Environment Canada **Environnement Canada**

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January 21st, 2008

Our file:

Mackenzie Valley Land and Water Board
7th Floor – 4910 50th Ave.
P.O. Box 2130
Yellowknife, NT X1A 2P6

Attention: Kathleen Graham, Regulatory Officer

Re: Type "A" Water Licence Application, MV2007L8-0031 (Preliminary Screening)
Giant Mine Remediation Plan (SRK Consulting, July 2007)
Indian and Northern Affairs Canada, Giant Mine Remediation Project

Dear Ms. Graham,

On behalf of Environment Canada (EC), I have reviewed the above noted application & accompanying Remediation Plan (the "Plan") submitted by DIAND, Contaminants and Remediation Directorate to the Mackenzie Valley Land and Water Board (MVLWB). EC's contribution to your request for specialist advice is based primarily on the mandated responsibilities of Section 36(3) of the *Fisheries Act*, the *Species at Risk Act*, the *Canadian Environmental Protection Act* and the *Migratory Birds Convention Act*. On the basis of the information provided, Environment Canada believes that the above noted project has the potential to affect fish pursuant to the *Fisheries Act*.

Background:

The proponent is proposing to carry out remediation activities of an abandoned contaminated gold mine located in Yellowknife, NT approximately 5km north of the city centre. The Giant Mine site lies along the western shore of Yellowknife Bay, an arm of Great Slave Lake. The application is for a Type "A" water license for a sufficient period of time to implement the Remediation Plan, carry out interim care & maintenance, the transition to a new water treatment system and a period of ongoing maintenance and monitoring. The proponent has applied for water use in the following areas: 1) to obtain water, 2) to modify the bed or bank of a watercourse, 3) to diver water, and 4) mine water management and water treatment.

In addition, it should also be noted that the 2005 version of the *Draft Giant Mine Remediation Plan* was reviewed by Federal Contaminated Sites Action Plan (FCSAP) Expert Support Departments, i.e. Environment Canada, Fisheries & Oceans Canada, and Health Canada in June 2005. The purpose of the review was to provide advice to the Custodial Department (i.e. DIAND), with the objective of reducing risks to human health and the environment. The scope of EC's review included the Main Document, and various Supporting Documents including *"Tier 2 Risk Assessment"*, (SENES Consulting Ltd., 2005). Technical comments were

submitted to DIAND on June 22nd, 2005 with a formal response from INAC shortly thereafter on the sections where revisions were made (attached).

EC believes that the concerns raised in June 2005 were, in general, adequately addressed. However, under the Section "Openings to the surface" (response table, pg 2), EC would suggest that once flooding occurs and any such holes begin to flow, that their quality be confirmed as benign. This could be specifically addressed in the future and a single campaign to monitor water quality could be sufficient.

General comments:

1). The proponent shall not deposit, nor permit the deposit of chemicals, sediment, wastes, or fuels associated with the project into any water body. According to the *Fisheries Act, Section 36 (3)*, the deposition of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any deleterious substance that results from the deposit of the deleterious substance, may enter any such water, is prohibited.

2). Section 3.2 & 5.2 of the Plan, "Other Underground Mine Components" states that *"Prior to discharge, the treated water will be monitored to ensure that it meets MMER and Environmental Effects Monitoring (EEM) criteria as well as the requirements of the water license"*. To clarify, for the EEM program, there are requirements regarding the necessary monitoring to be conducted (tests and parameters), however there are no criteria in terms of environmental performance or water quality.

Hazardous Material

3). Section 5.12, Waste Storage and Disposal Areas (pg 187) doesn't specifically address the disposal method for hydrocarbons (however options are discussed in Supporting Document I2). EC recommends that this Section be expanded to include an identified disposal option for hydrocarbons.

Section 5.12, Waste Storage and Disposal Areas (pg. 187) indicates that hazardous materials would be disposed of in several locations including 1). the NW Tailings Pond, 2). underground, and 3). off-site disposal and treatment.

4). EC notes that the Proponent has not proposed a hazardous landfill as part of the on-site disposal options within the Plan. However if, in the future, a hazardous landfill is considered, EC would suggest that the Proponent refer to the recently published CCME document entitled, *"National Guidelines for Hazardous Waste Landfills" (2006)* that presents the National Guidelines for "engineered hazardous waste landfill facilities". The Guidelines are not only for the use of regulatory agencies but also for hazardous waste management system designers, owners and operators. Topics include wastes characteristics, affecting landfill design, site selection, design and construction, operations and performance monitoring, closure and post-closure care, contingency and mitigation planning, and financial assurances and record keeping.

Storage Tank Regulations

5). Environment Canada has proposed to repeal the existing *"Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands and Aboriginal Lands Regulations"* and replace it with a Regulation that has a broader scope of application. The new Regulation under the *Canadian Environmental Protection Act* (1999), Part 9 will incorporate mandatory technical requirements (secondary containment, leak detection, corrosion protection, overfill, spill containment) and be more in line with those regulations that already exist in most provincial and territorial jurisdictions. Compliance with the proposed regulations will be mandatory, and EC will conduct inspections to ensure compliance with the Regulations. These new regulations are based on the 2003 CCME Guidance document PN 1326 *"Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing*

Petroleum and Allied Petroleum Products". Environment Canada encourages the Proponent to consult this document and ensure that the existing tanks and related containment system are designed and operated in accordance with it.

Reclamation Objectives & Closure Criteria/Performance Measures

As described in DIAND's *Mine Site Reclamation Guidelines for the Northwest Territories* (Jan. 2006), an effective Plan should follow an "objectives-based" approach that starts with clear statements of reclamation objectives for the general site and major mine components and, based on those objectives, develop site specific closure criteria for each of those mine components.

6). Section 1.3, Remediation Objectives (pg. 2) provides the general remediation objectives for the Plan which covers underground, surface, public health and safety, release of contaminants off-site, and Baker Creek. However, in Section 5.0 Remediation Plan (pg. 121), there does not seem to be a clear discussion of reclamation objectives, performance criteria, and proposed end land use for each mine component in their respective introductory sections. See example below:

Mine Component: Tailings Containment Area
Reclamation Objective: To minimize contact with surface water to reduced the rate at which port water contaminants are released
Reclamation Performance Criteria: To reduce the amount of precipitation runoff infiltrating through the tailings by holding water within a vegetative cover system and allowing this water to run off the surface or evaporate from the surface without coming into contact with the underlying tailing surface.
Proposed End Land Use: The future end land use proposed for the overall minesite is a combination of industrial use and open space for light recreational use. For this particular mine component, the TCA will be reclaimed as open space.

Periodic Updates to the Final Plan

Given that the Plan is considered a "living document" by regulators, updates may be necessary for any significant changes to the plan.

7). EC recommends that the Plan include a schedule for updates to the Plan while the work is being implemented.

Inspector's Approval

8). It is understood that the Proponent will require DIAND Inspector's approval prior to carrying out reclamation activities that are not described in the Final Plan. Will the MVLWB provide opportunity for input from regulators prior to the granting of an Inspector's approval?

Reclamation Completion Report

As stated in DIAND's "*Mine Site Reclamation Guidelines for the Northwest Territories"* (Jan, 2006), *"A Reclamation Completion Report is prepared upon completion of all of the reclamation activities or after completion of the primary reclamation activities in cases where some minor work continues. This report is similar in concept to an "as-built" construction report"*.

The *Guidelines* further state that, "*the general purpose of the Reclamation Completion Report is to provide details of the actual reclamation work completed, including progressive reclamation work completed over the term of the mining operations, with comparison to the plan presented in the Final Plan. This facilitates future assessment, maintenance and, if necessary, repair work*".

9). EC recommends that a "Reclamation Completion Report" be completed by the Proponent with a brief discussion included in the Final Plan (given the linkage between the two documents).

Performance Assessment Report

As stated in DIAND's "*Mine Site Reclamation Guidelines for the Northwest Territories"* (Jan, 2006), a "*Performance Assessment Report is prepared at the end of the initial monitoring period. This is typically a number of years following completion of the primary reclamation work at a time when environmental conditions were initially projected to demonstrate that all, or the primary, reclamation objectives have been achieved. At this time the closure criteria, and any ongoing residual and/or environmental risks are re-assessed and the monitoring and maintenance plan is updated"*.

The Guidelines further state that, *"The general purpose of the Performance Assessment Report is to provide a detailed comparison of conditions at the site against the reclamation objectives and closure criteria. In some cases where the reclamation objectives and closure criteria have not been fully achieved or where this remains uncertain, there may be need to carry out an extended monitoring and maintenance program"*.

10). EC recommends that a "Performance Assessment Report" be completed by DIAND with a brief discussion included in the Final Plan (given the linkage between the two documents).

11). At some point in the future, EC recommends that the MVLWB coordinate a joint effort amongst stakeholders to formally review the Updated Final Plan, Reclamation Completion Report, and Performance Assessment Report to confirm that the reclamation objectives have been met based on closure criteria/performance measures.

Post-Closure Information Management

12). EC is unsure as to where post-closure information/data will be housed? (INAC/Giant Mine website, Public Registry, DIAND Regional District Office?). EC suggests that this be identified in the Plan.

CWS

The Canadian Wildlife Service (CWS) of Environment Canada has reviewed the above-mentioned submission and makes the following comments and recommendations pursuant to the *Migratory Birds Convention Act* (the *Act*) and *Migratory Birds Regulations* (the *Regulations)*, and the *Species at Risk Act* (SARA).

13). Section 6 (a) of the *Migratory Birds Regulations* states that no one shall disturb or destroy the nests or eggs of migratory birds. In order to minimize the risk of accidentally disturbing or destroying nests or eggs of migratory birds during demolition or remediation activities, Environment Canada recommends the following mitigation measures for migratory birds:

a. Structures with known nesting areas should be taken down either before or after the nesting season.
b. If other demolition or remediation work occurs during the nesting season, these areas should be inspected for active nests before any demolition or remediation work starts.
c. If active nests (i.e., nests containing eggs or young) are discovered, the proponent should delay any work in the area until nesting is complete (i.e., the young have left the nest).

14). Section 5.1 of the *Migratory Birds Convention Act* prohibits persons from depositing substances harmful to migratory birds in waters or areas frequented by migratory birds or in a place from which the substance may enter such waters or such an area.

15). All mitigation measures identified by the proponent, and the additional measures suggested herein, should

be strictly adhered to in conducting project activities. This will require awareness on the part of the proponents' representatives (including contractors) conducting operations in the field. Environment Canada recommends that all field operations staff be made aware of the proponents' commitments to these mitigation measures and provided with appropriate advice / training on how to implement these measures.

16). Implementation of these measures may help to reduce or eliminate some effects of the project on migratory birds, but will not necessarily ensure that the proponent remains in compliance with the *Migratory Birds Convention Act* (the *Act*) and *Migratory Birds Regulations (*the *Regulations)*. The proponent must ensure they remain in compliance with the *Act* and *Regulations* during all phases and in all undertakings related to the project.

Spill Contingency Plan

17). The site specific Spill Contingency Plan should provide a clear path of response in the event of a spill and indicate how the proponent will meet the requirements of prevention, preparedness, response and recovery.

18). Section 7.0, Hazardous Material Disposal & Site Restoration (pg. 13-14): The Proponent is requested to supply:

- Confirmation that the Proponent has received permission from the City of Yellowknife to transfer proposed hydrocarbon waste types and quantities to the Yellowknife Solid Waste Facility; and
- Alternate disposal options in case the City cannot accommodate the waste.

19). In the event of a spill, the regulator is there to ensure clean-up and disposal occurs, not to direct the spill response.

20). Any sumps, pits, spill basins and fuel caches shall be located above the high water mark of any waterbody and in such a manner as to prevent the contents from entering any waterbody frequented by fish. Therefore, please note that maintaining a buffer of a specific distance may not always be an adequate preventative measure.

21). Refueling shall not take place below the high water mark of any waterbody and shall be done in such a manner as to prevent any hydrocarbons from entering any waterbody frequented by fish.

22). EC recommends the use of secondary containment with an impervious liner, such as self-supporting insta-berms, for storage of all barreled fuel rather than relying on natural depressions to contain spills.

23). Fuel or hazardous substance transfers – Secondary containment or a surface liner (drip pans, fold-a-tanks, etc) should be placed under all container or vehicle fuel tank inlet and outlet points, hose connections and hose ends during fuel or hazardous substance transfers. Secondary containment should be of adequate size and volume to contain and hold fluids for the purpose of preventing spills (the worst-case scenario). Appropriate spill response equipment and clean-up materials (absorbents, containment devices, etc) must be on hand during any transfer of fuel or hazardous substances and at vehicle-maintenance areas.

24). Transfer operations should be attended by trained personnel at all times.

25). Berm areas - Decanting of snow or water from the berm area should proceed only if the appropriate chemical analysis has determined the contents meet the requirements of Section 36.3 of the *Fisheries Act*.

26). Fuel/waste containers, including barrels, should be marked with the responsible party's name, product type, and year purchased or filled.

27). EC notes that the Reference Section (pg. 22) does not include "Guidelines for Spill Contingency Planning" (DIAND, April 2007). Did the Proponent refer to these Guidelines when developing the Spill Contingency Plan? If so, EC recommends that the Guidance document be cited in the Reference Section.

28). All spills shall be documented and reported to the 24 hour Spill Line at (867) 920-8130. The Plan should provide a copy of the NWT Spill Reporting Form and contact number for the Spill Line.

29). The Spill Contingency Plan should provide an inventory of spill response resources, and clearly indicate where these resources are located. For example, Section 8.1, Spill Equipment Inventory should list other spill kit materials (and storage locations) as part of the inventory.

30). The Proponent should identify appropriate measures to effectively reduce the impacts of a spill on birds and other wildlife in the environment (i.e. both land and water).

31). The Proponent must ensure that the project contractors meet the Proponent's due diligence standards with respect to oil and hazardous material spill prevention, preparedness, response, and restoration.

In closing, please do not hesitate to contact me with any questions or comments with regards to the foregoing at (867) 669-4724 or via email at lisa.lowman@ec.gc.ca.

Yours truly,

Lisa Lowman,
Environmental Assessment / Contaminated Site Specialist

cc: Carey Ogilvie (Head, Assessment & Monitoring, EPOD, Environment Canada)
Mike Fournier (EA Coordinator, EPOD, Environment Canada)

Giant Mine Remediation Plan Revisions
To address comments raised in FCSAP letter of June 22nd, 2005

The table below lists the sections in the Main Report of the Giant Mine Remediation Plan or Supporting Documents where revisions have been made to the Plan based on comments received from the Federal Contaminated Sites Action Plan (FCSAP) Expert Departments, consisting of Environment Canada, Fisheries and Oceans Canada, and Health Canada. The table follows the same organization and pagination as the June 22nd FCSAP letter sent to Bill Mitchell of the Giant Mine Remediation Team by Lisa Lowman.

Question	Reference Section	Comments
Page 2: Mine ownership	Main Report: section 2.4.5	This section has been revised. The report text now gives a full description of the changes in site jurisdictional control and the current Cooperation Agreement.
Page 2: Arsenic trioxide dust disposal	Main Report: section 1.5 and 2.2.1 Supporting Document I1	This has been addressed in the Remediation Plan and discusses the recent field investigations to identify arsenic contamination in surficial materials across the site. The historic disposal site is assumed to correspond to a dump located near Dam 1, which was found to contain a variety of mill waste, etc. (see Supporting Document I1 for details).
Page 2: Ore Processing		The risks resulting from the presence of mercury in the old tailings are believed to be very low and, for that reason, mercury was not discussed in the sections on tailings geochemistry (Section 3.5.5), or Historic Foreshore Tailings (Section 3.6). Only a small proportion of the mine's gold production was recovered using mercury amalgamation (decreasing from a maximum of 18% in 1951, to less than 1% by 1959, when the practice ceased). Almost all of the available data for mercury in tailings solids or tailings pore water come from studies of the Historic Foreshore Tailings. These tailings were deposited from 1948 to 1951, when use of mercury in the process was relatively high. Supporting Document F1 summarizes a 2001 study in which mercury was not detected in any of 23 tailings porewater samples from various depths and locations in the beach. Supporting Document F2 reports the results of sediment sampling throughout north Yellowknife Bay in 2004. Mercury in shallow sediments was greater than the CCME Interim Sediment Quality Guideline in three out of 50 samples, but was still less than the Probable Effects Level at these sites. There have been no measurements of mercury in tailings solids inside the Tailings Containment Areas. Tailings porewater drawn from a well in the Northwest Pond in 2001 contained detectable mercury at a low concentration (1.4 ug/L). The Northwest Pond could contain tailings produced in the 1950's, if it was transferred from the North Pond during the Tailings Retreatment Project in the late 1980's. Mercury could also occur naturally in the ore and mine tailings. Occasional measurements of mercury in shallow groundwater throughout the site, tailings dam seepage, effluent discharge, Baker Creek and other surface waters, have all resulted in no detection of mercury in site waters.

Page 2: Arsenic Trioxide Dust Storage Areas		
- Arsenic loading target	The Draft Plan would need to justify a performance target higher that currently borne by the environment given the mitigation effort to be undertaken.	The minimum objective of the remediation plan is to ensure that post remediation arsenic loading does not increase over current levels as the mine is reflooded. The expectation of the remedial work is that the loading will decrease when compared to current levels; however, water quality predictions reported in the Remediation Plan are deliberately conservative.
- ground expansion	Supporting Document J1 (p23 & p42)	Potential ground expansion has been taken in to account in the planning for final saturation and freezing of the dust as discussed in detail in Supporting Document J1 (p23 & p42). Freezing will take place from bottom of stopes up, so expansion will be into open void at top of dust stopes. Additionally, all lower bulkheads will be reinforced with cemented backfill. Backfilling the tunnels adjacent to the lower bulkheads is also required to provide a medium to drill through and install freeze pipes.
- mine flooding		Thermal modelling has taken into account controlled reflood and flow of water past frozen blocks. Models were run simulating using only the passive system to maintain the frozen ground. All results indicate that the frozen blocks can be maintained under fully flooded conditions.
- similar projects	Supporting Document J1 (p20)	A discussion of a full scale test program at the US Dept of Energy Oak Ridge Tennessee nuclear tests facility can be found on page 20 of Supporting Document J1. This project has been proven to be successful at maintaining frozen ground conditions at much warmed ambient annual air temperatures.
Page 3: Openings to surface		DIAND does not plan to seal any of the existing drillholes at the site. Recent field programs utilizing historic drillholes have shown that it is difficult to locate most drillholes on site as they have been covered, filled, etc. As there are know to be greater than 29,000 surface collared drillholes, it is not practical to attempt to seal them. Although identifying and blocking drillholes is a significant issue at many mines, the issue is usually associated with mines on slopes that have drillholes that will drain to lower valley areas, etc. As the Giant Mine is in flat lying terrain, any drillhole connected to mine workings will not flow until the entire mine is allowed to flood above the lake level (or higher). More importantly, as the Remediation Plan does not allow for flooding to this level until mine water is suitable for discharge to the open pit lakes and Baker Creek, any flow that may occur through drillholes is not expected to present a water quality discharge problem.
Page 3: Pits	Main Report: section 5.3	The discussion of open pit closure activities has been expanded in the Remediation Plan in section 5.3.

Page 3: Tailings and Sludge		
- geosyntheitics - vegetation - geosynthetics vs soil cover	Supporting Document K1 (p29)	Cover design trial tests will be carried out starting summer of 2006. The test pads will assess requirements for use of geotextile filter versus graded soil/crushed rock filter medium. Test will include excavation of the pads to assess tailings infiltration into the filter/capillary break layer. Additional information needs and testing are discussed on Page 29 of Supporting Document K1.
Page 3: Historic Foreshore tailings		In February 2000, EBA conducted a limited physical and geochemical assessment of the Back Bay tailings deposit. A report on this work was submitted to DIAND in January 2001. The 2001 EBA report recommends separate remedial options for the beach scarp and for the submerged tailings. There are three options suggested for physical stabilization of the scarp: • Cut back the vertical scarp and incorporate erosion protection in the form of rip-rap material • Remove the scarp by excavation and cover the exposed area with rip-rap • Leave the tailings in place and construct a break wall to dissipate erosive energy created by wave action In addition to the physical stabilization of the scarp, the use of liners for chemical stabilization and/or control of leachate were also recommended. Types of liners suggested included natural (clay) covers, and synthetic covers, such as geotextile or manufactured clay liners. The stabilization work that was completed between October-November 2001 involved re-grading of two areas as well as regrading of the scarp slope, placement of geotextile over the scarp tailings and finally placement of gravel and clean rip rap over the scarp tailings. The regrading was done between Dam 7 of the South Pond tailings impoundment and the beach area in two regions designated as the "lowland area" between Dam 7 and the beach and the upland area of the beach at the bay. This work was initiated to manage the tailings placed above the beach as well as those located on the scarp, which were believed to be rapidly eroding at the time. Subsequent to this restoration work two follow up studies *Environmental Assessment Yellowknife Bay Tailings Giant Mine Yellowknife, NT,* March 2002 and *Environmental Assessment Yellowknife Bay Tailings Giant Mine Yellowknife, NT,* April 2004 were commissioned to assess the biogeochemical conditions of the near-shore and submerged tailings. The 2002 report concluded the "submerged tailings do have an impact on the environment in Yellowknife Bay (however) the impact is low and that under present conditions, the water column above the tailings in the bay satisfies the water quality guidelines for aquatic life." It also suggests that reduction of the influence of the South and Central ponds on the hydrogeologic regime would minimize and reduce the large component of arsenic flux moving to the submerged tailings in the bay. The 2002 report recommended closure of these ponds in addition to an extension of the beach protection as a viable management option for the historic foreshore tailings. The 2004 follow up report reiterated these conclusions. Reduction of the influence of these two ponds was considered in the development and final design of the Remediation Plan.

		Additionally, conclusions presented in *Investigation of the Distribution of Historic Tailings in North Yellowknife Bay,* September 2005 suggest that arsenic contamination in the sediments of north Yellowknife Bay have negatively affected the benthic community. However, the data suggested that there were confounding reasons for this impact and it did not conclusively support that the historic tailings in the bay or on the beach were the source of the impact. After consideration of all the conclusions presented in all the available data to date from a risk based management approach the decision to remediate the historic foreshore tailings in-situ was deemed to be the most appropriate remediation option to advance.
Page 4: Water Treatment	Main Report: Section 5.7 Supporting Document L1	Revised support document and main text discuss this in more detail. As Giant does not produce ARD, the volume of sludge produced will be very small compared to other mine water treatment plants discussed.
	Main Report: section 5.7.5 Supporting Document L1 Supporting Document L2	- Diffuser design and operational impacts are discussed in Supporting Document L2. - SD L2 discusses the sludge production and disposal options, as well as outline the plan for building a post treatment holding pond to deal with QA assurance testing and potential requirements for secondary treatment if the plant is not operating properly. Holding pond storage design will be 5 days of average plant output.
Page 4: Baker Creek	Not in report	The option of rerouting Baker Creek around the mine site was not addressed directly in the Remediation Plan. However, this option has been looked into and discounted due to the fact that the mine site catchments will continue to drain to the current creek channel and so a creek will still exist through the site, albeit of significantly reduced flow. Flooding of the open pits has not been recommended at this time as interaction with the mine water system will either lead to direct infiltration to the mine (and therefore the mine water treatment system) if mine water levels are below the pit bottoms, or potential contamination of the resulting pit lakes from the mine water in the near future when mine water levels rise above the bottom of the pits.
Page 4: Assessment of Post-Remediation Conditions	Main Report: section 5.1 Supporting Document J1	Infiltration of water into the frozen arsenic dust will be prevented due to the volume of sub-zero rock overlying the frozen dust. Any water that does infiltrate downwards will be frozen. This freezing is expected to migrate to surface over time, with just a thin active thawing layer in summer months. In addition, groundwater in the vicinity of the frozen blocks will preferentially flow through the surrounding tunnel system, therefore, bypassing the frozen blocks. This is discussed in more detail in the Main Report and in Supporting Document C6 (Addendum to the Groundwater Model, SRK 2005). Any groundwater that does encounter open fractures in the frozen block will freeze in place, plugging the fracture. The design criteria for the frozen block is -10°C, therefore water would have to infiltrate through cracks of 0°C to -10°C before reaching the "block" volume.

Page 5: Monitoring Plans	Main Report: section 7	This section has been revised and expanded in the Remediation Plan. Specific timelines for monitoring different impacts and receiving media are discussed in the Main report.
Page 5: Water Treatment Discharge monitoring		This contingency has been addressed in the Remediation Plan. The contingency measure for contaminated groundwater escape from the mine has been addressed in the Main Report. Contingency measure would be to resume drawdown to below the level of Great Slave Lake to reassert the capture zone around the tunnels. Furthermore, water levels in the mine will not be allowed to rise above the level of Great Slave Lake until mine water geochemistry, monitored via the tunnel based system described in Section 7.2.1 of the Remediation Plan, meets discharge requirements. Therefore, future releases of mine water should only occur after the contaminant concentrations are below levels that are of any significance.
Page 5: Surface Water Monitoring		
- seepage pathways	Main Report: Section 7.1.1	Surface seeps have been identified and are part of ongoing monitoring. Changes in seeps are expected during implementation and post-remediation, so changes to samples sites will be made to accommodate these. A revised surface water sampling plan has been proposed to integrate all of the historic data collection program sites with new sites designed to monitor the effects of the proposed remediation work. An expanded list of parameters has also been proposed for the site monitoring. These changes are discussed in Section 7.1.1 of the Remediation Plan..
-remobilization of arsenic from sediments	Main Report: Section 7	This will be monitored as part of the surface water quality program at select locations along Baker Creek.
- sediment monitoring around new discharge pipe	Main Report: Section 7	This will be carried out as part of the site monitoring plan, and is discussed in the main report.
Page 5: Implementation Schedule	Main Report: Section 8	Current implementation schedule would have the new water treatment plant (WTP) start operating approximately 1 year after remediation works are started. At this time mine water would no longer be pumped to the tailings ponds for surface storage. The mine would be flooded to the 425 Level after the long-term dewatering system is installed, approximately 9 months after remediation works begin. Flooding to the 200 Level after freezing is shown in Figure 8.1 of the Remediation Plan.
Page 5: Miscellaneous		
- time to heat dust if exothermic		Laboratory testing was carried out in March 2006 to determine hydration effects of wetting arsenic trioxide dust. No net gain in heat was detected in the tests carried out, therefore, this is not expected to be an issue when saturating and freezing the dust.
- covering beach tailings	Supporting Document F2	Supporting Document F2 documents the work carried out to delineate the distribution of tailings and arsenic affected sediments in North Yellowknife Bay.

Supporting Document: Ecological Risk Assessment: "Draft Report, Tier 2 Risk Assessment Giant Mine Remediation Plan" (SENES Consulting Ltd., 2005).		
Page 6: Miscellaneous		
- finalising documents	Supporting Document F3	Supporting Document F3 has since been finalised and will replace the interim document in the Supporting Document list.
- executive summary	Main Report	Executive summary added to Main Report
Part 2: Tier 2 Risk Assessment		
Page 7: Use of 75% protection level	Supporting Document N1: Section 5.1.1	A sensitivity analysis has been added to the report using the 90% protection levels. The use of the 90% protection limits does not change the results of the assessment in Back Bay, North Yellowknife Bay or South Yellowknife Bay. In Baker Creek, the sensitivity analysis indicates that predator fish and bottom feeder fish exceed the TRVs; however, fish surveys in Baker Creek indicate that both predator and bottom-feeder fish are found in Baker Creek both upstream and downstream of the mine and that they appear to be relatively healthy. This survey was done at one point in time and more surveys would be needed to validate these observations.
Page 7: Discussion of mink in ERA	Supporting Document N1: Section 5.1.3	The risk assessment quantitatively examined both mink and muskrat. From a review of the results, the muskrat had higher arsenic exposure levels than the mink and thus were the most exposed species. As the TRVs derived for mink and muskrat are from the same study, there is no basis for distinguishing any differences in the sensitivities of these two species. Therefore, muskrat were considered to be used as a surrogate for other small mammals with an aquatic based diet. Also, because muskrat were observed in the area, biological studies were conducted on muskrat along Baker Creek. The results of these studies were used in a weight-of-evidence approach to elucidate whether adverse effects are occurring in muskrats and, by inference, other small terrestrial species, such as mink. The results indicate that there is a healthy population of muskrat along Baker Creek upstream and downstream of the Giant Mine site. Since muskrat and not mink were the focus of the field investigation it is not known whether mink are or have been noted in the area.
Page 7: Evaluation of 90% protection level for aquatic organisms	Supporting Document N1: Section 5.1.1	As discussed above, a sensitivity analysis was included in the report to evaluate the 90% protection level for aquatic organisms. The use of the 90% protection limits does not change the results of the assessment in Back Bay, North Yellowknife Bay or South Yellowknife Bay. In Baker Creek, the sensitivity analysis indicates that predator fish and bottom feeder fish exceed the TRVs; however, fish surveys in Baker Creek indicate that both predator and bottom-feeder fish are found in Baker Creek both upstream and downstream of the mine and that they appear to be relatively healthy. This survey was done at one point in time and more surveys would be needed to validate these observations.
Page 8: Remediation of sediments	Supporting Document N1: p. 6-8	The risk assessment document recommends additional benthic community sampling and toxicity testing in Baker Creek to determine possible adverse effects on these communities. The results of these studies and others will be used to guide the remediation of sediments.
Page 8:	Supporting	In the most recent version of the report, only one remediation case has been addressed and is described in section

Risk Assessment: which case describes post remediation conditions	Document N1: Section 3.4	3.4.
Page 8: Risk Assessment Aquatic; P. 6-17	Supporting Document N1: p. 6-16	This portion of the discussion on pg 6-16 focused solely on impacts within the water column. All the predicted concentrations are below the 80% and 90% protective levels and thus aquatic species are not at risk. A discussion on the benthic community was provided in the section related to sediments.
Page 8: Risk Assessment Terrestrial; P. 6-24		The risk assessment quantitatively examined both mink and muskrat. From a review of the results, the muskrat had higher arsenic exposure levels than the mink and thus were the most exposed species. As the TRVs derived for mink and muskrat are from the same study, there is no basis for distinguishing any differences in the sensitivities of these two species. Therefore, muskrat were considered to be used as a surrogate for other small mammals with an aquatic based diet such as mink. Also, because muskrat were observed in the area, biological studies were conducted on muskrat along Baker Creek. The results of these studies were used in a weight-of-evidence approach to elucidate whether adverse effects are occurring in muskrats and, by inference, other small terrestrial species with an aquatic based diet. The results indicate that there is a healthy population of muskrat along Baker Creek upstream and downstream of the Giant Mine site. Since muskrat, and not mink, were the focus of the field investigation it is not known whether mink are or have been noted in the area.
Page 9: Risk Assessment 6.2.3 Overall Ecological Significance Pg 6-34		
- effects reassessed with respect to EC10		The conclusions are still valid as demonstrated by the sensitivity analysis in the report. The significance section discussion has been removed from the report.
- benthic organisms in areas where sediments not remediated		The risk assessment document recommends additional benthic community sampling and toxicity testing in Baker Creek to determine possible adverse effects on these communities. The results of these studies and others will be used to guide the remediation of sediments.
Page 10: Risk Assessment 6.2.3 Overall Ecological Significance Pg 6-38 - discussion of mink	Supporting Document N1: Section 5.1.3	The risk assessment quantitatively examined both mink and muskrat. From a review of the results, the muskrat had higher arsenic exposure levels than the mink and thus were the most exposed species. As the TRVs derived for mink and muskrat are from the same study, there is no basis for distinguishing any differences in the sensitivities of these two species. Therefore, muskrat were considered to be used as a surrogate for other small mammals with an aquatic based diet such as mink. Also, because muskrat were observed in the area, biological studies were conducted on muskrat along Baker Creek. The results of these studies were used in a weight-of-evidence approach to elucidate whether adverse effects are occurring in muskrats and, by inference, other small terrestrial species with an aquatic based diet. The results indicate that there is a healthy population of muskrat along Baker Creek upstream and downstream of the Giant Mine site. Since muskrat and not mink were the focus of the field investigation it is not known whether mink are or have been noted in the area.

Page 10: Risk Assessment 6.2.3 Overall Ecological Significance Pg 6-34 - discussion of “future” case		The risk assessment document recommends additional benthic community sampling and toxicity testing in Baker Creek to determine possible adverse effects on these communities. The results of these studies and others will be used to guide the remediation of sediments.
Page 10: Risk Assessment 6.2.3 Overall Ecological Significance Pg 6-37		The most recent report only discusses one remediation case with the appropriate context.
Page 14: Were analyses conducted for all chemicals identified in Phase 1 as potential contaminants?		The risk assessment report indicates that antimony and petroleum hydrocarbons were found at elevated levels. Appendix E in the report provides an assessment of antimony exposure. Section 1.1 of the report also discusses antimony and indicates that after remediation the estimated antimony concentration will be well below the CCME guideline of 20 mg/kg. A discussion of the hydrocarbon contamination is also provided in Section 1.1 of the report. Hydrocarbon contaminated soils are associated with arsenic contaminated soils and therefore any remedial activities will result in remediation of the hydrocarbon contaminated soils.
Page 14: Were any site-related chemicals eliminated without appropriate justification? - as infrequently detected chemicals? - as common laboratory contaminants even though sample concentrations were significantly higher than that found in blanks? o as present at a "ubiquitous level"?		The risk assessment report indicates that antimony and petroleum hydrocarbons were found at elevated levels. Appendix E in the report provides an assessment of antimony exposure. Section 1.1 of the report also discusses antimony and indicates that after remediation the estimated antimony concentration will be well below the CCME guideline of 20 mg/kg. A discussion of the hydrocarbon contamination is also provided in Section 1.1 of the report. Hydrocarbon contaminated soils are associated with arsenic contaminated soils and therefore any remedial activities will result in remediation of the hydrocarbon contaminated soils.
Page 15: Contaminants selected for Detailed Analysis	Main Report: section 3.10. Supporting Document N1; section 1.1	A discussion of the hydrocarbon contamination is also provided in Section 1.1 of the report. Hydrocarbon contaminated soils are associated with arsenic contaminated soils and therefore any remedial activities will result in remediation of the hydrocarbon contaminated soils.

Page 16: Other comments		
a:		A remediation case scenario was evaluated in the report. This involved the covering of any exposed tailings areas on site. However, direct ingestion of tailings/sediments in Baker Creek, Back Bay and Yellowknife Bay were considered in the assessment.
C:		The assessment of aquatic receptors considers direct comparison of water concentrations to toxicity reference values and therefore in essence considers the direct contact pathways.
D:		As discussed above, the data considered in the assessment came from many different reputable sources and laboratories and all QA/Qc etc. were discussed in the original documents. The data were consistent across studies and thus were considered adequate for use at the site.
E:		Only one remediation scenario is considered in the report.
F:		An evaluation of antimony has been provided in an Appendix E. Section 1.1 of the report also discusses antimony and indicates that after remediation the estimated antimony concentration will be well below the CCME guideline of 20 mg/kg. Arsenic was the only contaminant identified in the original Terms of Reference.
G:	Main Report: section 3.10 Supporting Document N1; section 1.1	A discussion of the hydrocarbon contamination is also provided in Section 1.1 of the report. Hydrocarbon contaminated soils are associated with arsenic contaminated soils and therefore any remedial activities will result in remediation of the hydrocarbon contaminated soils.
H:		There would not be a great advantage to providing a conceptual model for the site given that a large portion of the sources were historical and that the ongoing sources are mainly groundwater releases to Baker Creek. These have been adequately described in the report.
Part 2: Fisheries and Oceans Canada		
Page 17: Section 3.6 Historic Foreshore Tailings	Main Report: Section 5.6 Page 160	- discusses remediation plans for covering historic foreshore tailings
Page 17: Section 5.5.5 Tailings Covers	Main Report: Section 5.5.2, 5.5.8, & 7.7.1	- discusses sediment control during construction, contingencies for remediating cover erosion, and monitoring program for sediment release.
Page 17: Section 5.8 Baker Creek		Options will be assessed based on summer of 2005 sediment sampling and testing program. This is discussed in Draft Plan.

Part 3: Health Canada		
Page 19: 1: Cancer Slope Factor	Main Report: Section 6.4 Table 6.5	A sensitivity analysis was provided in the report to address the use of different slope factors in Section 6.4 of the report. The overall conclusions of the report are unchanged.
Page 20: 2: Non Cancer TRV		All discussions on the non-carcinogenic effects of arsenic have been removed from the report and the report now only considers the most sensitive end-point of arsenic exposure namely cancer.
Page 20: Receptor Characteristics	Supporting Document N1: Page: 3-14	An assessment of a toddler was provided in the revised report and the arsenic intakes are higher than those of a child. Soil ingestion only represents 5% of the toddler intake. The majority of the arsenic intake came from ingestion of supermarket food, caribou, fish, backyard produce and berries. The risk estimates were calculated for a composite receptor.
Page 21: Bioaccessibility of Arsenic in Soils Q1 & 2	Main Report: Section 6.3.4 Table 6.5	A sensitivity analysis was carried out for different bioaccessibility values in the report. The use of different bioaccessibility factors does not change the overall conclusions of the assessment.
Page 22: Bioaccessibility of Arsenic in Soils Q3		Both the mean and the 95^{th} percentile results are presented in the report.
Page 22: Non-Cancer Risk Assessment		All discussions related to the non-cancer endpoint have been removed from the assessment
Page 22: Carcinogenic Risk Assessment	Main Report: Section 6.3.5 Table 6.4	A discussion of the acceptable risk level of 1 in 100,000 has been provided in the report.

Environment Canada Environnement Canada

Environmental Protection Branch
5204 - 50th Avenue
Suite 301
Yellowknife, NT X1A 1E2

June 22nd, 2005 Our file: 4105 005 113
(Revised from original letter dated May 31st, 2005)

Giant Mine Remediation Team
Department of Indian Affairs and Northern Development Fax: (867) 873-8185
5th Floor, Precambrian Building
Yellowknife, NT

Attention: Bill Mitchell, Project Manager

Re: FCSAP Review - Giant Mine NWT
"Giant Mine Remediation Draft Plan" (SRK Consulting, 2005)

As a *Federal Contaminated Sites Action Plan* (FCSAP) funded project, DIAND requested technical advise on the aforementioned plan from each of the three FCSAP Expert Departments, i.e. Environment Canada, Fisheries and Oceans Canada, and Health Canada. The purpose of the review is to provide advice to the Custodial Department, with the objective of reducing risks to human health and the environment. Summary comments are organized by Department, i.e. Environment Canada, Fisheries and Oceans Canada, and Health Canada.

PART 1: ENVIRONMENT CANADA

Environment Canada's (EC) contribution to your request for specialist advice is based primarily on the mandated responsibilities of Section 36(3) of the *Fisheries Act*, the *Species at Risk Act*, the *Canadian Environmental Protection Act* and the *Migratory Birds Convention Act*. On the basis of the information provided, Environment Canada believes that the above noted project has the potential to affect fish pursuant to the *Fisheries Act*.

The scope of EC's review includes the Main Document, *"Draft Giant Mine Remediation Plan"* (SRK Consulting Inc., 2005) and various Supporting Documents including, "*Tier 2 Risk Assessment"*, (SENES Consulting Ltd., 2005). For the purpose of the ERA review, comments were based on risk assessment protocol as well as the *"Reviewer's Checklist for Risk Assessments"* developed by the Ontario Ministry of the Environment. In addition, background information has been provided for MMER and EEM requirements during operation, closure, and post-closure (Attachments A&B).

Main Document

Section 2: Site History

Section 2.2.1 Mine Ownership

- This Section briefly discusses the terms of the purchase agreement between Miramar Giant Mine Ltd., DIAND, and the GNWT related to environmental liability on site. Given the recent signing of a Cooperation Agreement (March 15, 2005) on the management and remediation of the site, it is recommended that a brief description of the terms of this agreement be included in this Section to provide reviewers with a general understanding as to what future role the GNWT will play in the remediation of the site.
- Given that the site is located on Commissioner's land, it is suggested that jurisdictional responsibilities and liabilities be described in this Section also.

Section 2.3.2 Arsenic Trioxide Dust Disposal

- (pg.9) In July 1949 and again in February 1950, arsenic trioxide was disposed of "*in a suitable area north of the property*". Based on the production rates presented in Table 3.1, the volume of that material would be in the order of 3 to 5 thousand tonnes. It is unclear from the Draft Plan if that dumped material has been found and adequately addressed. This should be specifically addressed in the Draft Plan.

Section 2.2.3 Ore Processing

- (pg.5) Mercury was used in the milling of gold at Giant until 1959. The main document should address in the main text if any risk remains from the presence of mercury in the tailings deposit, including the beach deposit. Only in the Supporting Document F1 was the absence of mercury noted in the Tailings Beach.

Section 5: Remediation Plan

Section 5.1 Arsenic Trioxide Dust Storage Areas

- Arsenic Loading Target (pg. 78): the method for the determination of the 2,000 kg per year would be an appropriate target for maximum releases from the Giant Mine. Given that currently, the loading is in the order of 800 kg per year loading (p 66, Table 4.6), the target seems to be unrealistically high. The Target should drive technology to produce as low a loading as reasonably achievable. By controlling arsenic to low levels, other potentially problematic constituents would also be addressed. Post-remediation arsenic loadings are projected to be in the order of 600 kg per year (table 6.1). Given the proposed mitigation, it would the target should be 600 kg per year. Alternatively, a maximum allowable loading of 800 kg per year, that currently released, could be adopted. Such an approach is more in line with the practices of other historic mining camps, such as the Beaverlodge uranium complex in northern Saskatchewan. The Draft Plan would need to justify a performance target higher that currently borne by the environment given the mitigation effort to be undertaken.
- Has the potential for ground expansion been considered when it undergoes freezing? How might this affect the stability of the bulkheads or the initial frozen shell?
- Once the mine has been flooded, how will the frozen block be affected by the presence of adjacent liquid water? Could the passive system alone counteract any possible tendencies towards melting?
- It is suggested that additional discussion be provided in terms of where and how a similar method has been used successfully and how similar those conditions are to the situation at Giant Mine.

Section 5.2.4 Openings to Surface

- Open Bore Holes (pg. 31, pg. 43, Section 5.2.4, pgs 88-89): many thousands of exploration drill holes are described as intersecting the underground mine workings and creating an extensive drainage system. The Draft Plan does not indicate if any actions are going to be undertaken to address the open bore holes. For example, any identified open holes in workings should be sealed. At other decommissioned mines, as the underground workings have flooded, some of the open holes have flowed with mine-water effluent and required remediation consideration. A program should be considered and addressed in the Draft Plan regarding searching for and evaluating any flowing holes as they are discovered

Section 5.3 Pits

- (pg 32; Section 5.3.3) At the Giant Mine site, 8 open pits were identified. However, the Draft Plan appears to only address 3 of those pits (B1, C1, and Brock Pits). The Plan should describe how the other pits would be closed out. There may be opportunity to use these pits for the disposal of problematic mine waste such as the Tailings Beach, and the Calcine pond
- The plan doesn't explicitly address what remediation activities, if any, will be conducted at pits other than B1 and C1. What is the status of the A1, A2, B2, B3, and B4 pits? Are there any environmental risks (e.g. proximity to underground mine workings) or human health or safety risks (i.e. steep walls) associated with those pits?

Section 5.5 Tailings and Sludge

- Synthetic material in tailings cover (Section 5.5.5 and 5.6; Support Document K)**:** the conceptual design of the cover with filter protection and capillary break is an established technology and may be effective. However, the proposed plan to place the geotextile (filter cloth) over the beached tailings may be problematic in the long term. The geotextiles can be damaged if exposed to the elements. Their longevity and "forever" performance remains to be established. A soil cover with proper gradation control can be preferred in the long-term to ensure a stable cover. Damage to the cloth could jeopardize the stability.
- The mature vegetation which would come to be established on the tailings cover will provide some benefits through control of surface erosion and dusting, reduce runoff and likely infiltration of water to the tailings, but could also be problematic. The robustness of synthetic cover layer tree overtoppling or root penetration is uncertain.
- The Draft Plan should address the compare and justify the use of synthetic textile over a conventional engineered soil cover.

Section 5.6 Historic Foreshore Tailings (& Supporting Document F, pg 6)

- Tailings were directly discharged to Back Bay from 1948 to 1951. Approximately 375,000 tonnes of tailings were discharged to Back Bay of which about 35% are above the waterline. Studies suggest that submerged tailings have a low impact on the environment in Yellowknife Bay with the impacts apparently largely confined to those areas of direct deposit. The tailings present a very low risk of acid generation. Mercury, although likely originally present with the tailings, was not found in any tailings samples. The current footprint of the tailings is estimated to have doubled since its initial placement.
- In *"Assessment of Back Bay Tailings Deposits",* January 2001, EBA Engineering Consultants recommended chemically stabilized, such as with liners, and physical stabilized, such as regarding or removal, for the beach tailings.
- In the subsequent report "*Final Report: A Remediation Study on the Arsenic Contaminated "Beach Tailings" of the Giant Mine, Yellowknife, Northwest Territories"* March 2001, four remediation approaches were reviewed: dredging, excavation, containment and phytoremediation. The recommended reclamation option was to excavate the tailings and establish aquatic plants in the excavation.

- In October-November 2001, in apparent opposition to the recommendation of above cited reports, a portion of the Tailings Beach scarp was flattened and a geotextile-gravel-rip-rap cover placed on the tailings. This in-situ stabilization option is proposed in the Draft Plan.
- The proponent is requested to provide the basis for this apparent shift in decommissioning option from that initially recommended. Only the summaries of the above cited reports were provided with the Draft Plan. The rationale may be contained in the subsequent "*Environmental Assessment Yellowknife Bay Tailings, Giant Mine Yellowknife, NT, March 2002*" although the brief overview of that document in the Supporting Document F1 (pg 5-6) does not indicate any reason. As noted above, the decision had been made and acted on before that environmental assessment.

5.7.5 Water Treatment and Sludge Disposal

- Is there any estimate of how much volume will be needed in the sludge landfills for the new water treatment facilities?
- It has been proposed that treated water (which meets the discharge criteria) will be pumped through a pipeline into Back Bay which will run underwater for some distance out into the bay, and a diffuser system on the end of the pipe will be designed to ensure rapid dilution of the treated water. The use of a diffuser is reasonable if discharge quality is good, i.e. will not cause chronic toxicity outside a minimal mixing zone. The plan must also consider loadings; will a new area of sediments accumulate contaminants? In addition, excess capacity and system redundancy will need to be planned for, in case of worse than predicted water quality, higher quantities and/or treatment or pumping system upsets.

Section 5.8 Baker Creek

- Baker Creek winds through a watershed contaminated by historic mining activity. About seven eighths of the Creek flow reaching Yellowknife Bay (Table 4.6) is from upstream of the mine. However, about 72% of the arsenic load in the Creek at its mouth is from the Giant mine. During its passage through the minesite, the Creek passes over the dust-storage stopes (e.g. C212) and skirts problematic open pits and waste storage sites (calcine dump). The seasonal flows can be significant and problematic to handle. The Creek has been substantially altered through the mine site and provides little habitat and spawning opportunities.
- It is unclear if the Draft Plan considered entirely re-routing the stream around the mine property; i.e. intercepting the Creek before it enters the disturbed mine and routing it to Yellowknife Bay so as to totally avoid the mine-impacted area. Fish would not have to pass through the inhospitable reach through the mine and exposed to contaminants. Such a rerouting could address concerns for the pits and disposal sites. Some of the pit could perhaps now be flooded without any outlet. This should be considered and addressed in the Draft Plan.

Section 6: Assessment of Post-Remediation Conditions

- How likely is it that there will be absolutely no infiltration through the frozen arsenic dust (Table 6.3)? For example, is there any potential of cracks occurring in the frozen ice block that would allow water form outside or on top of the frozen block to flow through the block and contact the arsenic?
- The reference to *"Supporting Document 6"* in Section 6.2 is unclear. Should the reference be to Supporting Document N1?

Section 7: Monitoring Plans

- In general, this Section does not distinguish between closure vs. post-closure monitoring activities. It is recommended that the distinction be made given that monitoring plans will change during various phases of the mine life.
- This Section provides very little detail in terms of surface water and biological monitoring making it difficult to determine what is being planned and how this monitoring will relate to the past monitoring studies, or how the information gathered will be used. It is recommended that more detailed information be provided in this Section, including a brief description of EEM requirements for the site (EEM related reports could be presented as supporting documents).
- In terms of the request from DIAND to have EC take over responsibilities of the EEM program, it would first depend whether or not FCSAP funding would cover this aspect of the program. EC HQ is currently considering whether or not FCSAP funds could be applied to EEM program costs. If approved, the EC Yellowknife office would be open to discussing the idea further, with the understanding that EC would be managing the contracts with the consultants who would be conducting the EEM program.

Section 7.2 Water Treatment Discharge Monitoring

- As indicated in the Plan (pg. 126), the site must be in compliance with the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* during operation, closure and post-closure, which also includes the Environmental Effects Monitoring Program (EEM) that Miramar Giant Mine Ltd. has recently begun (see Attachments A&B: MMER and EEM Requirements).
- What contingency plans are in place or will be developed to address situations in which monitoring activities indicate unacceptable levels of contaminants in air, water, or biota? For example, what measures will be put in place if groundwater monitoring (7.6) indicates that contaminated water is migrating away from the source?

Section 7.5 Surface Water Monitoring

- Any identified historical seepage pathways on site should be monitored during closure and post-closure.
- Any potential arsenic re-mobilization from sediments occurring along Baker Creek into Great Slave Lake (including historical tailings deposited in Back Bay) should be monitored during closure and post-closure.
- It is recommended that sediments be monitored to determine whether arsenic loading is occurring in the vicinity of the new discharge pipe.

Section 8: Implementation Schedule

- The implementation schedule was very helpful (i.e. Figure 8.1). Please clarify when the new treatment facilities would be built/operational, and when water storage would switch from the tailings ponds to underground storage. Also, please indicate what portion of the underground workings will be flooded at each stage in the freezing process. In addition, it is suggested that reference is made Figure 8.1 earlier in the document so that individual activities can be put in the context of other remediation activities.

Misc. Items

- Time to freeze the ground. This is an item which may have been addressed but I could not find in the submitted Draft Plan. At other mines, the freezing of geological materials has been affected the character of the geological strata. For example, if the Arsenic Trioxide releases heat energy (exothermic) when wetted, the time required to freeze may be longer than anticipated and require more effort to draw out the heat. The effect may not affect the long-term stability of the alternative, but affect the time schedule

- Pending or Missing Reports. The supporting Document, Tailings Dispersion in Back Bay (Golder 2004) remains to be added to the EIS package. Although it is recognized that a substantial body of information has been undertaken over the years at the Giant site, consideration should be given to including some of the supporting cited reports. For example, the decision to cover the Beach Tailings was not supported in the material available in the Draft Plan and may be contained in reports not provided in the Plan.
- Interim reports, such as Supporting Document F3, remain to be finalized and all outstanding information described and assessed. I understand that some of the reports are also being revised and will need to be included.
- Structure of the Document. Lastly, an Executive Summary for the Draft Plan would have provided context for the following chapters. Similarly, the individual chapters could have similarly been structured. At the end of each Chapter tended to be the summary.

The Canadian Wildlife Service (CWS) of Environment Canada has reviewed the above-mentioned Remediation Plan and makes the following comments and recommendations pursuant to the *Migratory Birds Convention Act* (the *Act*) and *Migratory Birds Regulations* (the *Regulations)*, and the *Species at Risk Act* (SARA).

- Section 6 (a) of the *Migratory Birds Regulations* states that no one shall disturb or destroy the nests or eggs of migratory birds. Therefore, if the proponent is conducting activities during the migratory bird breeding season, which extends from approximately May 1 to July 15, and active nests (i.e. nests containing eggs or young) are encountered, the proponent should avoid the area until nesting is complete (i.e. the young have left the vicinity of the nest).
- Section 35 of the *Migratory Birds Regulations* states that no person shall deposit or permit to be deposited, oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds.
- The proponent must ensure they remain in compliance with the *Species at Risk Act*, *Migratory Birds Convention Act* and *Migratory Birds Regulations* during all phases and in all undertakings related to the project.

Supporting Document: Ecological Risk Assessment: "Draft Report, Tier 2 Risk Assessment - Giant Mine Remediation Plan" (SENES Consulting Ltd., 2005).

A. The following comments address primarily the suitability of recommendations within the Ecological Risk Assessment report and on apparent weaknesses in the risk assessment protocol.

General:

- The most significant item of concern in the ERA is the use of a 75% protection level for deriving a critical toxicity value for aquatic species that was then used to determine whether a risk existing and the significance of that risk. This protection level was based on an Environment Canada Guidance Manual for conducting chemical risk assessments. It is out of date and we are now considering whether 90 or 95% protection levels are more appropriate. Therefore, the result of this assumption on the part of the consultant may be an under-estimation of the risk to aquatic biota in the affected areas.
- As well, the ERA uses a strictly numerical approach to determining risk to terrestrial organisms, when it should have included more information that likely exists to develop a line-of-evidence approach. Most importantly is the lack of small carnivores, like mink, in the Baker Creek area. The question is whether mink ever existed there, or have they been extirpated from the watershed due to historical arsenic exposure. Mink are very sensitive to pollutants and are easily extirpated by rather low doses that may do little harm to other organisms. Public surveys (traditional/local knowledge) of whether mink/marten/fisher ever existed in the Yellowknife area would help to firm up whether their risk factors are significant.

S 5.1.1 Aquatic Toxicity Reference Values Pg 5-1

It states: "In this assessment, EC25 values or values which have the potential to affect 25% of the population were used to determine whether arsenic is likely to cause adverse effects in aquatic receptors in Baker Creek or Yellowknife Bay. The EC25 value is suggested by Environment Canada for use in Tier 2 assessments (Environment Canada 1997)."

Environment Canada 1997. *Environmental Assessments of Priority Substances Under the Canadian Environmental Protection Act.* Guidance Manual Version 1.0. EPS 2/CC/3E Chemicals Evaluation Division, Commercial Chemicals Evaluation Branch, Environment Canada. March.

This Guidance Manual is for conducting chemical risk assessments on existing chemicals, the process is significantly different from conducting risk assessments on contaminated sites and the terminology is not the same. In Chemical risk assessments "Tier II" means a process that uses reasonable point estimates of exposure concentrations and sensitive Canadian species that may be exposed to a chemical to generate a Risk Quotient with an appropriate application factor depending on specific data concerns. At the moment, Environment Canada, Existing Substances Branch-HQ, is discussing the appropriateness of using 90 or 95% protection levels.

The toxicity reference values to generate the screening indices are based on a 75% protection level for aquatic species; this is currently considered to be too low for Environment Canada; 90 or 95% protection for aquatic life should be considered for benthic and swimming organisms. The toxicity reference values should be recalculated and then the Screening Indices should be recalculated for Baker Creek and Back Bay.

Sediment Quality Predictions, Baker Creek, Back Bay and North Yellowknife Bay Pgs 6-11 to 6-15

This section identifies considerable impact on the aquatic ecosystems of Baker Creek, Back Bay and North Yellowknife Bay from the mine and its operations.

> It states: "The findings of the benthic community surveys support the results of the risk assessment. In the short-term, therefore, it is expected that the diversity of the benthic community will be impaired. In the long-term however, as sediment quality improves, it is reasonable to assume that a healthy, diverse benthic community will re-establish itself in most parts of Back Bay. Benthic community surveys will be necessary to verify this conclusion."

The sediment quality in portions of Baker Creek will remain excessively high (>1800 µg/g) in 2100, the extent of the modeling. It can be assumed that the benthic invertebrate community in these portions of the stream likely will not recover within this timeframe as the predicted concentration is considerably in excess of published Severe Effect Levels for arsenic. The sediment quality in Back Bay did not improve noticeably between the 1975 survey by Moore and the 2004 survey by Golder Associates, nor did the benthic invertebrate population. By 2100 the arsenic concentration in Back Bay will still be around 650 µg/g, well above any of the predicted sediment Probable and Severe Effect Levels (Table 6.1-3), so it can be assumed that the benthic invertebrates will also not recover. In 2100 the sediment quality in North Yellowknife Bay will still be above the Effects Range Medium (Table 6.1-3) for arsenic regardless of which remediation case is used. As this marginal sediment improvement is due to arsenic concentrations continuing to enter Baker Creek and the other water systems, and due to the low sedimentation rate in the system, it can be assumed that all of these water bodies will remain significantly degraded for the foreseeable future with remediation Cases 1 and 2.

It appears that the improvement of the benthic invertebrates off-site is not a priority for the mine. Waiting for more than 100 years for an improvement to occur is not an acceptable practice. The remediation plans should consider remediating the most severely contaminated sediments in Great Bear Lake and the remaining contaminated sediments in Baker Creek should be removed.

Risk Assessment

A better description of what Cases 1 and 2 represent within the remediation plan would make the risk assessment more understandable. Which of these cases represents what is to be accomplished in the remediation plan?

Risk Assessment Aquatic Pg 6-17

> It states: "This finding supports the results of this assessment which suggest that aquatic species are not at risk of adverse effects at current arsenic levels in Baker Creek water when there is no effluent release to the watershed from the mine water treatment plant."

The benthic invertebrates in portions of Baker Creek that will not be remediated will continue to be seriously impacted from sediment concentrations regardless of what is in the water; therefore, it is not accurate to state that aquatic species are not at risk.

Risk Assessment Terrestrial Pg 6-24

One problem in using strictly a numerical risk assessment approach is how to deal with species that are absent from the area, but have a reasonable likelihood of being present. This is the case with mink. They are known to be highly sensitive to pollutants and will suffer reproductive failure at relatively low concentrations. Considering the arsenic concentrations in mink food, the risk quotients for mink above 1 and the absence of mink from the area should form a line-of-evidence that seems to indicate that mink may be extirpated from this watershed as a result of the mine. Traditional/local knowledge on the historical presence/absence of mink (or on other species

that may have been in the area) from the area could be collected as a further line of evidence to determine if mink were ever in the area.

Risk Assessment 6.2.3 Overall Ecological Significance

Pg 6-34

> It states "Secondly, ecological significance can be evaluated in terms of the production dynamics of the selected ecological receptors. An effects concentration (EC25/LC25) was chosen as a toxicity reference value because effects or changes in populations in this range are generally not distinguishable from natural variation. Thus, an exceedance of the EC25/LC25 indicates that there is an increased risk of an effect on the population."

The consultant chose the EC25/LC25 effects concentration based on an out-dated Environment Canada publication for a risk assessment process that was not intended for contaminated sites risk assessment. There was no mention by either the consultant or Environment Canada that a 25% impact in a population is not distinguishable from natural variation, this number was chosen to be statistically significant in a data set. Environment Canada is currently revising its Guidance Manual and is now considering either a 10% or even a 5% effect level as being more appropriate. In fact, a 5% continuous, additional impact on a population over natural impacts like predation on a sensitive portion of an organism's life history can cause a slow but steady decline in population numbers. This effect depends on the type of organism and what part of the life history is impacted. For small, fecund organisms (r-selected species like many fish, hares, mink, etc.) the population can experience a population decline with a 5% reduction in birth rate or survival of young because these species depend on a high birth rate to maintain population numbers. For large, slow growing species with few young (K-selected species like moose, wolves, etc.) a 5% additional reduction in adult survival can have a concomitant reduction in population numbers because they depend on a long adult life span and reproduction over many years to maintain a population (Sample, et al. 2000).

These conclusions may not be valid considering the choice in selecting a 75% effects concentration for a Tier II ERA on a contaminated site. It is recommended that an EC10/LC10 or even an EC5/LC5 effects concentration be used. These numbers should be recalculated and the effects re-assessed in that context.

Pg 6-34

> It states: "With respect to benthic invertebrates, the risk assessment results indicate that there is a potential risk of lower species diversity in Baker Creek, Back Bay and perhaps North Yellowknife Bay at existing arsenic levels in the sediments. Field investigations on Baker Creek and Back Bay have shown reduced densities and species diversity in areas with elevated arsenic levels in the bottom sediments. These findings support the risk assessment results. In the future, as the arsenic concentration in the sediments decline, it is not unreasonable to expect that the diversity and population of benthic invertebrates will increase."

The arsenic concentrations in these affected areas, with the possible exception of Baker Creek if it is re-routed, are not expected to drop below significantly toxic concentrations within this century. The consultant’s conclusion is not appropriate based on this data. This part of the conclusion should be re-written to identify on-going, significant impacts on benthic organisms for the foreseeable future. Remediation plans may be appropriate for the most contaminated portions of Back Bay and Baker Creek.

Pg 6-38

> It states: "If these results are extrapolated to mink or other small terrestrial mammals that have a significant aquatic based diet, it is unlikely that adverse effects will be observed in any of these populations."

This is not necessarily true; mink are known to be highly sensitive to pollutants and may be at risk. As well, there are no mink currently in the Baker Creek watershed, which may be a line of evidence for an impact, if they are reasonably expected to be there.

Pg 6-34

> It states: With respect to benthic invertebrates, the risk assessment results indicate that there is a potential risk of lower species diversity in Baker Creek, Back Bay and perhaps North Yellowknife Bay at existing arsenic levels in the sediments. Field investigations on Baker Creek and Back Bay have shown reduced densities and species diversity in areas with elevated arsenic levels in the bottom sediments. These findings support the risk assessment results. In the future, as the arsenic concentration in the sediments decline, it is not unreasonable to expect that the diversity and population of benthic invertebrates will increase.

As we pointed out, the "future" in these cases will be much longer than 95 years, therefore this is an unreasonable expectation of recovery. While capturing contaminated sediments from much of the lake is not feasible, the remediation plan should include a discussion of options to remediate the most contaminated areas of Back Bay.

Pg 6-37

> It states: "The significance of the predicted and measured levels in fish from Baker Creek may be inferred by comparison to effects data reported in the literature. Data contained in the SETAC database indicates that at a concentration of between 3 to 13.5 µg/g (ww) a 50% decrease in growth and survival of rainbow trout (the only species for which data are reported) has been observed. While the data for rainbow trout are not necessarily directly applicable to other fish species, the data do support the results of the risk assessment that suggest that fish in Baker Creek may potentially be at risk of adverse effects."

It is not easy to determine if these predicted impacts are after the rechannelization of Baker Creek, as Cases 1 and 2 were not properly put into context with the remediation plans for the Creek. This should be done.

Supporting Document: Ecological Risk Assessment: "Draft Report, Tier 2 Risk Assessment - Giant Mine Remediation Plan" (SENES Consulting Ltd., 2005).

B. The following comments were prepared using a portion of the Reviewer's Checklist for Risk Assessments from the Ontario Ministry of the Environment:

1. General

Were the site-specific objective(s) of the risk assessment stated?

Yes. The site specific objectives of the risk assessment were stated: "The current risk assessment involved the evaluation of the different remedial options for arsenic contamination on the surface of the Giant Mine site as well as possible future releases of arsenic from the underground workings" (p. 1-1).

Was the scope of the assessment described (e.g. in terms of the complexity of the assessment and rationale, data needs, and overview of the study design)?

Yes. The scope of the assessment was described: "Therefore, this assessment considered exposure via water pathways of several aquatic and terrestrial species. Exposure of several of the terrestrial species to contaminated soils, sediments and terrestrial vegetation was also considered…The risk assessment included a complete review of available data on arsenic levels in various media, recent biological studies on fish and muskrat in Baker Creek and benthic invertebrate studies in Baker Creek and Back Bay, prediction of arsenic intakes by ecological and human "receptors", and a comparison of the predicted intakes to toxicological reference values. As was done previously, the risk assessment was undertaken within a probabilistic modeling framework" (p. 1-2).

2. Problem Formulation / Hazard Identification

a. Site Characteristics

Was an adequate history of site activities provided, including a chronology of land use (e.g. specifying agriculture, industry, recreation, waste deposition, and residential development at the site)?

Site history is included in Section 2 of the Giant Mine Remediation Draft Plan (SRK Consulting, 2005).

Was a general map of the site depicting boundaries and surface topography included, which illustrates site features, such as fences, ponds, structures, as well as geographical relationships between specific potential receptors and the site?

There was a site map showing the location of the mine site in relation to the City of Yellowknife, Dettah Community, and the three sections of Yellowknife Bay (Back Bay, North Yellowknife Bay, South Yellowknife Bay).

Additional maps were included in the Giant Mine Remediation Draft Plan (SRK Consulting, 2005). These maps showed site boundaries, surface topography, water bodies, and mine structures.

Were the current and future land use identified and adequately described?

Current and future land uses were not identified in the risk assessment document. However, one of the remediation objectives identified in the Giant Mine Remediation Draft Plan (SRK Consulting, 2005) was "to make the surface of the site usable by future generations, including industrial use of the central portion of the site, and traditional and recreational use of the remainder, while recognizing that portions of the site will require perpetual land use restrictions (p. 2)".

Was a qualitative overview of the nature of contamination included (e.g. specifying in a general manner the potential or suspected sources of contaminants, types and concentration of contaminants detected at the site, media potentially contaminated as well as potential exposure pathways and receptors)?

- The risk assessment identified the following sources of arsenic: treated mine water released to Baker Creek or Back Bay, vegetation on site, soil on site, and runoff to Baker Creek.
- The risk assessment makes reference to previous studies that measured arsenic in water, surface sediments, soil, and biota.
- The risk assessment considered the following aquatic receptors: aquatic plants, predator fish, bottom feeder fish, and benthic invertebrates. The risk assessment considered the following terrestrial receptors: barren ground caribou, moose, muskrat, snowshoe hare, spruce grouse, black bear, ducks (mallard, merganser, scaup), mink, and wolf.
- The risk assessment considered exposure to terrestrial receptors (except ducks) through ingestion of food, water, and soil/sediment (Figure 3.2-1).

Were key site characteristics documented?

- **soil/sediment parameters (e.g. particle size, pH, redox potential, soil type, organic carbon and clay content, bulk density, porosity)**
- **hydrogeological parameters (e.g. hydraulic gradient, pH/Eh, hydraulic conductivity, location, saturated thickness, direction, and rate of flow of aquifers, relative location of bedrock layer)**
- **hydrological parameters (e.g. hardness, pH, dissolved oxygen, temperature, total suspended solids, flow rates, and depths of rivers or streams; estuary as well as lake parameters such as area, volume, depth)**
- **meteorological parameters (e.g. direction of prevailing wind, average wind speed, temperature, humidity, annual average and 24 hour maximum rainfall)**

Yes. Key site characteristics were documented in the supporting documents of the Giant Mine Remediation Draft Plan (SRK Consulting, 2005).

2.2 Data Collection

Was there a statement specifying both the qualitative and quantitative nature of the sampling data, in terms of relative quality and adequacy for use for the intended objectives of the study?

No. Environmental data from the Yellowknife area were compiled from several sources and used in the risk assessment to characterize source inputs to the pathways analysis of arsenic intakes by terrestrial receptors. Although the data are referenced, the risk assessment does not specifically evaluate the quality and adequacy of the existing data.

Were all appropriate media sampled? Was there adequate justification for any omissions?

Yes. Soil, sediment, surface water, groundwater, air, and biota have been sampled at this site, though not specifically for this risk assessment.

Were all key areas sampled, based on all available information?

Yes.

- Water samples were taken from Baker Creek, Yellowknife River, Back Bay, North Yellowknife Bay, and South Yellowknife Bay (Table 2.3-1). Water samples were not collected from the tailings ponds or other surface water ponds. Surface water ponds were, however, considered in the assessment of risks.
- Surface sediments were sampled from Baker Creek, Back Bay, and Yellowknife Bay (Table 2.3-2).
- Fish were sampled from Baker Creek, Yellowknife Bay, and Resolution Bay (Table 2.3-3).
- Aquatic vegetation were sampled in the Yellowknife Area (Table 2.2-4) but the locations were not specified further.

- Soil was collected from Giant Mine property, Giant Mine Townsite, Latham Island, Dettah, and Yellowknife (Table 2.3-1).
- Terrestrial vegetation (moss, lichen, mushrooms – Table 2.3-2, birch, black spruce, grass, rose bushes, red raspberry, squirreltail barley) was collected from the Yellowknife area.
- Berries (raspberry, gooseberry, cranberry, rose hip and blueberry) were collected from Yellowknife, Giant Mine, Joliffe Island, and Dettah Road (Table 2.3-3).
- Muskrats living on Baker Creek were sampled (Table 2.3-5)

Did sampling include media along potential routes of migration (e.g. between the contaminant source and potential future exposure points)?

Yes. Water, sediments, and fish were sampled in Baker Creek, which could serve as a route of migration of contaminants from the mine site into Yellowknife Bay.

Were sampling locations consistent with nature of contamination (e.g. at the appropriate depth; at potential release locations for groundwater sampling)?

Yes. Soils were sampled from a range of depths. Sediments were sampled from only the top 5 cm.

Was ground water monitoring sufficient to identify contaminant plumes?

N/A. Pumping water out of the mine has resulted in the hydraulic gradient being directed towards the mine.

Were sampling maps provided, indicating the location, type, and numerical code of each sample?

Sampling maps were not provided in the risk assessment, though some of the supporting documents included such maps.

Were sampling efforts consistent with field screening and visual observations in locating "hot spots"?

N/A. Extensive sampling has occurred at this site.

Were analyses conducted for all chemicals identified in Phase 1 as potential contaminants?

The Giant Mine Remediation Draft Plan (SRK Consulting, 2005) summarizes which potential contaminants were analysed for in samples from the arsenic trioxide dust, waste rock, soils, water, biota, etc. However, the risk assessment focused exclusively on arsenic.

Were analyses conducted for toxicologically important degradation products?

N/A. The key contaminant at this site is arsenic, which will not degrade.

Did sampling include appropriate QA/QC measures (e.g. replicates, traveling blanks, traveling spiked blanks)?

This information is not reported in the risk assessment, but may have been included in the original studies in which the samples were collected.

If background samples were collected, were they collected from appropriate areas (e.g. areas proximate to the site, free of potential contamination by site chemicals or anthropogenic sources, and similar to the site in topography, geology, meteorology, and other physical characteristics) using methodologies consistent with the development of Ontario OTRs?

Samples taken from the vicinity of the Giant Mine site (e.g. upstream reaches of Baker Creek) are not suitable background samples because of historical deposition of arsenic from roasting operations.

The risk assessment used data on contaminant levels in wildlife from elsewhere in the NWT as a reference level and comparison for predicted levels. Arsenic was below detection limits for the vast majority of samples.

2.3 Data Evaluation

Were appropriate analytical methods, i.e. in accordance with the document "Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario" (MOEE, 1996), employed for collection of data upon which risk estimates are based?

Information on analytical methods was not included in the risk assessment.

Where monitoring data for specific chemicals indicated "< detection limit", were the method detection limits for these chemicals acceptable to the Ministry as defined in the document "Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario" (MOEE, 1996)?

Detection limits were not reported in the risk assessment. Sampling and analyses were conducted by various entities at different times so detection limits may have varied.

Where monitoring data show sample detection limits to be higher than method detection limits, are the results inconsequential?

This information was not reported in the risk assessment.

Were any site-related chemicals eliminated without appropriate justification?
- as infrequently detected chemicals?
- as common laboratory contaminants even though sample concentrations were significantly higher than that found in blanks?
- as present at a "ubiquitous level"?

Yes. Only arsenic was considered in the risk assessment. Although arsenic is the contaminant of highest concern, other metals co-occur with arsenic in some areas of the site. In addition, at least 15,000 cubic metres of soil are estimated to be contaminated with hydrocarbons.

Were inappropriate "proxy concentrations" assigned to site-related chemicals?
- was a value of zero or half the method detection limit (MDL) assigned?
- was an erroneous sample-specific quantitation employed?

For the summary of arsenic measured in surface waters (Table 2.3-1) and summary of arsenic measured in fish muscle (Table 2.3-3), values measured as < the detection limit were considered as ½ the detection limit.

Were uncertainties, limitations and gaps in the quality of collection or analysis adequately addressed?

No. The risk assessment did not discuss the uncertainties, limitations, or quality of sample collection or analysis. However, some or all of the original studies may have discussed these considerations

Were groundwater flow directions identified correctly?

Yes. Groundwater monitoring indicated that the hydraulic gradient is currently directed towards the mine. However, reflooding the mine might reverse the groundwater gradients and lead to movement of water away from the mine.

Does the report integrate the sampling, data interpretation, and modeling results into a consistent and reasonable conceptual model?

No. The risk assessment integrates sampling and modeling, but does not present a conceptual model for the site.

2.4 Contaminants Selected for Detailed Analysis

If screening is involved to reduce the number of chemicals for detailed risk assessment, were criteria for chemical selection provided? Were the criteria consistent with the general guidance provided in Appendix A, appropriate for the site and for the specific problem at hand?

No criteria for chemical selection were provided in the risk assessment. The Giant Mine Remediation Draft Plan (SRK Consulting, 2005) noted that exceedences of industrial criteria for the other metals co-occurred with arsenic. There was no explanation of why hydrocarbons were excluded from the risk assessment.

Were the chemical selection criteria appropriately applied to the list of contaminants found on site and was the application well documented?

N/A

If the pH of the soil was outside the ranges specified in the guidelines, was Table F, and not Table A, used as a screening tool?

N/A

Was the exclusion of any chemical from detailed analysis unjustified? Should any contaminants excluded as a result of the chemical selection process be considered for evaluation?

Yes. Hydrocarbons should be included in the assessment or better rationale provided for their exclusion.

Where a chemical detected at the site has the potential to degrade to toxicologically important species, have the degradation products been considered?

N/A

3. Other Comments

To assess the overall content and any information gaps

a. Exposure pathways did not include ingestion of tailings, from the tailings/sludge containment areas and/or those deposited directly into Back Bay.
b. Figure 3.2-1 could be improved by adding potential exposure pathways and ingestion rates for the three duck species and the four aquatic species. The description in the text implies that this figure represents the potential pathways for all the aquatic and terrestrial species but this is not the case.
c. Consider including, in Figure 3.2-1 or an associated conceptual model, exposure pathways through direct contact with contaminated water, soil, and sediments. These exposure pathways would be particularly relevant for the aquatic receptors.
d. Additional discussion of quality of the previously collected data and its relevance to the assessment would improve confidence in the conclusions of the assessment. For example, the previously collected data could have been evaluated by considering collection and analysis protocols, detection limits, QA/QC protocols, etc.
e. Clarify how Case 1 and Case 2 relate to current conditions and the planned remediation activities. It is not evident what is being modeled by these two scenarios.

To identify any environmental and human health risks that may have been overlooked

f. This risk assessment does not consider exposure to the other metals that co-occur with arsenic at some areas of the mine site.
g. This risk assessment does not consider exposure to hydrocarbons. The Giant Mine Remediation Draft Plan (SRK Consulting, 2005) identified at least 15,000 cubic metres of soil contaminated with hydrocarbons.

To recommend if additional follow-up may be necessary

h. The risk assessment should include a conceptual model that integrates information on contaminants, exposure pathways, receptors, and environmental characteristics. The exposure pathways presented in Figure 3.2-1 are a start, but the model should also include the sources of contaminants and present information on how those contaminants enter and move through the environment.

PART 2: FISHERIES & OCEANS CANADA (Provided June 16th, 2005)

As requested, and on behalf of the Department of Fisheries and Oceans, Fish Habitat Management – Western Arctic Area (DFO), I have reviewed the Giant Mine Remediation Draft Plan (Plan). My review was limited to potential impacts of the project on fish and fish habitat pursuant to the responsibilities of DFO under the habitat protection provisions of the Fisheries Act. Please note that Subsection 36(3) of the Fisheries Act, which deals with the deposit of deleterious substances, is primarily administered by Environment Canada.

It is my understanding that the above remediation plans are conceptual in nature. As DIAND moves progressively towards implementing each remediation measure, the intention is that detailed plans and engineering designs will be developed and submitted for review prior to implementation.

I am able to provide the following comments for this plan as specialist advice:

Section 3.6 Historic Foreshore Tailings
The Plan states that along the foreshore in the tailings disposal area the benthic invertebrate populations differ than surrounding areas, but that it is unclear if this is due to arsenic or the fine materials of the tailings. However, supporting Document F1 (Review of Yellowknife Bay Tailings Environmental Assessments, SRK Consulting, April 2004) indicates that it has been shown that elevated metal levels in the sediments does affect colonization by benthic organisms. It also identifies that the likelihood of submerged tailings have low use for fish spawning and rearing habitat is unlikely.

I recommend that options to remediate foreshore areas which have been affected by the deposit or migration of tailings should be investigated. This should include not only extending the existing riprap cover to just below the lake surface, but also covering the tailings where they occur in littoral zone. This would not only reduce migration of the tailings by lake currents and wave action, but also would likely stimulate benthic invertebrate production and create fish rearing feeding and spawning habitats.

Section 5.5.5 Tailings Covers
It is my understanding that a final layer of silt will be placed on top of the tailings as a medium for vegetation to grow in. Please note that the deposit of a deleterious substance, including sediment, into water frequented by fish is prohibited under the Fisheries Act. Until a vegetative cover is established which effectively stabilizes any exposed fine materials, effective sediment and erosion measures should be implemented to prevent sediment laden runoff from entering any fish bearing waterbody.

Section 5.8 Baker Creek
In general, DFO fully supports the remediation concepts and recommendations presented in the Plan and Supporting Document entitled Baker Creek Restoration Concepts (SRK Consulting, March 2005), including cessation of the current discharge of treated effluent into the creek. DFO acknowledges that bottom and shoreline of Baker Pond, which does not currently support fish, has widespread deposits of contaminated mine tailings. It is my understanding that there are plans to investigate the extent and depth of these tailings. I recommend that all options to remediate Baker Pond so that it becomes a productive wetland are investigated. Areas of emergent vegetation are highly productive, and are important fish spawning, rearing and feeding habitats.

Please note: As described, the proposed plans for the remediation of the Historic Foreshore Tailings and Baker Creek will likely result in the harmful alteration, disruption or destruction of fish habitat, which is prohibited under Subsection 35(1) of the Fisheries Act unless authorized by the Minister of DFO. Detailed plans and engineering designs for each of these components should be forwarded to DFO for review pursuant to the Fisheries Act prior to implementation.

DFO appreciates the opportunity to provide comments on the above plan and material. Please contact me at (867) 669-4927 if you have any questions or wish to discuss any of the foregoing in more detail.

Ernest Watson
Area Habitat Biologist
Fish Habitat Management
Department of Fisheries and Oceans - Western Arctic Area

PART 3: HEALTH CANADA (Provided June 6th, 2005)

The following presents preliminary comments of Health Canada's Environmental Health Assessment Service (EHAS), regarding the evaluation of anticipated human health risks following two proposed remediation scenarios as presented in the report titled "Giant Mine Remediation Draft Plan" dated January 2005, prepared by SRK Consulting. Comments are limited to the report titled "Tier 2 Risk Assessment Giant Mine Remediation Plan" dated December 2004, prepared by SENES Consultants Limited. Given the complexity of probabilistic modelling, and the time frame requested for comments by EHAS, the comments presented herein may be augmented at a future date following a more detailed investigation of the input parameters and model assumptions utilized in this risk assessment.

Comments are divided under the following headings:

- **Toxicity Reference Endpoints**
- **Receptor Characteristics**
- **Bioaccessibility of Arsenic in Soils**
- **Risk Characterization, and Conclusions**

Toxicity Reference Endpoints

1. Cancer Slope Factor

In Canada and the U.S. there is currently some variation in opinions of the most appropriate oral slope factor for use in assessing human health exposure risks from arsenic. The slope factors that have been employed by various regulatory and advisory agencies range from 1.2 $(mg/kg\text{-}d)^{-1}$ (Health Canada, 2005) to 3.67 $(mg/kg\text{-}d)^{-1}$(US EPA, 2001). The slope factor utilized in the current risk assessment was 1.2 ($mg/kg\text{-}d)^{-1}$, as presented by the Federal-Provincial-Territorial Committee on Drinking Water Document for Public Comment. This slope factor was derived based on internal cancers. There is some concern for EHAS with the selection of this slope factor, as it is from a draft document awaiting public comment. Currently it is uncertain as to whether or not this proposed slope factor will be adopted as being the most appropriate slope factor for use with federal contaminated site risk assessment.

Currently, published recommendations for Federal Contaminated Site Risk Assessment (Health Canada, 2004) advocates the use of an oral slope factor of 2.8 $(mg/kg\text{-}d)^{-1}$, derived based on skin cancers, and sourced from Health Canada (1996). The US EPA (2001) "National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring", derived a slope factor of 3.67 $(mg/kg\text{-}d)^{-1}$ based on internal cancers. This slope factor has subsequently been used by the US Consumer Product Safety Commission (CPSC, 2003) in its assessment for children's risks from arsenic in CCA-treated playsets, and by the US EPA Office of Pesticide Programs (US EPA OPP, 2004) for its evaluation of risks caused from arsenic in its Preliminary Risk Assessment for Wood Preservatives Containing Arsenic and/or Chromium.

It should also be noted that conservatism may be warranted in the selection of an slope factor due to emerging information regarding the potential for increased susceptibility from early-life exposure to carcinogens. As the current risk assessment includes mainly residential exposures where infants and toddlers will be exposed to the contaminant in question, erring on the side of caution in the selection of a slope factor, may serve as a buffer if regulatory agencies begin to add safety factors for carcinogen exposure in the young, as the EPA has tentatively proposed in its Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens (US EPA, 2003).

Given this information, EHAS suggests, at the minimum, to present calculated risks for a range of potential slope factors, to reflect the current uncertainty in selecting an appropriate slope factor.

2. Non Cancer Toxicity Reference Value (TRV)

Carcinogenic endpoints are almost always more sensitive than non-carcinogenic endpoints. For this reason in its guidance for risk assessment for Federal Contaminated Sites, Health Canada (2004) does not include non-cancer toxicity reference values for arsenic. In Health Canada's (1996) Health-Based Tolerable Daily Intakes/Concentrations and Tumorigenic Doses/Concentrations for Priority Substances, the non cancer TDI for arsenic is also blank, and under the comment section the reader is instructed to refer to estimates for carcinogenic potential. However, there is a foot-note that indicates that the FAO/WHO had derived a provisional weekly intake for As and Cd.

As with cancer, there is currently no international agreement on the most appropriate non-carcinogenic TRV for arsenic. The FAO/WHO (1988) Expert Committee on Food Additives (JECFA) concluded that "on the basis of the data available, the Committee could arrive at only an estimate of 0.002 mg/kg-d as a provisional maximum tolerable daily intake for ingested inorganic arsenic." This number has been adopted by the Food Directorate as their *Provisional* Tolerable Daily Intake (PTDI) for foods. The current risk assessment for Giant Mine utilizes this PTDI for its assessment of non-cancer human health risks.

EHAS has some concerns with the reference dose selected for this risk assessment. These include noting that the JECFA did not include the rationale for the value of 0.002 mg/kg-d, that the Food Directorate has only adopted the TDI as a provisional value and, as mentioned in the risk assessment, other international regulatory bodies promote a substantially lower reference dose (USEPA, and ATSDR have recommended a reference dose/minimum risk level of 0.0003 mg/kg-d)

It should be noted that the WHO/FAO PTDI that was adopted by the Food Directorate of Health Canada is applied by this department to food-borne exposures only. This value is not endorsed by EHAS as being applicable to water-borne (dermal, ingestion), soil-borne (dermal, ingestion) nor particulate-borne (for inhalation) exposures. As is the recommendation for cancer slope factor, EHAS believes it would be preferable to present the risk outcomes utilizing both TRVs (*i.e.* 0.002 mg/kg-d and 0.0003 mg/kg-d). An assessment which shows no unacceptable risks using either TRV would remove the uncertainty of reference does selection from the evaluation. Conversely, an assessment which shows acceptable risks with one TRV, but unacceptable risks with the other, would indicate that selection of the most appropriate reference value deserves special attention, including a critical review of the assumptions utilized when developing these reference doses.

Receptor Characteristics

The current risk assessment presents risks for 2 life stages, a 70 kg adult, and a 32.9 kg child. Health Canada (1994) and the CCME (1996), identify 5 life stages and corresponding characteristics, that should be utilized for human health risk assessments. These are infants (0 to 6 months of age); toddlers (7 months to 4 years of age); children (5 to 11 years); teens (12 to 19 years); and adults (20+ years of age). It is particularly relevant that the toddler be evaluated, consistent with advice and guidance proffered by Health Canada, CCME, and most provinces/territories, as they often represent the critical receptor for residential land use scenarios.

For the current risk assessment, EHAS recommends that with the exception of the marina site, all other modelled locations include representatives from each of the 5 life stages. In addition it is recommended that for the cancer assessment, cancer risk is amortized over all life stages.

Bioaccessibility of Arsenic in Soils

In the current risk assessment, a bioaccessibility factor of 17% for arsenic present in soil and sediments was used. The use of this value is of concern to EHAS. The specific concerns over the current choice of bioaccessibility factor are outlined below.

1. The use of sediment data as surrogate for soil data.

The justification for utilizing river sediments as a surrogate for typical residential yard and garden topsoil (assumed to be the primary source of material for soil ingestion) was not presented in the report. Potential differences between river sediments and topsoil which may influence bioaccessibility of arsenic may include: variation in soil characteristics such as particle size (and associated surface area to particle volume or mass), particle composition (clays versus oxides/oxyhydroxides, silicates, etc.), soil chemistry such as soil pH, cation exchange capacity, redox conditions, organic carbon content and the presence of anionic species that form complexes with metal cations such as organic acids, phosphate, chloride, carbonate, sulfides and hydroxides. As reported by Risklogic (2002), Ollson *et al.* 2001, measured potential bioaccessibility of 5 soils samples representative of residential soils in Yellowknife and measured bioaccessibility in those samples ranging from 22.9% to 73.1%. This indicates that the use of river sediments may not be a suitable surrogate for yard and garden topsoils.

2. The use of a 1:20 ratio of soil : simulated gastric fluid.

Various researchers have noted that, at least for some contaminants, bioaccessibility increases with an increasing ratio of acidic leachate to soil mass. The following is excerpted from Richardson *et al.* (2005), in an article that has been accepted for publication by the journal Human and Ecological Risk Assessment:

> Hamel *et al.* (1998) found that, for one soil type, the measured bioaccessibility of arsenic increased by a factor of approximately 5 when the ratio of simulated gastric fluid (mL) to soil (g) was increased from 100:1 to 5000:1. A variety of ratios of simulated gastric fluid to soil have been employed for bioaccessibility assays, ranging from 5:1 to 5,000:1 (reviewed by Ollson, 2004). The most common assay designs for measuring the bioaccessibility of soil-borne contaminants employ a ratio of leachate volume to soil mass of 100 mL:1 g (Kelley *et al.*, 2002, among others), but none approach the ratios likely to exist in the toddler or adult GIT; a ratio on the order of 10,000 mL:1 g soil, or greater. Although the 100:1 ratio used in in vitro studies does not approach the ratios likely to exist in the toddler or adult GIT, in vivo data correlates reasonably well, at least for lead, suggesting it is a reasonable surrogate for this element in most cases. Unfortunately, at present, it is impossible to predict when or how the use of a 100:1 ratio will not produce representative results for other elements.
>
> Adults are thought to ingest between 20 mg of soil per day (CCME, 1996) and 100 mg per day (USEPA, 1997), on average. Average soil ingestion by toddlers (assumed to be 0.6 years to 4 years of age) is higher at between 80 mg per day (CCME, 1996) and 400 mg per day (USEPA, 1997). Soil ingestion is unlikely to occur at a uniform rate throughout the day. However, it is also unlikely to be delivered as a single bolus dose, but be distributed irregularly (in both time and mass ingested) throughout waking hours (12 to 16 hours per day).
>
> The volume of gastric fluid produced in 12 hours by an adult averages about 960 ml at basal volume output but would exceed this amount when periods of stimulation (eating and digestion) are included (Lentner, 1981). Toddlers produce somewhat less gastric fluid at basal output but the total still approaches about a litre over a 12 hour period when stimulation is included (Lentner 1981). Therefore, the predicted ratio of gastric fluid (in mL) to soil (in g) in toddlers ranges from about 12,500:1 (1,000 mL of fluid to 0.08 g of

soil) to 2,500:1 (1,000 mL of fluid to 0.4 g of soil). For adults, this ratio could range between 50,000:1 (1,000 mL of fluid to 0.02 g of soil) to 10,000:1 (1,000 mL of fluid to 0.1 g of soil).

3. The use of overall mean value instead of upper 95% confidence interval.

Risk Characterization, and Conclusions

2. Non-Cancer risk assessment

From Section 7.5 of the Tier 2 risk Assessment - Giant Mine Remediation Plan:
"*People living in the study area are not at risk of adverse effects from arsenic exposure even though arsenic levels in the area are higher than found in most communities. The estimated total arsenic intakes for Yellowknife area residents are below the Health Canada Toxicity Reference Value.....*"

Not including concerns presented by EHAS in the previous sections, this statement appears to be incongruous with what is presented in Section 6.3.7:

"*At the 95th percentile level, the predicted total arsenic intakes for all child receptors were above the TRV. As well, the 95th percentile arsenic intake estimate for the most exposed adult (Receptor 4a) was above the TRV in the Case 2 remediation scenario.*"

3. Carcinogenic Risk assessment

From Section 6.3.6:
"Figure 6.3-10 provides a comparison of the predicted arsenic risks for Receptor 4 to other Canadian cancer statistics. As seen in the figure, the predicted cancer risks are below the lifetime incidence cancer rate of 3 in 10 for the Northwest Territories population (Canadian Cancer Statistics) as well as being below the risks of developing lung cancer (5 in 100) or developing skin cancer in the Canadian population (2 in 100). These results suggest that the development of lung cancer from exposure to arsenic present on or released from the Giant Mine site will not be distinguishable in the Yellowknife population from other causes of cancer."

And section 6.3.5:
"*In several of these communities, none to date has reported skin cancer (or other adverse effects associated with arsenic exposure) in cross-sectional evaluation of either the entire community (Chapels Cove, Newfoundland, arsenic in drinking water) or a population sample (Wawa, Deloro, arsenic in soil). Although these cross-sectional evaluations may not constitute an accurate measure of incidence of skin cancer in these communities, they do reflect an indirect measure of incidence. These results are not unexpected since the intakes are below intakes associated with skin cancer or other types of cancer (liver and bladder) which are associated with arsenic exposure*"

The comparison of incremental lifetime cancer risk from a single source (arsenic present on or released from the Giant Mine site) to lifetime risks of an individual developing cancer in general can lead to confusion and is not considered appropriate for a contaminated site risk assessment. Comparing incremental lifetime risk to entire classes of cancers, in this case lung cancer and skin cancer, blends together voluntary actions such as smoking and sun-bathing, to involuntary actions, such as a child living with his or her parents in a community which has been contaminated by industrial pollution.

In addition, the development and the use of a acceptable lifetime incremental risk levels (eg. 1 in 100,000) is done precisely because of the difficulty of distinguishing the development of cancer

caused from a single source from the high background level of other cancers. This distinction becomes even more difficult when the exposed population is small, and therefore one would need several generations of data to be able to detect a significant pattern of cancer caused by a particular source. If a population is sufficiently small, it is possible that a significant pattern of cancer will not be able to ever be determined. Failure to definitively distinguish increases in cancer occurrence, does not in itself signify negligible or inconsequential cancer risks.

In closing, FCSAP Expert Departments will continue to participate in providing technical advise to DIAND as requested working towards environmentally sound remediation solutions and site-specific best practices with the intention of minimizing risks to human health and the environment.

If you have any questions or concerns, I can be contacted at (867) 669-4724 or via e-mail at lisa.lowman@ec.gc.ca with regard to the foregoing.

Yours Truly,

Lisa Lowman,
Environmental Assessment / Contaminated Sites Specialist

cc: Distribution List (attached)
Steve Harbicht, Head of A&M, EPB of Environment Canada
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ATTACHMENT A:

Metal Mining Effluent Regulations, Fisheries Act

- Giant Mine Requirements -

Prepared by Ken Russell, Enforcement Officer
Environmental Protection Branch, Environment Canada

Operational Phase

Miramar Giant Mine Ltd. (MGML) has been subject to the Metal Mining Effluent Regulations (MMER) as of December 06, 2002. The application which captured this particular mine is the fact that the mine site exceeded an effluent flow rate of 50 cubic meters per day, based on effluent deposited from all final discharge points of the entire mine site area. It should be noted that MGML is currently required to meet all conditions and parameters set forth under the MMER, this includes but is not limited to:

- Section 7 Environmental Effects Monitoring
- Section 12 Effluent Monitoring Conditions
- Section 14 Acute Lethality Testing
- Section 17 *Daphnia magna* Monitoring Tests
- Schedule 5 Sampling Requirements
- Section 21 Reporting Monitoring Results

MGML is also currently subject to all provisions which fall under the MMER Schedule 5, Part 1 Effluent and Water Quality Monitoring Studies which include but is not limited to:

- Section 4 Effluent Characterization
- Section 5 Sublethal Toxicity Testing
- Section 7 Water Quality Monitoring

Additionally MGML is subject to all provisions set out under the MMER Schedule 5, Part 2 Biological Monitoring Studies, this includes but is not limited to:

- Section 9 Biological Monitoring Studies
- Section 10 First Study Design
- Section 16 Assessment of Data Collected from the Studies
- Section 19 Subsequent Biological Monitoring Studies
- Section 23 Final Biological Monitoring Study Prior to Closing a Mine

Shut Down Phase

If MGML wishes to be recognized as a Closed Mine, MGML must comply with the provisions set forth under section 32 of the MMER. In order to be recognized as a closed mine MGML must:

- Maintain the mines rate of production at less than 25% of the design rated capacity for a continuous period of three years starting on the day a written notice was received by an Authorization Officer
- Conduct a Biological Monitoring during the three year period in accordance with Division 3 of Part 2 of Schedule 5 of the MMER

Once all of these conditions are met the mine may be granted Closed Mine Status and the provisions set forth under the MMER to authorize the deposit of a Deleterious Substance as described under the Fisheries Act, no longer apply.

Closed Phase

It is of significant importance to note that if the MMER are no longer applicable the **authority to deposit a deleterious substance as defined under the Fisheries Act no longer applies to the MGML mine site**

area as a whole. At this point any discharge from the MGML mine site area is subject to Section 36(3) of the Fisheries Act which **prohibits the deposit of ANY deleterious substance** of any type in waters frequented by fish or in any place under any condition where a deleterious substance or any other deleterious substance that results from a deposit of the deleterious substance may enter any such water.

ATTACHMENT B:

ENVIRONMENTAL EFFECTS MONITORING

Fact Sheet on "Metal Mining Environmental Effects Monitoring Program" prepared by Sandra Blenkinsopp, DOE

METAL MINING ENVIRONMENTAL EFFECTS MONITORING PROGRAM[1]

What is Environmental Effects Monitoring (EEM)?

EEM is a scientific monitoring approach that can be used to help determine the health of aquatic ecosystems potentially affected by human activity and the effectiveness of environmental protection measures.

EEM studies consist of iterative scientific evaluations of fish, fish habitat and fisheries resources. The program is set up in 2-6 year sequences of monitoring, interpretation and reporting phases, whereby the frequency and type of monitoring is dependent on the results from previous studies.

The EEM program for metal mining is based on a consensus agreement between stakeholders. The program requirements and associated guidance documents were developed through a multi-stakeholder consultation involving industry, government and community representatives.

All mines regulated under the Metal Mining Effluent Regulations (MMER), as part of the *Fisheries Act*, are required to conduct EEM as part of their authority to deposit effluent.

The MMER were registered June 6th, 2002 and were published in Canada Gazette II on June 19th, 2002 (SOR/DORS/2002-222).

EEM Objective:

The objective of the EEM program is to evaluate the effects of mine effluent on fish, fish habitat and the use of fisheries resources.

What are the Main EEM Requirements?

Section 7 of the MMER obligates the mine to: conduct EEM studies, submit reports within prescribed timelines and use standards of good scientific practice to conduct studies and interpret results. The "Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring" provides recommended scientific practices that can be used to meet the EEM requirements.

Section 23 of the MMER requires mines to submit their data to Environment Canada in a written and electronic format.

Section 32 of the MMER outlines the requirements for mines that wish to obtain recognized closed mine status.

Schedule 5 of the MMER presents the specific EEM requirements and is divided into 2 parts:

Part 1: Effluent and Water Quality Monitoring
Part 2: Biological Monitoring

Effluent and Water Quality Monitoring:

The objectives of effluent and water quality monitoring are to monitor changes and trends in the receiving environment and collect supporting information to help interpret biological monitoring data. This portion of EEM requires:

- Effluent characterization: conducted 4 times per calendar year on aliquots of samples taken for compliance monitoring of deleterious substances. Hardness and alkalinity must be measured, as well as the total concentrations of: Al, Cd, Fe, Hg, Mo, NH_3, NO^+_3.
- Sublethal toxicity testing: conducted twice per calendar year for the first three years, then once per year thereafter on aliquots of effluent taken for effluent characterization. Sublethal toxicity is tested using a fish, an invertebrate, a plant and an algal species. Mines can use historical sublethal toxicity data to reduce this frequency, if the mine has data to meet the requirements.
- Water quality monitoring: conducted four times per calendar year in both reference and exposure areas near each final discharge point *and* at the same time and in the same sampling areas as biological monitoring studies. The parameters measured for water quality monitoring are the same as those measured for effluent characterization plus: temperature, dissolved oxygen, deleterious substances and pH.

An effluent and water quality monitoring report must be submitted to Environment Canada yearly, by March 31st. This report outlines when and where

[1] Note: this factsheet is intended to provide an overview of the EEM requirements. Specific EEM requirements are outlined in the MMER and these regulations must be used in order to obtain compliance with the MMER.

samples were collected, the results of effluent characterization, sublethal toxicity testing and water quality monitoring, methodologies and method detection limits, and the QA/QC implemented.

Biological Monitoring:

The objectives of biological monitoring are to determine whether or not there are effects on fish, fish habitat and the use of fisheries resources. This portion of the EEM requires:

- A fish survey (if the concentration of effluent is >1% within 250 m of a final discharge point)
- A fish tissue analysis (if the effluent characterization identifies a concentration of total mercury in the effluent equal to or greater than 0.10 µg/L)
- A benthic invertebrate community survey.

Study Design

Study designs describe how, when, where, and what biological monitoring studies will be conducted, and present the scientific rationale for the EEM studies.

The first study design must be submitted by December 6, 2003. However, if historical biological data exists at a mine, the mine may submit a report that contains the scientific results of the historical study by December 6, 2003. These latter mines would then submit their first EEM study design by December 6, 2004.

The second and subsequent study designs must be submitted at least 6 months prior to conducting field monitoring.

Data Assessment

Statistical analyses are conducted on specific endpoints to determine if there are significant differences between the exposure area and the reference area. A significant difference represents an "effect" in EEM. Fish endpoints are indicators of population growth, reproduction, condition and survival.

Benthic invertebrate endpoints include: abundance, richness, Simpson's Diversity Index, Bray

Curtis Index. An effect in fish tissue is defined as measurements of total mercury that exceed 0.45 µg/g wet weight in exposure fish tissue, and that are statistically different from reference fish.

Interpretative Reports

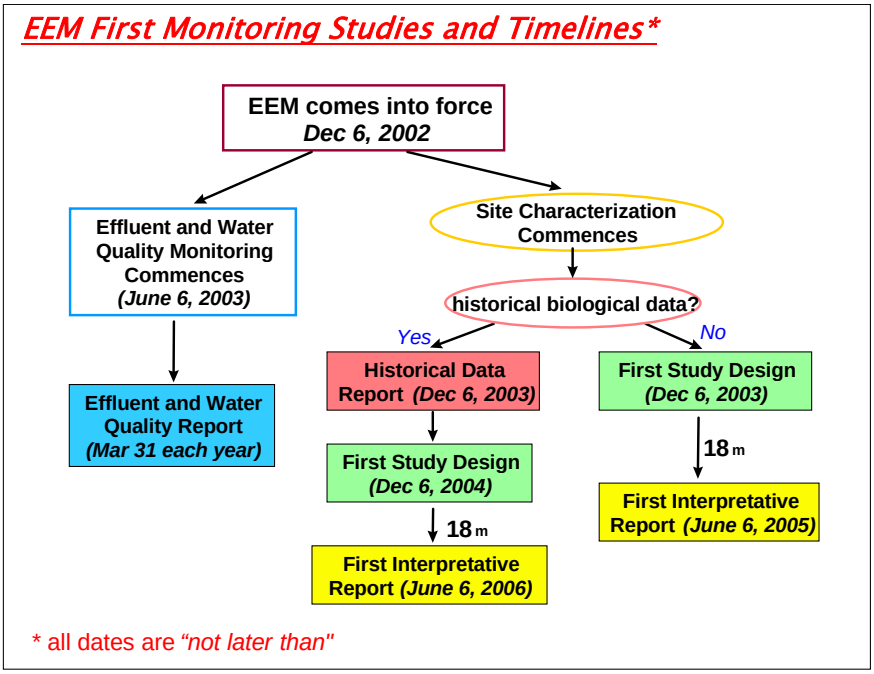
Interpretative reports outline changes in the study designs, present the monitoring and data interpretation results, the QA/QC procedures undertaken and the schedule for the next EEM phase.

For mines that did not submit a historical data report, the first interpretative report must be submitted by June 6, 2005. For mines that did submit a historical data report by December 6, 2003, the first interpretative report must be submitted by June 6, 2006.

The submission of the second and subsequent interpretive reports will depend on the results of previous monitoring. Generally, the frequency will be every 36 months; however it may range from 24 months (if effects are seen in all 3 components) to 72 months (if no effects are seen in any component of 2 consecutive biological monitoring studies).

Recognized Closed Mines

A mine is required to conduct a complete biological monitoring study, including the submission of an interpretive report, within 36 months of the owner or operator of the mine providing written notice of its intent to close. Effluent and water quality monitoring is continued until the mine obtains recognized closed mine status.



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Rhonda Miller

From: Kathleen Graham [kgraham@mvlwb.com]
Sent: Friday, January 25, 2008 8:43 AM
To: mitchellb@inac-ainc.gc.ca
Cc: Registry (permits)
Subject: FW: EC's Comments on Giant Mine WL Application: MV2007L8-0031
Attachments: GiantMineWaterLicenceRemediationPlanApplicationJan-2008.doc; RemediationPlanGiantMineFCSAPReviewJune22.doc; FCSAP-comments addressed May 2006.pdf

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From: Lowman,Lisa [Yel] [mailto:Lisa.Lowman@EC.GC.CA]
Sent: Thursday, January 24, 2008 7:36 PM
To: Kathleen Graham
Cc: Wilson,Anne [Yel]; Groskopf,Glenn [Reg]; Ogilvie,Carey [Yel]; Fournier,Mike [Yel]; Fox,Dave [Yel]; Robertson,Myra [Yel]; Watson,Ernest T: DFO XCA
Subject: EC's Comments on Giant Mine WL Application: MV2007L8-0031

Hi Kathleen,

Please find attached EC's comments on DIAND's Water Licence Application (MV2007L8-0031). Also attached are two supporting documents that accompany the comment letter. Please post all on the public registry.

If you have any questions, please do not hesitate to call me at 669-4724.

Thanks,
Lisa.

<<GiantMineWaterLicenceRemediationPlanApplicationJan-2008.doc>>
<<RemediationPlanGiantMineFCSAPReviewJune22.doc>> <<FCSAP-comments addressed May 2006.pdf>>

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