the total employment income for the region in 2001 was $54.5 million (RHA, 2003). The income generated for the company will permit an expanded exploration program for the rest of the Hope Bay Belt which may result in additional ore deposits being delineated.

On a national scale the Doris North Project will not make a significant contribution to the GDP.

c) **The FEIS must include additional socio-economic impact indictors such as impacts to country foods, crime/violence rates, and other health and wellness indicators.**

The proponent has not addressed this requirement of the guidelines. The indicators identified in the FEIS appear to be limited to those which were previously identified in the Draft Impact statement's assessment of the socio-economic impacts.

MHBL comments:
See SD E3 Pages 12 to 15. The consultants believe that because of the short term nature of the Project and its small footprint there will be no significant impact on the harvest of country foods.

Additional work is still required in the development of a socio-economic monitoring strategy to fulfill the requirements of the guidelines. As mentioned previously, indicators should be clearly linked to the VSECs, potential impact and impact effects, mitigation, and residual impacts.

See comments under section 4.8 of this document.

MHBL comment:
Please see answers provided for section 4.8

d) The FEIS must include a discussion of the impact of in-migration on local communities.

The proponent discusses the issue of in-migration on the region's communities as a whole; further information and rationale supporting the assessment of demographic impacts is still lacking. The original assessment in the draft impact statement indicated that a 2% increase in the demographic baseline was indicative of a significant impact (based on Yellowknife's demographic change), where it is now defined in the final impact statement as a 10% increase in the baseline. Specifically, details that support the proponent's change of criteria as they relate to the magnitude of demographic impacts should be substantiated.

MHBL comment:
The criteria used to evaluate the significance of any change were changed from those used in the draft document to conform with the criteria used in the environmental sections of the FEIS. (See Appendix A, page 26 in SD E3.)

Efforts to discuss the potential demographic impacts from indirect and induced employment could also be elaborated on and included in the assessment. Conservative estimates are incorporated into the assessment of potential impacts, which would support the proponent's commitment to implementing the precautionary principle in areas where their may be insufficient data and/or information to clearly define the potential impacts of a project.

MHBL comment:
The Doris North Project will last for a maximum of four years. Kitikmeot residents will accept positions at the Project site. Some of these will abandon jobs they have in their communities. It is the opinion of the consultants that there are enough unemployed people in the communities to replace those who have abandoned their positions.
Table 4.7 of SD E3 suggests that there will be 47 person years of indirect employment and 33 person years of induced employment in the northern territories as a result of this Project. Should these 80 person years all be hired from the Kitikmeot Region, this would reduce the 2001 unemployment rate by 21% to 15.6%.

Additionally the original assessment (Draft impact statement) identifies demographic changes as an indicator of community impacts given the increased demand that a larger population has on government services such as education, health, social services and infrastructure facilities. If these services are of value to the community and residence of the region, and they are potentially subject to the impacts from the project, they should be identified as a Valued Socio-Economic Component (VSEC) for the purposes of the impact assessment.

MHBL comment:
The consultants concluded that the impacts of demographic change as a result of this project would be minor to non existent (SD E3, page 16). Therefore, the impact on government services would also be minor.

e) **The FEIS must include the identification of appropriate management and mitigation measures.**

The proponent has listed a number of potential mitigation measure that could be employed by a number of agencies should it be required; however, there is no discussion about how these mechanisms work, nor their effectiveness at addressing potential impacts related to the VSECs. Additionally, it is unclear how the implementation of these mechanisms are linked to the indictors identified in the proposed project monitoring, an important component of appropriate management.

MHBL comment:
The consultants believe that it is inappropriate for them to prescribe solutions to the company and the local and territorial governments. The list of mitigative measures is illustrative of measures that have been used effectively elsewhere.

6. Public Consultation and Traditional Knowledge

NIRB Issue 6: Deficiencies in public consultation elements including: the lack of a continuing dialogue between the Proponent and the affected communities; the absence of the TKR in the DEIS; and the lack of integration of traditional knowledge and public comments into the DEIS.

a) The FEIS must document where, how, why and with whom public consultation was conducted and the Proponent's efforts to provide feedback to the communities on how the information that they provided was used in the FEIS.

It is acknowledged the proponent has made substantial efforts to inform the affected communities about the project and exploration at the site. INAC is aware these efforts are continuing, however, there continues to be little evidence to indicate these information updates are consultation. The proponent has not demonstrated that it has asked for and received information regarding the project, its design and the management of effects. Further, there continues to be little evidence that the input that has been received by the communities has been incorporated into the FEIS or that this is fed back to the communities. It appears the proponent is unable to conform to this requirement, as the approach to meeting with the communities did not intend to achieve these goals. Therefore, while the FEIS does not conform to this requirement, it is unlikely the proponent will be able to improve on the information provided to date.

b) The FEIS must document how public consultation contributed to: identifying current and historical patterns of land and resource use; identifying VECs and VSECs; determining criteria for evaluating the significance of potential impacts; deciding upon mitigating measures; formulating compensation packages; and identifying and implementing monitoring measures.

The Inuit Qaujimajatuqangit study (SD E1) has provided some of the information that could be used by MHBL to conform to this requirement (particularly current and historical patterns of land and resource use, identifying VECs, deciding upon mitigation measures, identifying monitoring measures) but it has not been incorporated into the FEIS. The proponent has not demonstrated how information obtained from other meetings with communities has been used for these purposes. Therefore, the FEIS does not conform, although some information is available to the proponent to address this requirement.

c) The FEIS must describe the communications programme that will be implemented if the Project is approved, with particular reference to initiatives to communicate changes to information, plans or strategies, and public involvement in the design of management and monitoring strategies

MHBL has mentioned hiring community liaison officers for ongoing communication with the communities, but has not described a communications programme. The Inuit Qaujimajatunqangit study provided some direction for the proponent to consider with respect to communication and consultation. In the conclusion to the study the proponent commits to looking at way to provide Inuit access to information generated from on-going studies in the area that may be needed for Inuit to made sound and educated decision (SD E1, page 68), but does not go so far as to commit to the development of a communications programme. Therefore, the FEIS does not conform to this requirement.

MHBL comment:
Ongoing consultation with KIA and Inuit in the Kitikmeot Region of Nunavut is an item to be addressed in the IIBA under negotiation between KIA and MHBL pursuant to the NLCA Article 26.

d) Address fully all of the components of Guideline 4.4 relating to traditional knowledge. Instead of simply submitting a copy of the TKR, the findings of the report must be incorporated into the body of the FEIS.

The effort the proponent undertook to conduct the Inuit Qaujimajatuqangit study is to be commended, particularly as it is apparent the results of the Naonayaotit Traditional Knowledge Study will not be available for use in this assessment. Although the proponent has stated the results of the study are incorporated into the FEIS, it is impossible to identify where this may be the case. A clearer statement of where and how this information has been used is necessary to fully conform to this requirement.

7. Life and Scope of the Project

NIRB Issue 7: The question of the anticipated life and scope of the project as it affects the project definition and the cumulative effects assessment.

a) The FEIS must contain a clarification of the projected life of the mine in the Project definition section.

The Doris North project life is clearly stated. However, only a weak argument is presented SD A3 concerning future development. Future development seems likely given the identified resources in the area. Development of those resources may require a significant modification to the mining plan because of water management issues. Without these modifications, significant impacts could arise.

b) The FEIS must address the issue of cumulative effects of extended operations at the site itself, including increased access to the area during operations and post closure monitoring.

The cumulative effects analysis will have to be revised if the project extends beyond the 2-3 year proposed lifespan. Much of the cumulative environmental effects discussion relies on the short-term nature of the project, and therefore, evaluates the impacts from that perspective i.e., duration of residual impacts. In other words, the temporal evaluation was limited to the 2-3 year lifespan.

MHBL comment:
The comment from Section 2 above is repeated below.

Future Development

The issue of future development on the Hope bay greenstone belt is a common theme in numerous comments from INAC and other interveners. It is addressed in general terms here and more specifically as it applies to specific issues, ie. tailings containment capacity.

The capacity and configuration of the Doris North Project is intended to process ores from Hope Bay belt gold deposits that will be developed for production after the known resources at Doris North are exhausted. The site at Doris North and the size of the proposed mill and tailings containment were all selected and proposed for development as the optimum size and location for incremental production from other deposits on the Hope Bay greenstone belt. At this time all other known gold deposits on the belt are prospects with development potential that are the subjects of additional and ongoing exploration effort. The status of each is summarized below:

- Doris Central and Doris Connector, immediately adjacent to Doris North but under Doris Lake are suitably drilled to establish 820,000 tonnes containing 280,000 ounces; however, at this time they can not be considered mineable because most of these resources lie within the minimum 100 m boundary interval from a lake bottom as set within the mining regulations. The remaining resources in Doris Connector and Central (outside the 100 m boundary interval) are too widely spaced to support any conceptual mining scenario and will require significant time and money to upgrade confidence levels.

- Madrid resources are considered a work in progress. Resource modeling and the incorporation of 2003 drilling results completed in January 2004 have dramatically changed the view of the Madrid deposits (primarily Naartok and Suluk) from higher grade selective deposits to lower grade bulk deposits. Insufficient data are available to discuss potential mining scenarios at this time.
- Boston has resources totaling 4.0 million tonnes containing 1.6 million ounces. An internal study has determined that 1.5 million tonnes containing 660,000 ounces are sufficiently drilled to define mining zones, the majority of which are accessible from the existing ramp. Additional drilling is required to upgrade confidence in the resource status of the remaining 2.5 million tonnes.

Exploration successes in 2003 point to Boston as the source of incremental production after Doris North ores are exhausted. MHBL is currently developing a critical path, subject to feasibility studies and permitting, that could facilitate mining at Boston in time to haul stockpiled ores to Doris North in January, February, and March 2008. Miramar strongly believes that an additional 4 to 5 years of economic operations at Doris North are readily available with a further 5 to 10 years depending upon continued exploration successes and resource conversions, and given the nature and history of similar greenstone hosted gold deposits. The critical path for development at Boston has MHBL submitting a Preliminary Project Description to KIA, the Nunavut Water Board, and NIRB in Q1 2005 while completing the previously initiated Boston development feasibility study. MHBL is confident that the scale of development at Doris North, especially the designed capacity of Tail Lake, is justified by the development potential on the Hope Bay greenstone belt.

8. Cumulative Effects Assessment

NIRB Issue 8: The inadequacy of the cumulative effects assessment.

There has been considerable improvement over the draft submitted in 2003 and a re-organization of the material. However, elements of INAC's initial evaluation still holds for the cumulative effects evaluation of the Doris North project and should be considered as part of this response. In particular,:

- traceability and reproducibility of the evaluation; and
- relationship to regional planning.

Please note: This review of the inadequacy of the cumulative effects assessment did not consider the adequacy of the baseline information collected or the approach taken to collect baseline information. It was left to other reviewers to comment on the information collected. Despite this, the adequacy of some of the data is questionable and the conclusions drawn from this information should be suspect as a result. The wildlife data and the socio-economic data should be looked at. However, as requested, Miramar did qualify the limitations of their data in their limitations section.

On another note, the overall approach to the cumulative effects assessment could have been more consistent. It was difficult to trace the evaluation, if not impossible. However, given the remoteness of the project and the short time frame, it is likely that there are no cumulative effects, except possibly for the following: caribou, migratory birds, wolverine, grizzly bear and green-house gases (GHG). Therefore, a more thorough cumulative effects analysis is needed for these particular areas.

The cumulative effects assessment suffered from not establishing appropriate spatial boundaries for the VECs (particularly wildlife and birds) being examined. Effects to caribou should be considered or at least discussed for their home range. Considerable methodology and literature exists from other mining projects that could have been pulled into the discussion here. Likewise, migratory birds should be looked at across their home range and what it the cumulative effect of habitat loss in their breeding grounds and wintering grounds. Similar comments apply to wolverine and grizzly bear, particularly as these are COSEWIC species of special concern. Any discussion of cumulative impacts should be done on a population basis in Nunavut and the NWT. In none of the evaluation was any mention of displacement from preferred habitat made or zone of influence of project effects. Rarely is direct mortality the effect of concern. The appropriate wildlife management/regulatory agencies may wish to comment on this.

a) The FEIS must include an explicit listing of other past, existing, certain, and reasonably foreseeable project or activities in the area, and the rationale for including or not including them in the assessment.

Miramar did consider the other projects in the area reference in the EIS guidelines including reasonably foreseeable projects i.e., exploration projects on their own property. They did reference consideration, in some of their evaluation, the other major projects as identified by NIRB. The evaluation of the impacts of these projects was often thin and relied on distance between projects as justification for no impacts.

There is no evidence that they considered other exploration projects outside the Hope Bay belt (e.g., Wolfden Resources High Lake project north of Ulu or exploration on Victoria Island), outfitter camps or hunt camps. There is also no evidence that they sought information on past projects. DIAND Lands, Kitikmeot Inuit Association, or possibly the Nunavut Planning Commission could provide this type of information.

With respect to the socio-economic chapter (chapter 6), the consideration of other projects is implicit, not explicit and there is no evaluation for impacts.

The reference to the *Canadian Environmental Assessment Act* (CEAA) and its requirements is incorrect. The CEAA does require the consideration of reasonably foreseeable projects, as does NIRB.

MHBL comment:
FEIS section 5.1.4 addresses cumulative effects of a general nature as these may apply to all VECs considered in the FEIS. The Wolfden Resources Ulu and High Lake projects could have been included but would not have added any potential cumulative effects because these projects, like those discussed in the FEIS, will not interact with significant elements of the project specific VECs at Doris North because of location and distance. FEIS section 5.1.4 acknowledges that "…cumulative effects may occur due to ongoing MHBL mineral exploration on the Hope Bay belt." These are indicated and reviewed separately in FEIS section 5.2 where the potential interaction between the project and the physical and biological environment and related impacts are reviewed for each VEC individually.

b) The FEIS must explicitly identify the residual adverse cumulative effects of the Doris North Project.

No ***residual adverse cumulative effects*** were identified. Miramar did use the descriptors i.e., frequency, magnitude, timing, etc., consistently where they identified residual impacts from ***direct-effects***. The entire residual impact discussion related to identified direct-effects residual impacts. Residual impacts from direct effects were identified for air quality, water quality, fish and fish habitat.

Though not directly obvious, there was a tendency to confuse lack of impact significance for direct effects with there being a possibility for generating residual adverse cumulative impacts. In most cases, there was no evaluation for cumulative impacts i.e., water quality, ARD, fish and fish habitat, etc., only a discussion of the possibility that cumulative effects "may" occur where the mining program was extended on the Miramar Hope Bay belt property. Distance from other projects was most often identified as the reason for no cumulative impacts.

MHBL comments:

FEIS Table 5.2 summarizes the "Potential Interactions and Measurable Cumulative Effects" albeit not for each criterion used in the overall environmental effects assessment in section 5.0 generally. The table below focuses on potential cumulative effects from ongoing exploration and development on the Hope Bay belt for each VEC and environmental effects assessment criterion.

Potential and rating of measurable residual cumulative effects on VECs from ongoing mineral exploration and development on the Hope Bay belt.

VEC	Probability	Frequency	Magnitude	Timing	Spatial Extent	Duration	Reversibility	Ecosystem Functioning and Integrity	Resource to Meet Present and Future Needs	Adverse Impact Rating
Land	Certain+	Continuous	Low	All seasons	Local	Permanent	Not reversible	Minor	Capable	Minor
Permafrost	Certain+	Continuous	Low	All seasons	Local	Permanent	Not reversible	Minor	Capable	Minor
Air Quality	Certain+	Continuous	Low	All seasons	Regional	Permanent	Reversible	Minor	Capable	Minor
Noise	Certain	Continuous	Low	All seasons	Local	Permanent	Reversible	Minor	Capable	Minor
Hydrology	Improbable[1]	Infrequent	Low	All seasons	Local / Regional	Permanent	Reversible	Minor	Capable	Minor
Water Quality	Certain	Continuous	Low	Summer	Local	Permanent	Reversible	Minor	Capable	Minor
Aquatic Habitat: Freshwater	Moderate	Continuous	Low	All seasons	Local	Permanent	Reversible	Minor	Capable	Minor
Marine	Moderate	Infrequent	Low	Summer	Local	Short term	Reversible	Minor	Capable	Minor
Fish /Aquatic Organisms: Freshwater	Moderate	Continuous	Low	All seasons	Local	Permanent	Reversible	Minor	Capable	Minor
Marine	Moderate	Infrequent	Low	Summer	Local	Short term	Reversible	Minor	Capable	Minor
Vegetation/ Wildlife Habitat	Certain+	Continuous	Low	All seasons	Local/ Regional	Permanent	Not reversible	Minor	Capable	Minor
Wildlife	Moderate+	Continuous	Low	All seasons	Local/ Regional	Permanent	Reversible	Minor	Capable	Minor
Heritage Resources	Moderate+	Infrequent	Medium	All seasons	Local	Permanent	Not reversible		Capable	Minor

Notes: + denotes that predicted residual effect is incremental to that of Doris North // 1 on the basis of current knowledge for known ore bodies

It was difficult to evaluate the socio-economic cumulative effects. The VSECs selected were so broad and would not have allowed for any comparison with other projects. Further, their discussion did not appear to actually undertake an evaluation. It read more like a baseline discussion. Miramar did use the descriptors i.e., frequency, magnitude, etc. for the characterization of the direct effects, but it is unclear if they actually applied to residual cumulative effects.

c) The FEIS must employ a consistent approach to the cumulative effects analysis for both VECs and VSECs.

There are inconsistencies. In some cases, linkage statements are provided and key questions offered and in others not. For some VECs, a considerable amount of data was collected and for others not. Frequently, the cumulative effects section rolled-up a discussion and did not refer directly back to the residual effects resulting from a particular activity. For example, for ground nesting birds the direct effects issue was loss of ground nest habitat. In the cumulative effects section, there is no reference to habitat loss resulting from other projects. Likewise, since these are migratory species, some mention could have been made of the status of these species and their habitat worldwide. It may be that Miramar inferred this information from species at risk information.

MHBL comment:
The conservation status for each species whose range includes the Hope Bay belt, the life history, known presence in the project area, and distribution in Nunavut and beyond are reviewed in Supporting Document D2.

There is no apparent cumulative effects analysis for impacts on VSECs. Any evaluation is implicit not explicit.

d) The FEIS must provide additional justification for the assessment as "minor" of the potential for air emissions from the Project to cause cumulative effects.

Miramar did expand on their discussion of GHG contributions as a result of their project since their first draft. They indicate that the other nearest source of GHG is Ulu, which is outside the selected regional study area. Miramar currently classifies the direct effect of its contribution to GHG as “moderate” (p. 5-11). Its evaluation is based on the 3% increase to the Nunavut GHG contributions and an overall 0.002% increase to GHG nationally.

Correction needed. The air quality text indicates that there will be no change to air quality during decommissioning. This suggests that no vehicles, generators will be required during decommissioning. This is unlikely and therefore impact to air quality should be re-evaluated for decommissioning.

MBHL comment:

Section 4.2 of Supporting Document B3, page 28 states that …"*All air emission sources from the project site will be removed during site decommissioning and no sources will be present during the post-closure phase.*" The reviewer is correct to note that limited air emission sources will be present during the decommissioning phase, which will follow the cessation of milling. After an initial care and maintenance phase, a crew will be mobilized to the site to close out the underground mine and to disassemble process structures. During decommissioning, emissions sources will be limited to minimal power generation (~10% of the operational requirements), several light vehicles and the equipment required to disassemble the site. Since the air emissions during decommissioning will be significantly lower than those assessed for the operations phase, effects are expected to be less than during operations. The air quality assessment for the operations phase of the project concluded that there would be no significant residual air quality impacts attributed to the project.

The air quality assessment assigned a rating of "moderate" to the magnitude of the impact of greenhouse gas emissions (GHGs) during the operations phase of the project. As discussed above, the GHG emissions during decommissioning are expected to significantly decline (by up to 90%) compared to operating levels. This would reduce the project GHG contribution during the decommissioning phase to less than 1% of the Nunavut totals. As a result, the magnitude rating would change from "moderate" to "low" as defined in Table 5.1 of the FEIS. However, the current level of science still does not allow the quantification of possible environmental changes associated with emissions of GHGs. Therefore, no environmental consequence has been assigned to the emissions of GHGs.

e) The FEIS must identify appropriate mitigation measures.

Where residual effects were identified, the mitigation applied was a repeat of the mitigation proposed for the direct effects. Given that none of the effects were considered significant, this is suitable for now. In the future, where an impact is tending towards significant adverse then the mitigation measure would need to be revised.

f) Other comments

1. There was not always a clear relationship between the linkage identified and the analysis undertaken. This is particularly true for the wildlife section. For example, the linkage reviewing the effect on productivity and population sustainability (5-57), there is actually no evaluation for effects on productivity and population sustainability. The discussion repeated 1) the earlier discussion of impact on habitat, 2) focused on the possibility of direct kill i.e., hit by vehicles; 3) considered the fact that direct effects were minor and that no other projects were in the region.

2. The NIRB "guidelines" (October 2002) require consideration of how Project specific CEA fits into regional planning initiatives. There is a draft land use plan for the West Kitikmeot region. There is no discussion of how this project fits into the objectives of the draft land use plan. The land use plan speaks to mining initiatives and marine transportation.

MHBL comment:

MHBL met with NPC in January 2004 to review the current draft of the Kitikmeot Regional Land Use Plan. MBHL learned that there were significant revisions to the draft plan in progress and that it will not be in public circulation for review and comment until late March 2004.

3. Except for air, water, archaeological resources, there was no discussion of "*the incremental contribution of the Project to regional thresholds for VECs and VSECs, as established by the Proponent or by any other authoritative source, …*". (NIRB guidelines, p. 57)

4. The "guidelines" require a discussion of the relationship between impacts to the biophysical environment and "how this may influence socio-economic systems and how cumulative socio-economic effects might influence the regional environment". This evaluation/ discussion seems to be lacking from the report.

9. Project Alternatives

NIRB Issue 9: The lack of Project alternatives, particularly alternative tailings disposal methods.

a) **The FEIS must investigate and consider all alternative methods of project development including a full consideration of the "No-go" alternative.**
b) **The FEIS must fully document the data, assumptions and impacts of the alternatives identified, including the associated costs and biophysical, social, economic, and cultural impacts.**

No Project Alternative:
It seems sensible to limit the discussion of the no project alternative to social and economic conditions in affected communities, as it seems reasonable to assume the ecosystem in the study area will remain as it is without the project. However, the analysis of the no project alternative should proceed with a prediction and assessment with respect to the valued socio-economic components (VSECs) selected by the proponent. What is expected is a comparison of the impact of the project on VSECs against the change to the baseline conditions of the VSECs (if there will be one) if the project is not to proceed (over an appropriate time period justified by the proponent). This level of assessment is not provided.

Mining and Ore Processing:
Although the factors considered are listed, the analysis with respect to valued environmental components (VECs) is not evident. While the conclusion with respect to mining method appears reasonable, MHBL did not fully document the impacts of each alternative. For instance, if one method is predicting less waste rock how significant is this difference and what is the effect on the VECs (for instance, water quality)? In terms of ore processing, the proponent states that quality of effluent and treatability are factors considered, but it is not clear how each of these alternatives change the effect on VECs such as water quality.

Ore Stockpiles, Waste Rock Management:
No alternatives have been assessed.

MBHL comment:
The location of the ore stockpile has been determined based on the location of the ore processing plant, which has been sited such that it could be constructed on competent bedrock. Ore will be hauled from underground, and stockpiled in an area between the portal and the crushing plant. This area was selected due to the short above ground haul distance, and the ease of feeding the crusher. Within the general confines of the mill complex, the proponent believes that this location is the only viable alternative for the ore stockpile.
The proponent has considered three alternatives for waste rock management. The first alternative entails using all non-acid generating waste rock for general construction purposes. All acid-generating waste rock will be temporarily stored in a demarcated and contained area, and will then be disposed of under

ground. The alternative to underground disposal was permanent on-land disposal or deposition of the waste rock in the tailings impoundment. A permanent on-land waste rock pile was not desirable, as it would increase the long-term waster management risk for the site. Disposal of waste rock in Tail Lake was considered practical; however the dams would have to be raised, and the increased capital cost would be greater than using it as backfill.

Mill Tailings Disposal
See comments in part c.

Process Water Recycling
No alternatives have been assessed, although some information is provided in SD A5 that could support an alternatives assessment.

MHBL comment:
The proponent considered only two sources for process water; Doris Lake and Tail Lake reclaim water. The preferred approach is to use Tail Lake reclaim water since it reduces the water volume in Tail Lake, and since it is already an impacted water body, it reduces the overall environmental impact. It was however recognized, that there is a real possibility that reclaim water would not be available for the entire year, and therefore the final impoundment design has been based on using reclaim water for only 4 months of the year, with the remainder of the process water being drawn from Doris Lake. A sensitivity analysis of this on the Tail Lake water balance is presented in SD A4. The proponent does not believe that there are other viable alternatives to consider for process water recycling.

Transportation
With respect to bulk materials transport, there is no assessment of the impact of the two alternatives. It appears one alternative was been eliminated for economic reasons but little evidence is presented to support this choice.

With respect to transport of goods from the coast to the site, the location of the barge site was subject to some brief comments on the impact of disruption to fish habitat, but little evidence was presented to suggest the habitat disruption of a bridge or culvert, and the longer road required by the western barge site is less significant than that of the jetty proposed at the eastern site.

Therefore, the assessment of alternatives is not complete and does not conform to the NIRB requirement.

MHBL comment:
A number of different alternatives for barge off-loading and road access were considered by the proponent. These were documented in a report by SRK in August 2002. "Hope Bay Project, August 2002 Surface Infrastructure Site Visit Field Report Doris North Trial Operation". This report considered the following alternatives for surface infrastructure:
<u>Barge Landing & Lay-Down Area:</u>

Alternative 1 – Keep using the existing lay-down area used for exploration re-supply. This alternative would reduce the need to construct a Jetty since the bay is deep enough that barges could be pushed on directly onto shore. The primary disadvantage of this alternative is that and additional 1.5km long all-weather road would be required to circle the bay, and an additional clear span river crossing would have to be constructed.
Alternative 2 – The new Jetty as proposed in the FEIS, but with the lay-down area on the tundra 100m from the shoreline. The lay-down area was relocated to the rock quarry area due to the high ice-content in the soils immediately adjacent to the coastline. Although a suitable thermal pad can be constructed to protect the permafrost, it was felt that the potential impact of fuel spillage due to settlement of the pad would be too severe, and therefore a stable foundation was preferred.
Alternative 2 – The new Jetty area as proposed in the FEIS.

Tank Farm & All-Weather Road:
Alternative 1 – Temporary fuel pipeline from the coast to the mill. Under this alternative a temporary flexible fuel line would be placed on the tundra between the coast and the mill when fuel re-supply ships arrive. Fuel would then be pumped from the ships 4.5km across the tundra to the mill. The benefits of this alternative were reduced capital since an all-weather road was not needed. The proponent felt that this would be an extremely difficult alternative to get approved, and therefore did not pursue it further.

Alternative 2 – Permanent fuel pipeline from the coast to the mill. Under this alternative a permanent pipeline would be constructed between the coast and the mill, such that re-supply of the mill tank farms could be done at any time. The primary benefit of this alternative would have been reduced requirements for an all-weather road between the coast and the mill. An all-weather road would still be needed for daily inspections; however this road could be smaller than that required for fuel hauling trucks.

Alternative 3 – A 6 million litre tank farm at the coast and an additional 3 million litre tank farm at the mill. Under this alternative the proposal was to alleviate the need for a permanent all-weather road completely. Fuel would be off-loaded into the shore tank farm in the summer, and once a winter road could be established between the coast and the mill, the mill tank farm would be re-supplied.

Alternative 4 – The tank farm as proposed in the FEIS.

Table C following presents perceived interactions and potential impacts on each of the physical and biological VEC's by the various project alternatives considered. In each case the project component alternatives were compared against the base case (i.e. the preferred project alternative as presented in the final EIS). The interactions with the VECs and the potential impacts for the preferred alternatives were extensively presented in Section 5 of the final EIS. Table C focuses on comparing the interactions and potential impacts of each of the project component alternatives with the base case being the reference point. In other words the Table attempts to provide the reader with an indication of whether the potential impact of the alternative on each specific VEC that is applicable is either the same, less or greater than the potential impact for the preferred alternative.

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		**Mining**		**Waste Rock Management**		**Ore Processing**						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Physical Elements of Local Ecosystem												
Climate	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Land and Terrain	No further ground disturbance. Less impact on existing land and terrain	Base Case Covered in FEIS	Open Pit Mining will result in larger ground disturbance than U/G mining due to the surface disturbance caused by development of the open pit and from the required land used by waste rock dumps (open pit mining will generate more waste rock than U/G mining).	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case

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Geochemistry / Acid Rock Drainage	No waste rock generated, no tailings generated. No potential for increased release of ARD or metals to receiving waters.	Base Case Covered in FEIS	More waste rock generated, all PAG rock has to be stored on surface. Potential for greater release of ARD and metals however this can be mitigated by relocating PAG rock into the pit and flooding the pit to submerge all PAG rock	Permanent storage of all waste rock on surface increases the potential for release of acidic drainage and metals from PAG rock. Increased potential for release of contaminants to receiving environment.	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Permafrost	No disturbance of current permafrost regime.	Base Case Covered in FEIS	Open pit will disturb more surface land than U/G mining with the potential for greater disturbance of permafrost in the immediate area.	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		**Mining**		**Waste Rock Management**		**Ore Processing**						
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Air Quality	No emissions of dust, greenhouse gases or other contaminants. No further impact on local air quality.	Base Case Covered in FEIS	Larger blasts, all blasting activity exposed to surface air, potential for greater dust releases from blasting, loading and hauling of waste rock and ore resulting in increased risk of air emississions (dust and gasses from blasting)	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Reduced air emmissions due to no smelting on site resulting in potentially better air quality than base case.	Same as base case. No smelting on site but concentrate has to be dried before shipping replacing smelting emissions with dryer emissions.	Same as base case. No smelting on site but concentrate has to be dried before shipping replacing smelting emissions with dryer emissions.	Same as base case	Same as base case	Same as base case
Ground Water	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Hydrology	No change in surface hydrology patterns caused.	Base Case Covered in FEIS	Creation of open pit will create a hole that will likely fill with water after mining ceases resulting in the potential for localized change in surface runoff patterns.	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as bae case	Same as base case	Same as base case	Same as base case	Same as base case

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		**Mining**		**Waste Rock Management**		**Ore Processing**						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Water Quality	No generation of waste rock or tailings. No creation of sediment from mining activity. Consequently no potential for impairment of water quality.	Base Case Covered in FEIS	Potential for increased release of metals from surface waste rock dumps and pit walls. Potential for larger contaminant loadings from waste rock dumps resulting in greater impact on surface water quality in nearby watersheds than for U/G mining.	Increased risk of contaminant release to surface waters from PAG rock.	Base Case Covered in FEIS	Base Case Covered in FEIS	No use of cyanide in the mill. Potentially reduced risk of contaminant release from tailings impoundment. Potentially less impact on downstream water quality.	No use of cyanide in the mill. Potentially reduced risk of contaminant release from tailings impoundment. Potentially less impact on downstream water quality.	No use of cyanide in the mill. Potentially reduced risk of contaminant release from tailings impoundment. Potentially less impact on downstream water quality.	Cyanide leach of more material. Possibly greater use of cyanide. Potentially higher contaminant concentrations in final mill tailings slurry. Potentially increased risk of impact on downstream water quality.	Intensive cyanide of gravity conc. May use higher concentrations of cyanide. Possibly greater use of cyanide. Potentially higher contaminant concentrations in final mill tailings slurry. Potentially increased risk of impact on downstream water quality.	Same as base case

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		Mining		Waste Rock Management		Ore Processing						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Living Elements of Local Ecosystem												
Marine Organisms and Habitat	No shipment of bulk commodities to project site resulting in decrease risk of harm from potential spills. No construction within Roberts Bay resulting in less impact on the marine environment.	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Freshwater Oganisms and Habitat including Arctic char, lake trout and lake whitefish	No release of effluent. No use of freshwater. No stream crossings. Resulting in reduced risk to freshwater organisms and habitat.	Base Case Covered in FEIS	Same as base case	Increased risk of harm to freshwater organisms and habitat from potential acid rock drainage and metals released from PAG rock stored on surface over the longer term.	Base Case Covered in FEIS	Base Case Covered in FEIS	Potentially lower impact on downstream water quality resulting in lower impact on freshwater organisms and habitat.	Potentially lower impact on downstream water quality resulting in lower impact on freshwater organisms and habitat.	Potentially lower impact on downstream water quality resulting in lower impact on freshwater organisms and habitat.	Potentially greater impact on downstream water quality resulting in greater impact on freshwater organisms and habitat.	Potentially greater impact on downstream water quality resulting in greater impact on freshwater organisms and habitat.	Same as base case

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		Mining		Waste Rock Management		Ore Processing						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Fish Tissue Quality	No release of effluent, resulting in lower risk of impact to fish tissue metal concentrations in local water bodies.	Base Case Covered in FEIS	Same as base case	Increased risk to fish tissue from potential metals released from PAG rock stored on surface over the longer term.	Base Case Covered in FEIS	Base Case Covered in FEIS	Potentially lower impact on downstream water quality resulting in potentially lower impact on fish tissue quality in downstream watersheds.	Potentially lower impact on downstream water quality resulting in potentially lower impact on fish tissue quality in downstream watersheds.	Potentially lower impact on downstream water quality resulting in potentially lower impact on fish tissue quality in downstream watersheds.	Potentially greater impact on downstream water quality resulting in potentially greater impact on fish tissue quality in downstream watersheds.	Potentially greater impact on downstream water quality resulting in potentially greater impact on fish tissue quality in downstream watersheds.	Same as base case
Vegetation	No further ground disturbance. Less impact on existing vegetation.	Base Case Covered in FEIS	Larger ground disturbance will result in increased loss in vegetation from footprint of open pit and from larger waste rock dumps	Increased risk to vegetation from potential acid rock drainage and metals released from PAG rock stored on surface over the long term.	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case

Table C: (Part 1) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component		**Mining**		**Waste Rock Management**		**Ore Processing**						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Wildlife including caribou, muskox and carnivores	No further activity to disturb wildlife or damage habitat. Reduced potential of impact to existing wildlife habitat or wildlife movements in the project area.	Base Case Covered in FEIS	Larger ground disturbance from the open pit, creation of larger waste dumps on surface, resulting in potential for greater loss of habitat and barriers to wildlife movement. Increased noise from mining activity could cause wildlife displacement during mine operating life.	Increased risk of harm to wildlife and habitat from potential acid rock drainage and metals released from PAG rock stored on surface over the longer term.	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Caribou tissue quality	No release of effluent, resulting in lower risk of impact to caribou tissue metal concentrations in local project area.	Base Case Covered in FEIS	Same as base case	Increased risk to caribou tissue from potential metals released from PAG rock stored on surface over the longer term through vegetation uptake and ingestion of contaminated water.	Base Case Covered in FEIS	Base Case Covered in FEIS	Potentially lower impact on downstream water quality resulting in potentially lower impact on caribou tissue quality through water ingestion.	Potentially lower impact on downstream water quality resulting in potentially lower impact on caribou tissue quality through water ingestion.	Potentially lower impact on downstream water quality resulting in potentially lower impact on caribou tissue quality through water ingestion.	Potentially greater impact on downstream water quality resulting in potentially greater impact on caribou tissue quality through water ingestion.	Potentially greater impact on downstream water quality resulting in potentially greater impact on caribou tissue quality through water ingestion.	Same as base case

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Mine Component		**Mining**		**Waste Rock Management**		**Ore Processing**						
Alternative	**No Project Alternative**	**Underground Mining**	**Open Pit Mining**	**Permanent Storage on Surface**	**Relocate PAG Rock to UG**	**Gravity + Froth Flotation & Cyanide Leach**	**Gravity & Ship Conc.**	**Froth Flotation & Ship Conc.**	**Gravity + Froth Flotation & Ship Conc**	**Whole Ore Cyanide Leach**	**Gravity & Extract Gold on Site**	**Froth Flotation & Cyanide Leach**
Birds and bird habitat including raptors and migratory birds	No further activity to disturb birds or damage bird habitat. Reduced potential of impact to existing bird habitat or bird movements in the project area.	Base Case Covered in FEIS	Larger ground disturbance from the open pit, creation of larger waste dumps on surface, resulting in potential for greater loss of habitat. Increased noise from mining activity could cause bird displacement during mine operating life.	Increased risk of harm to birds and habitat from potential acid rock drainage and metals released from PAG rock stored on surface over the longer term.	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Heritage resources	No construction or further disturbance. Lower risk of damage to identified archaeological resources.	Base Case Covered in FEIS	Increased surface disturbance has potential to impact archaeological resources, however no resources were identified in the area of the potential pit and waste dumps.	Same as base case	Base Case Covered in FEIS	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case

Table C: (part 2) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	**Cyanide Detoxification**					**Tailings Disposal**						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
Physical Elements of Local Ecosystem												
Climate	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case
Land and Terrain	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	On land tailings impoundment would cover more land, resulting in greater impact on surface land but reduced impact on lake terrain.	Same as base case
Geochemistry / Acid Rock Drainage	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Sub aerial tailings storage could increase risk of contaminant release from tailings solids. This can be mitigated by constructing water retaining dams to allow material to be permanently stored under a water cover.	Same as base case

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Mine Component	Cyanide Detoxification					Tailings Disposal						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
Permafrost	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Doris Lake can accommodate more tailings volume so the lake level would not have to be raised. The lake level would not have to be raised so the existing talik zone would not expand. Potential for less impact on permafrost than base case.	Twin Lakes are smaller in area than Tail Lake and cannot accommodate all of the tailings generated. Raising level in Twin Lakes will cause flooding which will increase existing talik zone. Loss of permafrost is potentially less than the base case.	South Windy Lake is smaller in area than Tail Lake and cannot accommodate all of the tailings generated. Raising level in South Windy Lake will cause flooding which will increase existing talik zone. Loss of permafrost is potentially less than the base case.	Roberts Bay can accommodate all of the tailings without resulting in an increase in ocean level. The Bay level will not rise consequently there will be no added potential for impact on permafrost outside the existing talik zone.	No expansion of lake talik zones. Deposition of tailings slurry may thaw permafrost below tailings impoundment. Potential for greater impact on permafrost than base case.	No expansion of lake talik zones. Potential for less impact on permafrost than base case.
Air Quality	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Sub aerial tailings deposition could result in more exposure of dry tailings to wind action. Increased risk of wind erosion of exposed tailings. Increased risk of air quality impacts due to dust release.	Same as base case

Table C: (part 2) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Cyanide Detoxification					Tailings Disposal						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
Ground Water	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Twin Lakes watersheds are located on a natural high, draining into Ogama and Doris watersheds. Increased risk of groundwater release from Twin Lakes impoundment to these watersheds.	Same as base case	Same as base case	Thawing of permafrost under tailings impoundment could create new talik zone. Potential seepage of tailings porewater into new talik zone. Impact likely restricted to immediate area of impoundment.	Placement of tailings UG could cause thawing of permafrost. Potential release of tailings pore water into surrounding rock. Impact likely short term and very localized.
Hydrology	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Reduced water storage volume available in Doris Lake, resulting in reduced retention time in Doris Lake. Likely no impact volume released from Doris Lake. No impact on Tail Lake hydrology. Overall potentially less impact on hydrology than base case.	Twin Lakes watersheds are smaller than Tail Lake watershed. Potentially less overall change in hyrology in area.	South Windy Lake watershed is smaller than Tail Lake watershed. Potentially less overall change in hyrology in area.	No impact on fresh water systems hydrology. Potentially less impact on hydrology.	No impact on fresh water systems hydrology. Potentially less impact on hydrology.	No impact on fresh water systems hydrology. Potentially less impact on hydrology.

Table C: (part 2) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	**Cyanide Detoxification**					**Tailings Disposal**						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
Water Quality	Base Case Covered in FEIS	Same as base case	Potential generation of chloramine by-products. Increased risk of release of these contaminants into the downstream receiving waters.	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Potential metal release impacts associated with tailings effluents are transferred from freshwater to the marine environment where greater dilution is available and pH levels are higher possibly increasing precipitation of metals. Potentially less water quality impacts.	No impact on existing freshwater resources in any project lakes. Effluent will still have to be released into receiving waters. Contaminant loadings will be the same as the base case.	No impact on existing freshwater resources in any project lakes. Effluent will still have to be released into receiving waters. Contaminant loadings will be the same as the base case.

Table C: (part 2) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Cyanide Detoxification					Tailings Disposal						
Alternative	Caro's Acid	Ferrous Sulphate	Alkaline Chlorination	Hydrogen Peroxide	Sulphur Dioxide Air	Sub-Aqueous Deposition in Tail Lake	Sub-Aqueous Deposition in Doris Lake	Sub-Aqueous Disposal in Twin Lakes	Sub-Aqueous Disposal in South Windy Lake	Submarine Disposal in Roberts Bay	Sub-Aerial Deposition in Surface Impoundment	Mine Backfill
Living Elements of Local Ecosystem												
Marine Organisms and Habitat	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Direct deposition of tailings and treated effluent into the marine environment. Increased loading of contaminants directly into the marine environment. Increased impact likely to marine organisms and habitat in Roberts Bay than base case.	Same as base case	Same as base case

Table C: (part 2) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Cyanide Detoxification					Tailings Disposal						
Alternative	Caro's Acid	Ferrous Sulphate	Alkaline Chlorination	Hydrogen Peroxide	Sulphur Dioxide Air	Sub-Aqueous Deposition in Tail Lake	Sub-Aqueous Deposition in Doris Lake	Sub-Aqueous Disposal in Twin Lakes	Sub-Aqueous Disposal in South Windy Lake	Submarine Disposal in Roberts Bay	Sub-Aerial Deposition in Surface Impoundment	Mine Backfill
Freshwater Oganisms and Habitat including Arctic char, lake trout and lake whitefish	Base Case Covered in FEIS	Same as base case	Increased risk of release of chloramine compounds resulting in increased risk of harm to freshwater organisms downstream.	Same as base case	Same as base case	Base Case Covered in FEIS	Deposition of tailings over a larger freshwater lake area. Likely greater impact to freshwater organisms and habitat than base case. Quantity and quality of freshwater resources impacted is greater than base case.	Deposition of tailings over a smaller freshwater lake area. Likely less impact to freshwater organisms and habitat than base case.	Deposition of tailings over a smaller freshwater lake area. Likely less impact to freshwater organisms and habitat than base case.	No impact on freshwater organisms and habitat from tailings deposition. Impacts are transferred to the marine environment.	No direct impacts on freshwater organisms and habitat from tailings deposition. Effluent must be released into receiving environment but overall impacts to freshwater organisms and habitat is likely less than base case.	No direct impacts on freshwater organisms and habitat from tailings deposition. Effluent must be released into receiving environment but overall impacts to freshwater organisms and habitat is likely less than base case.
Fish Tissue Quality	Base Case Covered in FEIS	Same as base case	Chloramine compounds could increase harm to fish tissue	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case. Impacts transferred to marine species and andranomous species such as Arctic char.	Same as base case	Same as base case
Vegetation	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	No flooding through rising lake levels consequently no loss of vegetation around perimeter of lake. Less impact on	Less flooding through rising lake levels consequently less loss of vegetation around perimeter of lakes. Smaller watershed.	Less flooding through rising lake levels consequently less loss of vegetation around perimeter of lakes. Smaller watershed.	No flooding through rising lake levels consequently no loss of vegetation around perimeter of lake. Less impact on	Loss of vegetation under the tailings impoundment. More land disturbance than base case. Increased loss of vegetation than base case.	No loss of vegetation through flooding. Less impact or loss of vegetation than base case.

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Mine Component	Cyanide Detoxification					Tailings Disposal						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
							vegetation than base case.	Less impact on vegetation than base case.	Less impact on vegetation than base case.	vegetation than base case.		
Wildlife including caribou, muskox and carnivores	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	No flooding through rising lake levels consequently no loss of habitat. Potential loss of a larger lake area for drinking water. Potentially less impact on wildlife than base case	Less area flooded than base case consequently potentially less loss of wildlife habitat. Potentially less impact on wildlife than base case.	Less area flooded than base case consequently potentially less loss of wildlife habitat. Potentially less impact on wildlife than base case.	No loss of wildlife habitat. Potentially less impact on wildlife than base case.	Greater loss of land area, consequently greater loss of wildlife habitat. Potentially greater impact on wildlife than base case.	No loss of wildlife habitat. Potentially less impact on wildlife and wildlife habitat than base case.
Caribou tissue quality	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	No contaminant loadings into freshwater. Potentially less risk of metals ingestion through drinking water and vegetation. Potentially less impact	Same as base case	No deposition of tailings into any freshwater lake or marine environment. Treated effluent would have to be discharged to the freshwater receiving environment. Loadings will be similar to

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Mine Component	**Cyanide Detoxification**					**Tailings Disposal**						
Alternative	**Caro's Acid**	**Ferrous Sulphate**	**Alkaline Chlorination**	**Hydrogen Peroxide**	**Sulphur Dioxide Air**	**Sub-Aqueous Deposition in Tail Lake**	**Sub-Aqueous Deposition in Doris Lake**	**Sub-Aqueous Disposal in Twin Lakes**	**Sub-Aqueous Disposal in South Windy Lake**	**Submarine Disposal in Roberts Bay**	**Sub-Aerial Deposition in Surface Impoundment**	**Mine Backfill**
										on caribou fish tissue quality than base case.		the base case, consequently impacts to caribou tissue quality through water ingestion will be the same as for the base case.
Birds and bird habitat including raptors and migratory birds	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	No increase in lake levels. No loss of shore habitat. No loss of lake habitat. Potentially less impact on birds and bird habitat than base case.	Less flooding of shoreline than base case, consequently potentially less loss of shore habitat. Potentially less impact on birds and bird habitat than base case.	Less flooding of shoreline than base case, consequently potentially less loss of shore habitat. Potentially less impact on birds and bird habitat than base case.	No increase in lake levels. No loss of shore habitat. No loss of lake habitat. Potentially less impact on birds and bird habitat than base case.	Increased loss of land and thus potentially increased loss of land habitat for birds. No impact on lake habitat. Potentially greater impact on birds and bird habitat than base case.	No increase in lake levels. No loss of shore habitat. No loss of lake habitat. Potentially less impact on birds and bird habitat than base case.
Heritage resources	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case	Same as base case

Table C: (Part 3) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Process Water Recycle			Transportation				Barge Offloading	
Alternative	**Partial Recycle in Mill**	**No Recycle in Mill**	**Full Recycle in Mill**	**Annual Sealift**	**Winter Road**	**Air Transport Only**		**South End of Roberts Bay**	**West Side of Roberts Bay**
Physical Elements of Local Ecosystem									
Climate	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Land and Terrain	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Potentially greater land disturbance through construction & operation of winter road. Potentially greater impact to land disturbance than base case.	Potentially less land disturbance through construction & operation of roads. Potentially less impact to land disturbance than base case.		Base Case Covered in FEIS	Increased land disturbance required to construct longer road to connect to barge offloading site. Potential for greater impact than base case.
Geochemistry / Acid Rock Drainage	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Permafrost	Base Case Covered in FEIS	More water to be stored in tailings impoundment. Increased flooding of shoreline, consequently increased expansion of talik zone. Potentially increased impact on permafrost than base case.	Less water to be stored in tailings impoundment. Reduced flooding of shoreline, consequently less expansion of talik zone. Potentially less impact on permafrost than base case.	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Air Quality	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Potentially increased emissions (dust and exhaust gasses) from more trucks required to haul materials to project site. Potentially increased air quality impacts than base case.	Potentially increased emissions (dust and exhaust gasses) from more aircraft required to haul materials to project site. Potentially increased air quality impacts than base case.		Base Case Covered in FEIS	Increased hauling distance from barge off loading site to project site. Increased dust and vehicle emissions from longer haul distance. Potential for greater impact than base case.

Table C: (Part 3) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	**Process Water Recycle**			**Transportation**				**Barge Offloading**	
Alternative	**Partial Recycle in Mill**	**No Recycle in Mill**	**Full Recycle in Mill**	**Annual Sealift**	**Winter Road**	**Air Transport Only**		**South End of Roberts Bay**	**West Side of Roberts Bay**
Ground Water	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Hydrology	Base Case Covered in FEIS	Increased withdrawal of water from Doris Lake. Increased effluent to be released from tailings impoundment. Potentially increased impacts on hydrology of Doris Lake and outflow than base case.	Decreased withdrawal of water from Doris Lake. Decreased effluent to be released from tailings impoundment. Potentially liss impact on hydrology of Doris Lake and outflow than base case.	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	One additional large stream crossing required to access this site. Potential disturbance can be mitigated by construction of clear span bridge. With mitigation potential impact is the same as the base case.
Water Quality	Base Case Covered in FEIS	Potentially less dilution water in Doris outflow. Increased outflow from Tail Lake. Loadings should be similar. Potentially greater impacts on water quality in Doris outflow below discharge point.	Potentially greater dilution water in Doris outflow. Potential decrease in outflow from Tail Lake. Loadings should be similar. Potentially less impact on water quality in Doris outflow below discharge point.	Base Case Covered in FEIS	Inreased risk of sediment release from longer winter road during spring freshet. Increased risk of spillage from accidents & malfunctions from increased number of trucks as compared to the base case. Potentially greater impact on water quality than base case.	Lower risk of spillage from accidents and malfunctions. Potentially lower risk of impact on water quality than the base case.		Base Case Covered in FEIS	Same as base case
Living Elements of Local Ecosystem									

Table C: (Part 3) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Process Water Recycle			Transportation				Barge Offloading	
Alternative	**Partial Recycle in Mill**	**No Recycle in Mill**	**Full Recycle in Mill**	**Annual Sealift**	**Winter Road**	**Air Transport Only**		**South End of Roberts Bay**	**West Side of Roberts Bay**
Marine Organisms and Habitat	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	No risk of impact on marine environment from spills or accidents as winter road would come overland from the south avoiding the ocean. Less risk of impact than the base case. Risk transferred to freshwater environment.	No risk of impact on marine environment from spills or accidents as flights would come overland from the south avoiding the ocean. Less risk of impact than the base case. Risk transferred to freshwater environment.		Base Case Covered in FEIS	Smaller offloading jetty required at this site due to the presence of deeper water. Potentially less impact on the marine environment and associated habitat.
Freshwater Oganisms and Habitat including Arctic char, lake trout and lake whitefish	Base Case Covered in FEIS	Loadings in effluent discharged from tailings impoundment will likely be the same as the base case but available dilution water from Doris Lake may be lower. This would be mitigated by reducing discharge rates from Tail Lake. Likely impacts on freshwater organisms and habitat would be the same as the base case.	Same as base case	Base Case Covered in FEIS	Increased risk of spills into freshwater from winter road. Increased risk to freshwater environment than base case. Risks transferred from the marine environment.	Lower risk of spillage from accidents and malfunctions. Potentially lower risk of impact on freshwater than the base case.		Base Case Covered in FEIS	Additional stream crossings increases risk of harm from accidental spillage.
Fish Tissue Quality	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Vegetation	Base Case Covered in FEIS	Potentially more flooding of shoreline required in Tail Lake resulting in potentially greater loss of vegetation. Potentially greater impact on vegetation than base case.	Potentially less flooding of shoreline required in Tail Lake resulting in potentially less loss of vegetation. Potentially less impact on vegetation than base case.	Base Case Covered in FEIS	Increased potential for vegetation disturbance through construction and operation of winter road.	Decreased potential for vegetation disturbance through avoiding construction of the all weather road to Roberts Bay and the associated lay down areas.		Base Case Covered in FEIS	Required road construction is greater to access this site. Loss of vegetation due to road construction will be greater.

Table C: (Part 3) Doris North Project - Summary Of Impacts By VEC Associated With Doris North Project Alternatives

Mine Component	Process Water Recycle			Transportation				Barge Offloading	
Alternative	**Partial Recycle in Mill**	**No Recycle in Mill**	**Full Recycle in Mill**	**Annual Sealift**	**Winter Road**	**Air Transport Only**		**South End of Roberts Bay**	**West Side of Roberts Bay**
Wildlife including caribou, muskox and carnivores	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Increased risk of accidental contact with wildlife on the winter road. Increased risk of disturbing wildlife movements and habitat through construction and operation of the winter road. Potentially greater impact on wildlife than base case.	Increased noise from higher air traffic to and from site. Increased risk of contact with wildlife at site airstrip from higher traffic levels. Potentially greater impacts on wildlife than base case.		Base Case Covered in FEIS	Longer haul distances will increase risk of contact with wildlife. Additional road construction will increase potential for disturbance of wildlife habitat and movements.
Caribou tissue quality	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Same as base case	Same as base case		Base Case Covered in FEIS	Same as base case
Birds and bird habitat including raptors and migratory birds	Base Case Covered in FEIS	Increased loss of land and thus potentially increased loss of land habitat for birds. Potentially greater impact on birds and bird habitat than base case.	Decreased loss of land and thus potentially decreased loss of land habitat for birds. Potentially lower impact on birds and bird habitat than base case.	Base Case Covered in FEIS	Increased risk of accidental contact with birds on the winter road. Increased risk of disturbing bird habitat through construction and operation of the winter road. Potentially greater impact on birds than base case.	Increased noise from higher air traffic to and from site. Increased risk of contact with birds at site airstrip from higher traffic levels. Potentially greater impacts on birds than base case.		Base Case Covered in FEIS	Additional road construction will increase potential for disturbance of bird habitat and movements.
Heritage resources	Base Case Covered in FEIS	Same as base case	Same as base case	Base Case Covered in FEIS	Increased land disturbance from construction of the longer winter road. Potential for greater impact on heritage resources than base case.	Decreased land disturbance by avoiding construction of road to Roberts Bay and lay down facilities at Roberts Bay. Potential for disturbance of heritage resources remains the same as the base case.		Base Case Covered in FEIS	There are a number of heritage resources along the shoreline of Roberts Bay. The additional road construction required to access this site increases the risk of impacting these resource sites.

c) The FEIS must investigate and consider all alternative methods of tailings disposal, including land-based and underground tailings disposal, and other sub-aqueous locations.

Various tailings disposal methods were evaluated in Supporting Document A5, Appendix 3A. These included: subaqueous disposal in Tail Lake, Windy Lake and Doris Lake, submarine disposal in Roberts Bay, subaerial deposition and underground mine backfill. This should satisfy NIRB requirements.

In the selection process, however, the Proponent fails to properly consider all the environmental impacts associated with each of the various options. For instance, the selected option of subaqueous disposal in Tail Lake ignores the potential for long term permafrost degradation and associated impacts and mitigation requirements. By avoiding the wet cover of 3 m, the Proponent would eliminate the need to construct dams and avoids the potential for large scale permafrost degradation around Tail Lake (see Section 4.7, part e of this document). The potential long-term mitigation costs required to address permafrost degradation could be balanced against the increased cost of other tailings disposal measures such as landbased/dry cover options, which do not have these potential impacts.

Since the impacts of each of the various alternatives were not considered in the selection process, this component of the FEIS is found to be deficient.

MBHL comment:
A revised and updated "Table 1: Summary of Hope Bay Doris North Tailings Disposal Alternatives" originally presented in SD B5, will be prepared and presented prior to the Technical Meetings Scheduled for March 29 – April 2, 2004.

d) The FEIS must contain a risk assessment to justify the selection of Tail Lake as the tailings disposal location.

The Proponent has completed a human health and ecological risk assessment of the tailings disposal options (Supporting Document F2). This document only partially satisfies the NIRB requirements.
A geotechnical risk assessment is also required to justify the selection of Tail Lake as the tailings disposal location and was not provided in the FEIS and supporting documents. This risk assessment would address the potential for long-term permafrost degradation associated with the operation and closure of the proposed Tail Lake tailings disposal facility.

MBHL comment:
A revised and updated "Table 1: Summary of Hope Bay Doris North Tailings Disposal Alternatives" originally presented in SD B5, will be prepared and presented prior to the Technical Meetings Scheduled for March 29 – April 2, 2004.