ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #01**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Review Board IR #06

Linkage to Other IRs (from Round I)

Alternatives North IR#19, #20
North Slave Métis Alliance IR #08
Yellowknives Dene First Nation IR #12, #17
Review Board IR #09, #27
City of Yellowknife IR #01, #07, #13
Environment Canada IR #15

Date of this Response

February 17, 2012

Request

Preamble

It is important to understand exactly what the Developers have committed to do as a result of this ongoing Environmental Assessment.

Question

1. Please prepare a consolidated list of commitments and agreements the Developers have made in the Developer's Assessment Report, Round One Information Responses and during the Technical Sessions.

2. Please indicate what the commitment is, who will carry it out, when it will be accomplished and the appropriate reference in the public registry.

Reference to DAR (relevant DAR Sections)

Tables 15.3.1 and 15.3.2

Response

In response to the Question #1 request for a consolidated list of commitments and agreements the Developers have made in the Developer's Assessment Report (DAR), Round One Information Responses and during the Technical Sessions, information is presented in a series of attached tables as follows:

> Table 1(a) – Table 1(e) are commitments from the IR Responses Round I (June, 2011); and
> Table 2(a) – Table 2(d) are commitments from the Technical Session (October, 2011).

For DAR commitments, and in an effort to avoid duplication or paraphrasing of those commitments, the reader is referred directly to the DAR itself. Where a DAR commitment has been duplicated in an Information Request or during the Technical Session, it is not listed in the tables below.

The tables provide the Giant Mine Remediation Project Team's (Project Team) understanding of the commitments. In Table 1 the commitments (IR1-9) also reference the specific Round I IR response. In table 2 the commitments (TS1-5) also reference the date and line of the Technical Session verbatim transcript. In terms of who will carry out the commitments, all will be by the Project Team.

Please note that the commitments tables have been developed based the knowledge currently available and changes may arise due to the outcomes of the Environmental Assessment, the final project design, or during project implementation. As a consequence, this list of commitments may be altered to reflect those outcomes. Any such changes will be communicated.

Attachment 1

Table 1a. Information Request – Round 1 Commitments A) Water and Regulatory		
#	**Commitment**	**Reference**
IR1	The Project Team commits to working with City of Yellowknife regarding the construction of the outfall/diffuser to avoid any periods in which the City of Yellowknife would also be constructing a new drinking water intake.	Round One: Information Request: - North Slave Métis Alliance #08
IR2	In addition, the Project Team will develop an Aquatic Effects Monitoring Program for operations at Giant Mine, utilizing INAC's 2007 "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories."	Round One: Information Request – Yellowknives Dene First Nation #12

Table 1b. Information Request – Round 1 Commitments B) Surface		
#	**Commitment**	**Reference**
IR3	The re-vegetation strategy for the site will be determined during the development of detailed designs for the tailings covers and other areas. The decision-making process will include the implementation of additional community engagement to determine preferred approaches to re-vegetation, including long-term monitoring and adaptive management.	Round One: Information Request - Review Board IR #09
IR4	Giant Mine Remediation Project Team (Project Team) will continue to work with interested parties to minimize impacts on the continued use of the marina and town site.	Round One: Information Request - City of Yellowknife #01 Round One: Information Request - Yellowknives Dene First Nation #17

Table 1c. Information Request – Round 1 Commitments C) Monitoring		
#	**Commitment**	**Reference**
IR5	The Project Team is committed to developing a monitoring program in a manner that is inclusive. It will be done in a manner that is transparent and meets the principles listed in IR Response to Review Board #27 in the first Round of IRs, including accountable, adaptive and credible.	Round One: Information Request - Review Board #27 Round One: Information Request - Environment Canada #15
IR6	Subject to limitations set out in ATIP, the Project Team is committed to providing all final research and data regarding monitoring, environmental management plans, spills and any information required by legislation, regulation, policy and guidelines.	Round One: Information Request - Alternatives North #19
IR7	Summaries of Public Consultations including issues raised and responses will be made publicly available.	Round One: Information Request - Alternatives North #20

Table 1d. Information Request – Round 1 Commitments D) Roles and Responsibilities		
#	**Commitment**	**Reference**
IR8	The Project Team will participate with the City of Yellowknife and other parties during the creation of Land Use and Transportation Plans for the Giant Mine Site.	Round One: Information Request - City of Yellowknife #07

Table 1e. Information Request – Round 1 Commitments E) Other		
#	**Commitment**	**Reference**
IR9	The Project Team has committed to holding further Industry Day information sessions in the DAR, Table 13.13.2 Looking Forward: The Consultation and Engagement Plan. Additional community meetings, public sessions and information sessions will be held to inform Aboriginal, local and northern businesses, as well as business at large, about the opportunities the Remediation Project has and inform the Project Team about local resources.	Round One: Information Request - City of Yellowknife #13

Attachment 2

Table 2a. Commitments Arising from 17 – 21 October 2011 Technical Sessions A) Compensation / Apology		
	Commitment	**Location within Technical Sessions Transcripts**
TS1	The Giant Mine Remediation Project Team commits to arranging a meeting between YKDFN and RDG.	Day 1 – 17 October 2011 110: 4-10

Table 2b. Commitments Arising from 17 – 21 October 2011 Technical Sessions B) Perpetual Care		
#	**Commitment**	**Location within Technical Sessions Transcripts**
TS2	The GMRPT to review the project after 100 years to determine whether the remediation plan is doing what it is supposed to and whether it is the correct approach to continue.	Day 4 – 20 October 2011 247: 8-25; 248: 1

Table 2c. Commitments Arising from 17 – 21 October 2011 Technical Sessions C) Future Land Use / Marina Expansion		
#	**Commitment**	**Location within Technical Sessions Transcripts**
TS3	The GMPT to work with the City of Yellowknife on maintaining access to the boat launch and marina.	Day 2 – 18 October 2011 255: 15-21

TS4	The GMPT will participate in a public workshop on future land use for Giant Mine.	Day 3 – 19 October 2011 147: 8-10

Table 2d. Commitments Arising from 17 – 21 October 2011 Technical Sessions **D) Independent Monitoring**		
#	**Commitment**	**Location within Technical Sessions Transcripts**
TS5	To have a workshop/meeting on independent oversight with the Parties to the Environmental Assessment.	Day 5 – 21 October 2011 142: 1-3

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #02**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Alternatives North IR #15

Linkage to October 2011 Technical Session

Technical Session Day Four transcripts, pp. 227-230 and pp. 232-236.

Linkage to Other IRs (from Round I)

Alternatives North IR #03
City of Yellowknife IR #03
Yellowknives Dene First Nation IR #24, #27

Date of this Response

February 17, 2012

Request

Preamble

During the Technical Sessions, the Developers described a number of situations and specific risks at Giant Mine that may require emergency work before the conclusion of this Environmental Assessment. It would be helpful to have this information consolidated in one place and communicated to the parties and the general public.

Question

1. What are the emergency measures that the Developer anticipates are necessary at the site prior to the conclusion of this Environmental Assessment?

2. What are the anticipated licensing and permitting requirements for this work?

3. How will the above be communicated to the parties and the general public?

Reference to the EA Terms of Reference

s.3.2.6 Consultation

Summary

There are some larger scale elements of the overall remediation plan that need to proceed on an urgent basis in order to continue to protect human health and safety, and the environment. Discussions are underway with the Mackenzie Valley Land and Water Board (MVLWB), the City of Yellowknife and the Mackenzie Valley Environmental Impact Review Board (Review Board) to determine the necessary authorizations to implement this work. An engagement process to communicate this information to parties and the public is being developed and implemented.

Response 1

As mentioned during the Technical Sessions[1], because of the deteriorating conditions of the site, the Minister of Aboriginal Affairs and Northern Development (AANDC) has approved advanced remediation of high risk items. Therefore, the Giant Mine Remediation Project Team (Project Team) is proceeding with a Site Stabilization Plan to deal with those dangers at the site. Please see the attached chart for information about the Site Stabilization Plan

These activities need to proceed as soon as possible in order to continue to protect human health and safety as well as the environment. Work on these elements will take place on an urgent basis over the next two to three years.

Response 2

The Project Team is working with the Mackenzie Valley Land and Water Board (MVLWB), the City of Yellowknife and the Mackenzie Valley Environmental Impact Review Board (Review Board) to determine the necessary authorizations for the Site Stabilization Plan. The project team is preparing applications accordingly. See the attached Table 1, *Summary of Site Stabilization Activities*, for additional information.

[1] Mackenzie Valley Environmental Impact Review Board, Giant Mine Environmental Assessment (EA0809-001) Technical Sessions, transcripts from October 20, 2011 pages 227 to 230.

Response 3

The engagement process began at the Review Board technical sessions in October 2011 when the Site Stabilization Plan was introduced to the parties of EA0809-001,[2] and will continue through public hearings. Additional engagement and meetings will take place to explain the Site Stabilization Plan to the public and parties.

As part of the permit application process, the Project Team will be sending letters to all affected parties in the Yellowknife area explaining the purpose of the applications. The Project Team is open to meeting with these parties if requested.

Additional public meetings are being planned for the first quarter of 2012 to explain the Site Stabilization Plan. The Project Team has already conducted some of these meetings, including one with the Back Bay Community Association in November, 2011.

In December, 2011, the Project Team met with local media to discuss the removal of the cladding on the C-Shaft headframe. Additional interviews will occur at the request of the media to explain elements of the Site Stabilization Plan.

As well, the Project Team regularly meets with the Giant Mine Community Alliance to update their members on activities occurring onsite. These updates will continue to occur.

[2] Mackenzie Valley Environmental Impact Review Board, October 20, 2011, Technical Sessions (Failure Modes), pages 227 to 236.

Attachment

Table 1: Summary of Site Stabilization Activities

REF. NO.[a]	SSP COMPONENT	TASK DETAILS
1	Baker Creek Improvements	Erosion Protection Maintenance of existing riprap and placement of additional riprap as required along Baker Creek near the old bridge site and along Baker Pond shoreline needs to be carried out. The riprap is being used as an erosion protection measure to entrain flows within the Baker Creek channel.
		Jo Jo Tailings The Jo Jo Lake Tailings Cap is a permanent cap on existing tailings in the Baker Pond/Jo Jo Lake area, including submerged tailings extending approximately 2 metres from one shoreline. The cap consists of geotextile, granular fill, fine grained fill and top soil to support vegetation. Work done to date and future work is being done under AANDC Inspector's directive dated May 30, 2011. Once Baker Pond is thawed, additional work needs to be completed including: ♦ maintenance of the fill and erosion protection materials as required ♦ spreading of the topsoil (i.e. vegetation support layer) on the tailings cover ♦ seeding of the vegetation support layer ♦ maintenance of the vegetation support layer (e.g., grading) and reseeding as required
2	B1 Pit Wall Stability	Seasonal maintenance and monitoring of the existing flood protection berm between Baker Creek Reach 4 and B1 Pit is required. This berm prevents Baker Creek from overflowing its bank and entering the sinkhole at the southern edge of B1 Pit.
3	Securing C-Shaft	The following actions are required to eliminate significant health and safety risks associated with the deteriorating C-Shaft: ♦ removal of metal cladding and fasteners from the C-shaft head frame which extends up to 45 m above the ground surface. This cladding can become detached in high winds and blow significant distances. For example, 3 years ago cladding blown off in high winds was found on the west side of the Ingraham Trail. ♦ securing the shaft conveyances and removal of conveyance ropes. ♦ removal of large steel shoes / saddles from the redundant sheave-house to eliminate the risk of these falling. ♦ installation of a wooden bulkhead over the shaft opening. ♦ installation of a chain link fencing around the headframe building to prevent entry.
4	A1 Pit Ditch Upgrades	The A1 Pit Ditch, a constructed water management feature, is being repaired and upgraded to improve drainage around the northern edge of the A1 Pit and to prevent surface drainage from entering A1 Pit. Specific upgrades include the installation of liners and emplacement of culverts. This activity is in response to DFO letter dated July 6, 2010.

5	Securing Building Cladding	The metal cladding on the Mill and Warehouses 3 & 4 needs to be secured because these buildings are located close to the Ingraham Trail and within the most active portion of the site. Their ongoing deterioration creates significant risk to the health and safety of on-site personnel and the general public because the cladding may blow off in high winds.
6	C1 Pit Channel Stability	Flood events in Baker Creek adjacent to C1 Pit could result in flows overtopping the banks and entering the underground mines. In order to design and implement emergency mitigations, a geotechnical investigation into the stability of the creek banks is required. A geotechnical investigation consisting of test holes, test pits, piezometer installation, material testing, and evaluation will be carried out to determine key information including groundwater levels, depth to bedrock and bedrock surface geometry.
7	Roaster Complex Demolition	Recent inspections of the Giant Mine Roaster Complex have identified deteriorating structural elements and building envelopes. The Roaster Complex includes the following buildings: Dorrco Building, Cottrell Building, AC Roaster/Pipe Shop, Baghouse, Calcine Plant, Fanhouse, arsenic silo and scale house, exterior Roaster Flues and Roaster Stack. Due to the change in condition of this infrastructure, there is the potential for the release of arsenic trioxide and asbestos dust into the environment, and potential for injury to onsite workers. To address these risks, the Roaster Complex needs to be demolished. Specific details about the work include: ♦ Removal and containerization of all hazardous materials from the Roaster buildings; ♦ In the case of asbestos waste, on-site transportation of bagged asbestos wastes to an existing disposal/holding area at Giant Mine. ♦ Offsite shipping and disposal of all other hazardous wastes (lead amended paint, PCBs, mercury, oils, petroleum products, chemicals, miscellaneous designated substances, etc.) at approved facilities will occur unless otherwise authorized going forward. ♦ Containerization of arsenic dust and transportation to a temporary disposal facility located at Giant Mine. Structural and mechanical building materials that are coated with arsenic dusts will be cleaned to allow them to be stored with other demolition rubble. ♦ Clean inert wastes (wood, steel, paper, concrete rubble, plastic, glass, etc.) generated from the demolition of the buildings will be moved to a temporary storage area located at Giant Mine. To support this task, a storage area will need to be prepared to store the demolition wastes. These wastes will be re-located (under separate contract) to a permanent disposal area once the Greater Remediation Plan receives the necessary regulatory authorizations. ♦ Any water used to clean contaminated materials or to control dust will be captured and stored on site until the Greater Remediation Plan receives the necessary regulatory authorizations.

9	Underground Stabilization	Significant risks associated with the failure of crown pillars exist at the Giant Mine, including the potential release of arsenic trioxide dust to the environment; flow of Baker Creek into the underground mines via a sinkhole; and creation of a sinkhole under the Ingraham Trail. Geotechnical investigations including diamond drilling of up to 33 holes in several locations into the stopes, borehole camera and cavity monitoring surveys need to be carried out in order to design appropriate mitigations to crown pillar failure. Drilling wastes will be collected and stored on site in a single contained location for final disposal when the Greater Remediation Plan is implemented. At this time, construction of new drift plugs and tight backfilling of the stopes are being considered as options for stabilizing the underground workings; however, the geotechnical investigations need to be carried out before all potential options can be identified and evaluated.
10	Mill Conveyor Demolition	The Mill Conveyor structure has been unmaintained since the mine closed and recent inspections indicate structural degradation of the A-frame structure that supports the elevated conveyor. This is a significant human health and safety risk because a primary travel route across the site crosses beneath the Mill Conveyor. To address this risk, the Mill Conveyor needs to be demolished as soon as possible.
11	Freeze Optimization Study	The Freeze Optimization Study (FOS) consists of diamond drilling up to 20 holes in an area 50 m x 100 m near Arsenic Trioxide Chamber 10. Drilling is required to provide for the installation of monitoring instrumentation (e.g., thermistors), freeze pipe installation and other components of the study. Drilling muds will be recirculated and drill cuttings will be collected and stored on site until such time that a permanent disposal solution is approved of as part of the Greater Remediation Plan. Temporary disposal options include the Tailings Retreatment Plant tanks or other temporary storage containers. Potential long term disposal options include injection into the underground chambers.
12	Design Support Testing	Design support testing includes two phases: (a) Soils testing using augers or similar equipment to delineate contaminated areas, physical properties of soils, and water table properties. (b) Diamond drilling to determine the geotechnical properties of the bedrock (e.g., surface geometry, geological structures). This testing is required at various locations across the site to develop a more comprehensive understanding of existing site conditions at a fine scale. Improved site understanding will allow better decisions about appropriate mitigations and work planning to be made going forward.
13	Inadvertent Access Prevention	Several structures are considered potential hazards to people who may trespass on the property, including the Tailings Retreatment Plant (TRP), the A-Shaft Building, and the A-Boiler Lift Station. Actions to secure these structures include: ♦ remove a section of the stairs on the TRP and any debris in the area that could be used as a ladder to access the structure. ♦ install a chain link fence around the perimeter of the A-Shaft buildings, which is located near the Ingraham Trail, in order to prevent unauthorized access. ♦ the two sumps located at the A-Boiler Lift station are approximately 5 m deep and represent an unprotected confined space that need to be filled in order to prevent injury to or entrapment of individuals that climb into or fall into the sumps.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #03**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Yellowknives Dene First Nation IR #03

Date of this Response

February 17, 2012

Request

Preamble

There were numerous discussions at the Technical Sessions on the organization, structure, content and framework for environmental management at Giant Mine. Some parties, including Alternatives North, suggested that the Developers adopt the framework set out in the recently released draft Guidelines for the Closure and Reclamation of Advanced Exploration and Mine Sites in the NWT by AANDC and the Land and Water Boards of the Mackenzie Valley (see http://mvlwb.com/files/2011/10/Draft-Closure-and-Reclamation-Guidelines_INAC-and-LWBs_Aug-11-2011.pdf). This IR will allow the Developer to demonstrate how it intends to apply these guidelines to the remediation for the Giant Mine and to show the progress from the Technical Sessions.

Question

1. Can the Developers commit to following the above Guidelines in preparation of its environmental management framework and environmental management plans for the Giant Mine?

2. Please provide the overall environmental management framework structure including a set of site-wide closure goals, component-specific objectives, measurable performance criteria (where known), and indicate where there are uncertainties. As part of this framework or table, please outline the anticipated design work and research completed to date, along with a schedule, anticipated funding and detailed tasks for any remaining work. The framework should also include details on anticipated monitoring (VEC's to be measured, locations, frequency, duration, reporting, thresholds for adaptive management and contingencies) or at a minimum, where this information can be located.

3. Please provide details on how the Developer anticipates public involvement and engagement in the development of the environmental management framework and environmental management plans.

Reference to DAR (relevant DAR Sections)

s.6 Remediation Project Description
s.8 Assessment of Likely Environmental Effects and Mitigation
s.13 Consultation and Engagement
s.14 Environmental Monitoring and Evaluation Framework and Long-Term Environmental Monitoring

Reference to the EA Terms of Reference

s.3.2.6 Public Consultation; S. 3.6 Monitoring, Evaluation and Management

Summary

Content recommendations discussed in Part Two of the Guidelines (Technical Considerations for Effective Closure and Reclamation of Mine Sites) will significantly inform environmental management plans (EMPs). The closure and reclamation of the Giant Mine site will be consistent with the goals set out in the Guidelines consistent with the life cycle stage of the mine. Due to the complexity of the Giant Mine site, and the need for very long-term monitoring of some components, it is likely that EMPs will be developed by aspect, not as a single closure plan document.

Work is currently underway to identify the information gaps that require filling, either through augmentation of information from existing sources, or with primary research and/or site investigations. Much of the detail requested in the IR will be addressed in the detailed design and EMP stages of the project.

Engagement on the development of EMPs will be in the context of the larger consultation and engagement plan for the Project. It is anticipated that primary engagement on the development of EMPs will be through workshops with an Environmental Management System (EMS) working group composed of affected Aboriginal groups and interested parties. Workshops will be structured to share and solicit input as well as to validate progressive work in the development of EMPs.

Response 1

The closure and reclamation of the Giant Mine site will be consistent with the closure goal set out in the *Draft Guidelines for the Closure and Reclamation of Advanced Exploration and Mine Sites in the NWT* (Guidelines) of returning "…the mine site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities." The Guidelines will inform Giant Mine Remediation Plan (Remediation Plan) to the extent that they are

applicable to the current life cycle stage of the mine. As such, the use of the Guidelines must take into account that they are being applied to an abandoned, as opposed to a planned or operating mine and that and that a Remediation Plan with specific remediation options has been developed and is undergoing environmental assessment,.

In meeting the Guidelines closure goal and other project remediation goals as articulated in the Developers Assessment Report (DAR), the Environmental Management System (EMS) and Environmental Management Plans (EMPs) for the Giant Mine remediation project will largely incorporate the objectives-based approach outline in the Guidelines.

It is noted that the Remediation Plan has been developed to satisfy 3 of the 4 closure principles outlined in the Guidelines; those being "physical stability, chemical stability and compatibility with future use". The fourth principle outlined in the Guidelines cannot be achieved for all components of the site (e.g., the freeze system will require ongoing care and maintenance, mine water treatment will be required for several decades and the cover on the tailings areas will require periodic maintenance).

Content recommendations discussed in Part Two of the Guidelines (Technical Considerations for Effective Closure and Reclamation of Mine Sites) will significantly inform the content of EMPs and as appropriate, approaches will be translated to the creation of the EMPs.

Due to the complexity of the Giant Mine site, and the need for very long-term monitoring of some elements, it is likely that EMPs will be developed by remediation components and as appropriate, by aspect. As committed to at the technical sessions, EMPs will be developed with community and stakeholder engagement.

As a minimum, EMPs will address the following as set out in Figure 2 C*losure goal, principles, and component-specific objectives of the Guidelines*:

- Underground Mine Workings;
- Waste Rock and Overburden Piles;
- Tailings;
- Open Pits;
- Buildings and Equipment;
- Transportation Route;
- Infrastructure;
- Landfills and Other Waste Disposal; and
- Water Management Systems.

In doing so, EMPs will address sub-topics of permafrost, soils, re-vegetation, pit wall stability, Baker Creek realignment groundwater and surface water management, including water treatment plant discharge.

During development of the EMPs emphasis will be placed on elements set out in the guidelines including:

- closure objectives for each mine component;
- criteria for each objective;
- progressive reclamation scheduling;
- appropriate level of detail;
- contingencies;
- research plans;
- determinations of effectiveness;
- reporting and monitoring; and
- assessment of risks.

Monitoring will occur over both the short and long term, including implementation phases of the project; recognising that progressive closure and ultimately a shift to long-term monitoring EMPs and associated monitoring may have varying temporal and spatial scopes as the project unfolds.

Response 2

The overall framework for environmental management of the site was outlined in Chapter 14 of the DAR, setting out that monitoring, performance evaluation and adaptive management will be governed by the application of an EMS, with topic-specific EMPs providing the details on objectives, performance criteria and action levels.

Work is currently underway to identify the information gaps that require filling, either through further design, augmentation of information from existing sources, or with primary research and/or site investigations. The majority of information gaps will be filled during the detailed design and EMP stages of the project. Part of the EMP process will be to identify environmental performance criteria and measurement that require linkages to design work. Environmental management planning is anticipated to begin in March 2012. It is too early in the process to provide details on funding.

Table 1 (attached) provides an overview of the areas of focus for the information gathering and analysis processes underway. In addition to setting out the overall objectives and outcomes for each component the table sets out the general criteria that will guide the selection of specific measures and the establishment of targets. As the majority of research work is not complete, the table identifies those areas where research is ongoing or required. EMPs are intended to link back to design so that the development of monitoring and evaluation criteria is established in tandem with effective systems to assess project success. Measures and targets for each component will be integrated within the appropriate EMP. These will be prepared before the implementation of a particular project element proceeds.

Throughout the development of the EMS and EMPs, the objective will be to progressively reduce uncertainty. Uncertainty may be reduced in a number of ways, including the use of traditional and community information to refine assumptions and adjust objectives, the feedback between design and environmental management plan development, and improvements to the understanding of the physical characteristics of the site. The Freeze Optimisation Study is an example of how increased understanding

of the thermal and physical properties of rock surrounding the chambers is aiding in the design of the freeze system, which will ultimately result in performance criteria, and a reduction in uncertainty.

During project implementation applying adaptive management will be significant in addressing uncertainty. The marrying of a plan of long-term monitoring as envisioned in Chapter 14.2 of the DAR with the rigor of an EMS and the specificity of EMPs will ensure that where uncertainty exists in meeting outcomes that information will be available and processes will be in place to take corrective actions, evaluate objectives and refine criteria to ensure the long-term environmental stability of the site.

Response 3

Engagement on the development of EMPs will be in the context of the larger consultation and engagement plan for the Remediation Project. As set out in Chapter 13 of the DAR and the technical sessions[1] the Giant Mine Remediation Project Team is committed to providing the Aboriginal groups and the general public with multiple avenues to participate in design, the development of monitoring criteria and long-term plans for the Giant Mine site. This will be accomplished through public sessions and workshops, and meetings with Aboriginal communities.

In addition to public sessions and community meetings, it is anticipated that primary engagement on the development of EMPs will be through workshops with an EMS working group composed of affected Aboriginal groups and interested parties.

The engagement is expected to be topic-focused; addressing, among other matters, objectives, criteria and research needs necessary for effective long-term environmental monitoring, assessment and response. Workshops will be structured to share and solicit input as well as to validate progressive work in the development of EMPs.

[1] Giant Mine Remediation Project, Mackenzie Valley Environmental Impact Review Board, October 20, 2011 technical sessions, pages 27 - 28

Attachment

Table 1 Objective and Criteria for the Environmental Components of the Giant Mine Remediation Project

Component	Currently Identified Sub-components/ VECs	General Objectives/ Outcomes	Criteria Guidelines (for the selection of specific measures and the establishment of targets)	Ongoing Research
Surface Water Environment	Hydrology	Minimising sediment transport and the mobilisation surface contaminants into water bodies during project development. Re-alignment of section of the Baker Creek channel to carry peak design flows and thus prevent possible flooding of underground mine workings Long-term reduction in contaminant loading from all site sources. Maintenance of CWQG-FAL at the edge of the diffuser mixing zone. Public safety at diffuser.	Percentage change to baseline flow Whether a change results in hydrology being more representative of natural conditions	Further modeling of diffuser design. – This ongoing work is incorporated with water treatment plant design Further site-specific delineation of surface contaminants. – This ongoing work is incorporated into the ongoing surface remediation design Mine water treatability investigations for input to water treatment plant design Design of Baker Creek. Design for Baker Creek is a specific area of design.
	Water Quality		Health Canada's Guidelines for Canadian Drinking Water Quality Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-FAL) taking into consideration background conditions and the results of the Human Health and Ecological Risk Assessment findings Metal Mine Effluent Regulations Water quality criteria from former water licence Criteria established for other relevant industrial developments	
	Sediment Quality		CCME Interim Sediment Quality Guidelines (ISQGs) and Probable Effects Levels (PELs) guidelines as well as results of Human Health and Ecological Risk Assessment findings	
Geological and Hydrogeological Environment	Groundwater Flow	Long-term depression of the groundwater level on site to ensure the capture and treatment of all site waters and to lower the	The degree to which groundwater flows may result in contaminant migration to areas beyond the SSA	Ongoing modeling/ determination of appropriate monitoring stations.

		risk of migration of any contaminant to surrounding ground water	Whether a change may result in groundwater flows being more representative of natural conditions	Site-specific delineation of on-site permafrost.
	Groundwater Quality		Monitoring of contaminant concentrations in groundwater beyond the SSA Health Canada Canadian Drinking Water Quality Guidelines	
	Soil Quality		Monitoring of contaminant concentrations in soils Site Remediation Criteria for Arsenic in the Yellowknife Area CCME Soil Quality Guidelines (Industrial Criteria) Human Health and Ecological Risk Assessment findings	
	Permafrost		Loss of permafrost in previously undisturbed ground	
Atmospheric Environment	Air Quality	Minimising the release of arsenic dust from the site during demolition and tailings stabilizing activities. Long-term stabilization of tailings through armouring/vegetation Minimising air pollution from the operation of equipment and generators. Minimizing noise levels from operation of heavy equipment during reclamation phase and operation on freeze plant	GNWT Ambient Air Quality Guidelines for SO_2, TSP and $PM_{2.5}$ Canadian National Ambient Air Quality Objectives – Maximum Acceptable Concentration for NO_2 Ontario Ministry of the Environment Ambient Criterion for PM_{10} and Airborne Arsenic (adopted by the GNWT)	Types of tailings covers
	Noise Environment		NWT Occupational Exposure Limits Complaints from residents made to municipal authorities	

Aquatic Environment	Aquatic Habitat	Maintaining the quality and quantity of habitat and where appropriate and feasible enhance habitat	Quantity (i.e., area) and quality (i.e., function and relative productivity with respect to the aquatic community)	On-going monitoring of fish and fish habitat
	Aquatic Biota		Potential for population effects on VC species	
Terrestrial Environment	Terrestrial Habitat	Maintain the quality and quantity of terrestrial habitat and species mix and where appropriate and feasible enhance habitat and species use.	Quantity (i.e., area) and quality (i.e., function and relative productivity with respect to the regional terrestrial community).	Baseline studies including habitat utilization studies
	Terrestrial Biota		Potential for population effects on VC species.	
Aboriginal Interests	Aboriginal Communities	Maintain and enhance opportunities for traditional use, where appropriate and desirable. Conserve on-site archaeological resources	Community perceptions of environmental health	Consultation with communities on the inclusion of traditional knowledge and use preferences in project design and implementation. Archeological Assessment
	Traditional Land Use		Magnitude of Project-related changes in Traditional Land Use activities relative to baseline conditions	
	Aboriginal Heritage Resources		Loss or displacement of archaeological artefacts or sites determined to have heritage value	
Additional Community Interests	Land Use, Visual & Cultural Setting	Minimise disturbances to nearby public use during the project development stages. Where appropriate, enhance opportunities for local use of the site. Where appropriate, accommodate heritage conservation interests. Minimize disruption of public use of roads a highways Minimize risk of injury to public in the site development area	Regular disturbance/nuisances to offsite residences, businesses and institutions which may change the manner in which land is used (i.e., increased noise, dust, or traffic) Compliance with legislation, regulations, policy and good planning practice Existing and future use and development of land (impact on present and planned land use) Impact on views and vistas (based on sensitivity of the vantage point; extent of obstruction, distance from mine site and duration of view) Loss or displacement of built heritage features	Consultation with the public and stakeholders on the consideration of use preferences in project design and implementation

	Socio-economic Conditions		Magnitude of Project-induced changes in the population relative to baseline and/or projected conditions Magnitude of Project-induced changes in employment, business activity, income, municipal costs and revenues relative to baseline and/or projected conditions Magnitude of direct and indirect Project-induced demands on municipal infrastructure and services relative to baseline and/or projected conditions Magnitude of Project-induced changes in housing stock relative to baseline and/or projected conditions	
	Transportation		Likelihood and/or magnitude of changes in onsite traffic levels on public roads Likelihood and/or magnitude of changes in offsite traffic levels Magnitude and frequency of Project-induced changes in motor vehicle accidents relative to baseline conditions	

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #04**

Date Received

November 30, 2011

Linkage to Other IRs (from Round II)

Review Board IR #06

Linkage to Other IRs (from Round I)

Review Board IR #19
Review Board IR #27

Date of this Response

February 17, 2012

Request

Preamble

The Developers made new commitments to periodically review management of the underground arsenic and water treatment technology in its first round IR responses and during the Technical Sessions. These are important commitments in the eyes of the public and some parties. Alternatives North is seeking additional information on how these reviews will be conducted in the hope that this will be done in a collaborative manner and subject to public review.

Question

1. How do the Developers see the above referenced periodic technology reviews being conducted? Are the Developers committed to a collaborative approach that involves interested stakeholders and the public?

2. Will there be opportunities for public involvement and review in the technology reviews? Will the results of the technology reviews be made publicly available?

Reference to DAR (relevant DAR Sections)

s.6.2.2.4 Future Reconsideration of Alternatives

Reference to the EA Terms of Reference

s.3.6.1.h Monitoring, Evaluation and Management

Summary

Technology reviews will be conducted on a 10 year basis following remediation. Results will be made public with an opportunity to comment.

Response 1

For a response to Question 1 the reader is respectfully referred to the response to Review Board Round 2 Information Request #06.

Response 2

As stated in the response to Review Board Round 2 IR #06, the process will be developed through the design of the Environmental Management System and, as such, will be available to and reviewed by the public. Furthermore, the result of the reviews will be reported in the State of the Environment Report for the year in which the reviews are conducted. State of the Environment Reports are publicly available documents.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #05**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Alternatives North IR #11, #18, #24
Review Board IR #01, #05, #06, #07
Yellowknives Dene First Nation IR #03, #05

Date of this Response

February 17, 2012

Request

Preamble

There is a growing interest in better understanding exactly what the perpetual care requirements will be for the Giant Mine given the closure options and methods specified in the Developer's Assessment Report and subsequent filings. To better plan for the management of these requirements, it would be helpful to have a consolidated list and inventory of perpetual care requirements once the Giant Mine frozen block method has been fully implemented.

Question

Please prepare a detailed table and inventory showing the perpetual care requirements for the site once the frozen blocks have stabilized. The table should show the mine component (e.g. frozen block, water management, tailings covers, open pits, etc.), monitoring requirements (general information on frequency of collection, analysis and reporting), human and financial resources and skill sets including certifications required to carry out this work, materials and specialized equipment or tools required for care and maintenance (including regular replacement schedules for equipment and facilities), and any other significant aspects of perpetual care requirements.

Reference to DAR (relevant DAR Sections)

s.6.13.5 Human Resource Requirements

s.14.2 Long-term Environmental Monitoring

Reference to the EA Terms of Reference

s.3.6.1.3 Monitoring, Evaluation and Management

Summary

Long-term planning and monitoring will be an ongoing process and will be repeated throughout the life-cycle of this project. The Developers Assessment Report (DAR) and the Giant Mine Remediation Plan (Remediation Plan) contain a variety of information on this topic. The Environmental Management System (EMS) and Long-Term Monitoring Plan will elaborate further on the details required for the long-term management of the site. At the present time it is anticipated that there will need to be 8 full time equivalent positions devoted annually to the general monitoring of the site. Contracted personnel will also be required annually. Additional funding and contract positions will be examined annually for any additional work required in the subsequent years.

Response

Long-term planning for and implementation of monitoring will be revisited periodically throughout the life of this project through the EMS and Environmental Management Plan (EMP) processes. The DAR and Remediation Plan both addressed the topic of periodic reevaluation and long-term monitoring. The information contained within these documents is based on what is currently known, however, detailed planning far into the future is difficult as it is uncertain what advances in technology may occur in the next 10, 25 or 100 years that will be applicable to the management of the Giant Mine site. As a result, elements of long-term monitoring plans developed and available to the public near the end of the active remediation stage will necessarily be more comprehensive than preliminary plans and forecasts developed in the near-term. Integral to the plans will be the requirement to monitor science and technology on a regular basis, evaluate such information and adjust management of the site as appropriate.

The EMS and EMPs will continue to examine and define all requirements for long-term monitoring throughout the life of the project.

Table 1 (attached) includes the monitoring components currently under consideration, human resources and sources of funding. Table 1 is based upon the information found within the DAR in Table 14.2.1 Outline of Proposed Long-term Environmental Monitoring Program. It does not contain information on the material and specialized tools required for this monitoring because it is unclear what tools/materials will be available at the start of the long-term operating, maintenance and monitoring phase, and beyond. These will be more clearly defined during the development of the EMPs addressing the long-term requirements and updated at appropriate intervals afterwards.

Section 6.13 of the DAR addresses the full employment needs (Table 6.13.3). Table 6.13.3 does not however include the contract employment needs for long-term monitoring which will be further defined near the end of the implementation phase.

Table 6.13.3 Estimated Full-time Equivalent Positions During Long-term Operations and Maintenance

Component	Full-Time Equivalent Positions
Site manager	1
Environmental technician	1.5
Water treatment operators	4
Trades	0.5
Heavy equipment operator	1
Total	8

A vision of the site in the future, along with a more detailed description of the long-term monitoring needs, can be found in section 6.1 of the Remediation Plan.

Attachment

Table 1 – Giant Mine Remediation Project – Long Term Monitoring, Maintenance & Management Requirements

Monitoring Requirements			Resource Requirements			Other Requirements
Activity	**Frequency**	**Analysis & Reporting**	**Human Resources[1]**	**Anticipated Financial Resources**	**Specialized Tools**	
Frozen Blocks						
Inspect cooling systems (e.g. thermosyphons)	Annually or as required	Entry in annual performance report	Consultant engineers	Annual O&M budget		
Monitor ground thermistors	Continuously	Connected to internet	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Maintain & upgrade cooling & monitoring systems	Annually or as required	Entry in annual performance report	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Replace cooling & monitoring systems	About every 100 years or as required	Report of options analysis & selected approach posted on internet	Consultant engineers & contractors	Capital improvement budget		
Water Management & Treatment						
Operate well pumps to take water from underground	Continuously	Key information connected to internet	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Operate WTP	Continuously	Key information connected to internet	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Maintain & upgrade WTP	Annually or as required	Entry in annual performance report	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Replace WTP	About every 25 years or as required	Report of options analysis & selected approach posted on	Consultant engineers & contractors	Capital improvement budget		

[1] The Table lists titles of functions to be performed (e.g. Perpetual Care manager, Business manager, Environmental manager). It is expected that a single individual may perform more than one of these functions. Further planning and analysis is required to design the Perpetual Care organization and determine more precisely the number of FTEs required.

Monitoring Requirements			Resource Requirements			Other Requirements
Activity	**Frequency**	**Analysis & Reporting**	**Human Resources[1]**	**Anticipated Financial Resources**	**Specialized Tools**	
		internet				
Water quality (groundwater)	Annually	Entry in annual performance report	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Water quality (treated mine water)	Daily or weekly depending on sampling location	Key information connected to internet	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Water quality (surface water)	Monthly or bi-monthly depending on sampling location and ice cover	Key information connected to internet	Site operator – WTP operators & environmental technicians	Annual O&M budget		
Physical Works						
Inspect & maintain dams, spillways, ditches & relocated sections of Baker Creek	Annually for as long as they remain in use	Entry in annual performance report	Consultant engineers & contractors	Annual O&M budget		
Tailings & sludge containment area covers	Annually for first five years or until vegetation is fully established and erosion rates are consistent with those in the local environment	Entry in annual performance report	Consultant engineers & contractors	Annual O&M budget		
Pit walls, crown pillars & closed mine entries	Annually for first five years and every second year thereafter	Entry in annual performance report	Consultant engineers & contractors	Annual O&M budget		
Open Pits						
Inspect & maintain fences (also around WTP, freeze system & admin facilities)	Annually or as required	Entry in annual performance report	Site operator	Annual O&M budget		
Replace fences	About every 25 years or as required	Entry in annual performance report	Consultant engineers & contractors	Capital improvement budget		
Flora & Fauna						
Aquatic ecology (fish and benthic invertebrates)	Annually for first three years followed by periodic	Entry in annual performance report	Environmental technicians and biologists	Annual O&M budget		

Monitoring Requirements			Resource Requirements			Other Requirements
Activity	**Frequency**	**Analysis & Reporting**	**Human Resources[1]**	**Anticipated Financial Resources**	**Specialized Tools**	
	monitoring until full restoration is complete					
Aquatic ecology (emergent vegetation)	After remediation work is completed on Baker Creek until full restoration is confirmed	Entry in annual performance report	Environmental technicians and biologists	Annual O&M budget		
Terrestrial environment (vegetation & soil)	Once after successful revegetation is reported at remediated areas	Entry in annual performance report	Environmental technicians and biologists	Annual O&M budget		
Terrestrial environment (vegetation & soil)	Annually after remediation work is completed until full restoration is confirmed	Entry in annual performance report	Environmental technicians and biologists	Annual O&M budget		
General Site Monitoring & Maintenance						
Provide security & infrastructure (roads, buildings, power, communications, heat, etc.)	Ongoing	Entries in annual performance report	Site operator	Annual O&M budget		
Operate the EMS, perform other site monitoring, analyze results and produce reports	Ongoing	Annual and three-year EMS performance reports posted on internet	Site operator – Environmental manager & technicians	Annual O&M budget		
Administration						
Oversee the management of residual risks (frozen blocks, water management, WTP, tailings caps, open pits, etc. – see above)	Ongoing	Entries in annual performance report	Perpetual Care manager & staff (WTP operators, Environmental manager & technicians, Information manager, Business manager, etc.)	Annual admin budget		
Oversee future uses of tailings & other areas of site	As required	Input to future management organization	Environmental manager			
Manage stewardship information	Ongoing		Information manager & technicians	Annual admin budget		
Use science & technology	Ongoing plus 10 & 100 year	Entries in annual	Environmental manager &	Annual admin		

Monitoring Requirements			Resource Requirements			Other Requirements
Activity	**Frequency**	**Analysis & Reporting**	**Human Resources[1]**	**Anticipated Financial Resources**	**Specialized Tools**	
	reviews	performance report	expert consultants	budget		
Integrate requirements, prepare plans, obtain funding & manage budgets, provide oversight, report, etc.	Ongoing	Annual business plans & performance reports posted on internet	Business manager	Annual admin budget		

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #06**

Date Received

November 30, 2011

Linkage to Other IRs (from Round I)

Review Board IR #09
Review Board IR #12

Date of this Response

February 17, 2012

Request

Preamble

Various standards appear to have been used in designing the facilities and aspects of the Remediation Plan such as 1 in 500 year event for a flood on Baker Creek (see slide 4 Day Two, first presentation) and in 2,500 year earthquake for high consequence dams (see Review Board IR#9 response #1). Given that the Remediation Plan sets up a perpetual care situation requiring monitoring and management forever, the use of various periods for risk management should be fully justified and explained.

Question

1. Please detail what standards have been used in the design of various components of the Remediation Plan and why?

2. Please explain how any specified design criteria meet the perpetual care needs for the site?

Reference to DAR (relevant DAR Sections)

s.6.1.2 Summary of Post Remediation Conditions
s.1.7.2 Key Environmental Legislation and Regulations

Reference to the EA Terms of Reference

s.3.2.2.3 Developer

Response 1

Designs will be in accordance with current Canadian Codes and Standards and best practices in the engineering and science discipline, recognizing that the components of the remediation plan need to perform in the long term. Various time periods for risk management have been developed and considered appropriate for the short and long term during the preliminary design process.
A list of standards and codes that have been used to date is noted below. There are other codes that will be identified as the project advances. The codes that have been referenced include but are not limited to:

- Mine Health and Safety Act and Regulations for NWT
- Mine Site Reclamation Guidelines for the NWT
- CSA B52 Refrigeration Code for the Freeze Plants
- ASME B31.3 Industrial Piping Code
- Canadian Electrical Code
- CSA M421 Use of Electricity in Mines
- National Building Code
- Northwest Territories Guideline for the Management of Waste Asbestos
- N.W.T Environmental Protection Act
- Canadian Environmental Protection Act
- Federal Fisheries Act
- Northwest Territories Water Act
- Federal Contaminated Sites Action Plan
- Guideline for the General Management of Hazardous Wastes in the NWT

In addition, a list of Key Environmental Legislation and Regulation can be found in the Developer's Assessment Report, October 2010, Section 1.7.2, SRK Consulting.

Response 2

As described in the October 2011 Technical Session presentation, Day 5 - Monitoring, Evaluation, and Management, the performance or targets of the remediation components will be monitored and measured. It is acknowledged that the components need to perform for a very long time. Continuous performance monitoring will be completed for each remediation component to measure actual versus specified design criteria to provide early warning of poor component performance.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #07**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Yellowknives Dene First Nation IR #01

Linkage to Other IRs (from Round I)

Alternative North IR #14 Q1
City of Yellowknife IR #04 Q2

Date of this Response

February 17, 2012

Request

Preamble

The Developer has proposed various discharge criteria and performance criteria for a new water treatment plant at Giant Mine. A limited set of parameters were presented on Day Two of the Technical Sessions on slide 36 on Water Treatment. It would be helpful to know if the proposed effluent discharge criteria reflect the use of best available technology. Nitrates should also be included in the set of contaminants of interest due to the historical mining at the site and the requirement for additional underground workings for the frozen block method that will likely involve the further use of explosives.

Question

1. For the Table shown on the slide referenced above, and adding in nitrates, please add a column that shows the expected effluent levels using best available technology (BAT).

2. Where there is any variance between the figures reflecting best available technology and those shown as the "Existing Maximum Criteria"? If so please explain why BAT is not being used.

Reference to DAR (relevant DAR Sections)

s.6.8.5 Water Treatment and Sludge Disposal
s.6.8.6 Outfall and Diffuser

Reference to the EA Terms of Reference

s.3.5.2.8 Fish and Aquatic Habitat

Summary

The water treatment system is designed to protect the environment by meeting water quality objectives at the edge of the mixing zone. The key element of concern is arsenic.

The proposed system is considered best available practical technology (BAPT) based on the raw water quality and predicted effluent quality requirements. Nitrates have not traditionally been a parameter of concern and will not be reduced by the system.

Response 1

Multiple technologies could potentially be considered best available technology (BAT) for the treatment of a particular parameter depending on the treatment context (wastewater treatment, freshwater treatment, recycling, etc.).

Given the many options available, the team has selected the BAPT for the treatment process by taking the following aspects into consideration as well:

- Water quality objectives at the edge of the mixing zone,
- Raw water quality
- Residuals management
- Capital and operating costs
- Ability to handle fluctuations in raw water quality
- Future operating conditions

The selection of a BAT for a particular raw water matrix is influenced by the water quality objectives at the edge of the mixing zone, the chemistry of the water, operating conditions, the downstream diffuser design and the mixing zone.

The degree of removal for each potential BAT for each single parameter can, at this stage, not be predicted nor presented in a table. This is due to the complexity of the likely process configuration and its interactions (e.g. Reverse Osmosis will always be preceded by an extensive pre treatment). The degree or range of removal of a specific parameter is also a function of the design criteria (e.g. size of process units, number of process units etc.).

The proposed treatment process is the BAPT based on the factors outlined above; however, the process will still be subject to bench scale and pilot tests.

Based on past results nitrates do not appear to be a concern. Further water characterization studies are to be undertaken to determine if nitrates may be an issue.

Response 2

As the proposed system is considered BAT given the conditions listed in Response 1, there is no difference between the values.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #08**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Alternatives North IR #07, #10, #14
Yellowknives Dene First Nation IR #01

Linkage to October 2011 Technical Sessions

Technical Sessions Day Two transcripts, pp. 132-138

Linkage to Other IRs (from Round I)

North Slave Métis Alliance IR #08

Date of this Response

February 17, 2012

Request

Preamble

It is fully understood that the Developers' objective in site water treatment should be to improve water effluent discharge from Giant Mine. The City of Yellowknife is planning to move its potable water intake to Yellowknife Bay. The City and some residents have expressed concerns over the potential impacts on potable water given that there will be direct discharge of Giant Mine water effluent into Yellowknife Bay. There is some potential for malfunctions and accidental releases of contaminated water from Giant Mine. Such events may result in increased incremental costs for potable water treatment and it is unclear who would be responsible for these costs.

Question

Is there a commitment from the Developers to pay for any incremental water treatment costs for the City of Yellowknife should there be upset conditions with the water treatment system at Giant Mine or accidental water releases.

Reference to the EA Terms of Reference

s.3.5.1.2 Water

Summary

The effluent water quality for the new water treatment plant would be as set by the Mackenzie Valley Land and Water Board (MVLWB). The new plant will include effluent monitoring and contingency measures to ensure that non-compliant water is not discharged. Arsenic loadings to Yellowknife Bay will decrease once the new plant is operational, relative to pre-remediation conditions. As such, the Developers do not anticipate adverse impacts on the water quality in Yellowknife Bay.

Response

The Giant Mine remediation plan described in the Developers Assessment Report (DAR) and discussed at the October 2011 Technical Session includes the management of surface and underground water and treatment in a new water treatment plant. The treated water will be discharged into Yellowknife Bay through a diffuser. The water treatment plant effluent quality would be as licensed by the MVLWB.

The Giant Mine water treatment plant effluent quality will be monitored and measures built into the plant design and operating procedures to ensure that the water licence limits are met. These measures include: adjusting the plant's operating conditions in response to changes in influent volume and composition and temporarily storing and re-treating water that does not meet effluent quality criteria. The option of adding additional treatment capacity (e.g. a second treatment train) will also be built into the plant design.

The remediation measures planned for Giant Mine will result in decreased loadings of arsenic into Yellowknife Bay as compared to the loadings of arsenic entering Yellowknife Bay pre-remediation. This, and the contingency measures described above, lead the Developers to conclude that there will not be adverse impacts on the water quality in Yellowknife Bay. As a result, the Giant Mine Remediation Project Team does not feel that it is appropriate to commit to pay for incremental water treatment costs.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #09**

Date Received

November 30, 2011

Linkage to October 2011 Technical Sessions

Technical Sessions Day Two transcripts, pp. 135

Date of this Response

February 17, 2012

Request

Preamble

It is fully understood that the Developers wish to reduce power use and consumption as part of cost avoidance and that every effort will be made to avoid the need for additional local power capacity. Given that the project is at an early stage in design of the frozen block method and the current Freeze Optimization Study power requirement analysis has not been completed, there is some potential for a need for increased electricity generation capacity. The City of Yellowknife and some residents have expressed concerns over who would be responsible for the cost of such increased capacity.

Question

Is the Developer committed to pick up any incremental costs associated with its power demands at the Giant Mine to avoid any cost increases to other residential and business consumers in the City of Yellowknife?

Reference to DAR (relevant DAR Sections)

s.8.11.5.3 Mitigation Measures

Reference to the EA Terms of Reference

s.3.2.4.13 Development Description

Summary

Active cooling systems will be used to freeze the arsenic chambers over a period of 5-10 years and then replaced with passive thermosyphons. The Freeze Optimization Study (FOS) indicates that power requirements will peak at 2.5-3 MW and that this load can be interrupted for short periods without adverse impacts. The proponents plan to obtain this power from the Northwest Territories Power Corporation (NTPC), which is regulated by the Northwest Territories Public Utilities Board via a public process.

Response

The Giant Mine Remediation Plan described in the Developers Assessment Report (DAR) and discussed at the technical session includes the use of active cooling to freeze the arsenic dust chambers over a period of 5-10 years. Once the chambers are frozen, the cooling systems would be converted to passive cooling (i.e. thermosyphons). Results from the FOS indicate that the peak power demand during the active freezing period will be 2.5-3 MW, and that this load can be interrupted without adverse impacts to freezing.

The proponents plan to continue obtaining power from NTPC. NTPC is a regulated utility whose rates are reviewed and approved by the Northwest Territories Public Utilities Board via a public process. NTPC has adequate generating capacity to meet the Giant Mine requirements. At such times during the year that there are localized increases in demands to the system, the proponents will limit usage for short periods of time at the request of the NTPC.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #10**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Yellowknives Dene First Nation IR #04

Date of this Response

February 17, 2012

Request

Preamble

The effects of the diffuser on ice thickness and water quality in Yellowknife Bay are concerns that have been expressed many times as part of the Environmental Assessment. In committing to provide the Review Board and parties with the major design changes to the development as part of Undertakings 3 and 9, a summary of the diffuser design study was to be provided and is not in the materials filed by the Developer.

Question

Please provide a summary of the diffuser design study promised during the Technical Sessions Day Two as recorded on pages 259-260 of the transcripts.

Reference to DAR (relevant DAR Sections)

s. 6.8.6 Outfall and Diffuser

Reference to the EA Terms of Reference

s.3.2.4.9 Development Description

Response

The attached document prepared by Golder Associates (Doc 139) summarizes the work completed to date for the Preliminary Design of the diffuser system. The document sets out the water quality standards in Yellowknife Bay based on current information and available background data. The design work sets out the proposed water quality targets in the mixing zone in the bay, and the design criteria which were used for determining the configuration (length of diffuser, number of port, port diameter) of the diffuser.

TECHNICAL MEMORANDUM

DATE	November 12, 2011	**PROJECT No.**	11-1427-0030/3000
TO	Lisa Dyer PWGSC	**AECOM DOC. No.**	318-WTP-10-MEM-0001-Rev3_20111112
		GAL DOC. No.	139
FROM	Nicolas Lauzon and John Hull	**EMAIL**	nlauzon@golder.com; jhull@golder.com

SUMMARY OF GIANT DIFFUSER PRELIMINARY DESIGN

1.0 INTRODUCTION

The proposed new water treatment plant at Giant Mine is a facility that is intended to operate year-round. Treated effluent from the facility would be discharged to the environment through a diffuser located in Yellowknife Bay (Figure 1). An effluent diffuser is a hydraulic structure intended to promote rapid mixing of an effluent in close proximity to the structure using high discharge velocities. A diffuser may include several discharge ports on a main pipeline to achieve the required effluent dilution. Diffusers are often used for the discharge of mine effluents into local aquatic environments.

This document summarizes a preliminary design for the proposed diffuser in Yellowknife Bay and is subdivided into the following components:

- Description of regulatory requirements defining the effluent quality criteria and the ambient receiving environment water quality standards, in order to establish the dilution ratio required from the diffuser (Section 2);
- Listing of design criteria guiding the determination of the diffuser ports configuration and characteristics of the diffuser pipeline (Section 3);
- Characterization of effluent mixing within the ambient environment (i.e., Yellowknife Bay) and determination of a preliminary diffuser port configuration (Section 4); and
- Conclusion and recommendations of tasks to advance the diffuser to its detailed design phase (Section 5).

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Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

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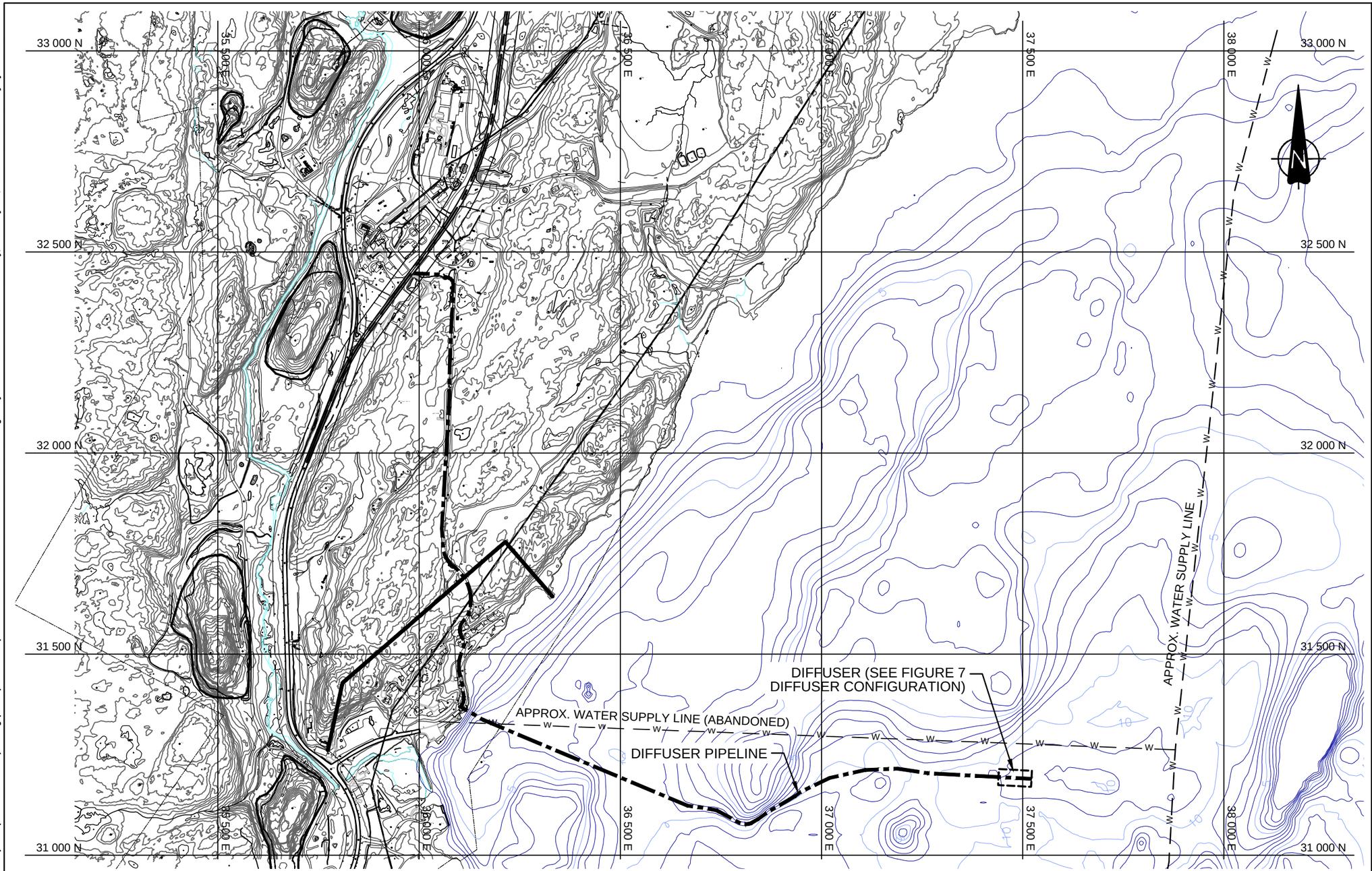
This preliminary design is a progression and advancement of the initial design proposed in the Developer's Assessment Report (INAC and GNWT 2010) and developed by Hay (2005). This progression, which satisfies the objectives of the DAR, includes the considerations of the following:

- A more comprehensive assessment of effluent quality criteria and water quality standards (Section 2), for a larger array of water quality constituents instead of only arsenic;
- Updated effluent discharge rates (Section 3), based on the preliminary design of the water treatment plant;
- An updated bathymetry for refining the selection of the location of the diffuser within Yellowknife Bay (Section 4); and
- Assessment of effluent mixing in the Bay under an ice cover (Section 4).



LEGEND

- TOPOGRAPHIC 2.5m INTERVAL CONTOUR
- EXISTING WATER COURSE
- BATHTYMETRIC 1m INTERVAL CONTOUR
- BATHYMETRIC 5m INTERVAL CONTOUR

REFERENCES

1. PWGSC, CAD FILE: GIANT MINE - CONTOURS (0.5M) - 2009 - GMRP.DWG, DATE RECEIVED: JANUARY 10, 2011.

NOTES

1. EXISTING TOPOGRAPHY, CADASTRAL AND MINE LAYOUT PROVIDED BY PWGSC.
2. ALL COORDINATES SHOWN REFER TO THE GMRP COORDINATE SYSTEM.
4. TOPOGRAPHIC CONTOURS SHOWN AT 2.5m INTERVALS.
5. BATHYMETRY CONTOURS SHOWN AT 1m INTERVALS.

0 100 200 300 400 500
SCALE IN METRES

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

PRELIMINARY
NOT FOR CONSTRUCTION

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DO NOT SCALE DRAWINGS

Revision/ Revision	Description/Description	Date/Date
0	ISSUED WITH MEM-0001-R3	20111112
0	ISSUED WITH MEM-0001-R2	20111110
A	ISSUED WITH MEM-0001-R1	20111110
A	ISSUED WITH MEM-0001-R0	20111107

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT
GIANT MINE REMEDIATION PROJECT, NWT

WETER TREATMENT PLANT TASK NO. 10

Approved by/Approuve par: **JAH**
Designed by/Concept par: **NL**
Drawn by/Dessine par: **JK**
PWGSC Project Manager/Administrateur de Projets TPSGC: **HENRY WESTERMANN**
PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'ingénierie, TPSGC:
Client/client: **PWGSC**
Drawing title/Titre du dessin:

PLAN VIEW OF DIFFUSER LOCATION

Project No./No. du projet	Sheet/ Feuille	Revision no./ La Révision no.
R.014204.318	FIGURE 1 OF 7	0

Drawing File: N:\Bur-Graphics\Projects\2009\1427\09-1427-0006\Drafting\4000\Task 4100\60162479_R014204-318-MEM-0001-CF01-R0.dwg Layout:DIFFUSER LOCATION Thursday, February 09, 2012 11:07:18 AM By: jkownacki

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2.0 REGULATORY REQUIREMENTS

The water and effluent quality management policy of the Mackenzie Valley Land and Water Board (MVLWB 2011) requires the determination of:

- Water quality standards applied to the aquatic environment beyond a mixing zone of the discharged effluent; and
- Effluent quality criteria for end-of-pipe discharges of effluent into an aquatic environment (i.e., ambient waters).

A mixing zone is an area of the aquatic environment where the effluent is mixed with ambient water and outside of which must meet the water quality standards. The water quality standards for the project were determined from the following regulatory guidelines:

- Federal and territorial drinking water guidelines (RRNWT 1990 and HC 2010); and
- Environmental guidelines for the protection of aquatic life (CCME 2007).

These guidelines were compared to background concentrations observed in Yellowknife Bay (i.e., ambient waters). Table 1 summarizes the comparison of the water quality constituents together with existing guidelines. For any given constituent, the water quality standard for ambient water was considered as follows:

- If the median of observed concentrations in the bay were lower than that guideline then the most stringent regulatory guideline applies;
- If the median is higher than one or more regulatory guidelines then the standard becomes a threshold 10% higher than the median of observed concentrations in the bay; or
- If there is no regulatory guideline then the standard becomes a threshold 10% higher than the median of observed concentrations in the bay.

The water quality standards considered for the project are highlighted in bold in Table 1.

Effluent quality criteria for selected water quality constituents were defined as part of the design of the proposed new water treatment plant. These criteria are summarized in Table 2, along with regulatory guidelines that include the metal mining effluent regulation (MMER 2002) and the expired water license N1L2-0043 for Giant Mine (MVLWB 1998). Effluent quality criteria for constituents targeted for water quality standards in Table 1, but not part of the selection identified in the design of the water treatment plant were determined from the observed concentrations at the existing water treatment plant at Giant. The maximum observed concentrations at the existing water treatment plant (see Table 2), were selected as effluent quality criteria, since they would impose more stringent design considerations for the diffuser. The effluent quality criteria considered for the project are highlighted in bold in Table 2.

The effluent quality criteria, water quality standards and ambient water median concentrations were used to calculate the dilution ratio to be achieved by the diffuser (see Table 2). This ratio was determined for each constituent with an effluent quality criterion that is higher than the water quality standard (i.e., for constituents that require dilution). The highest calculated dilution ratio was then retained as a design criterion for the diffuser, since it represents the critical dilution requirement. This highest dilution ratio is that calculated for arsenic (100 to 1) and is based on the calculations summarized below:

- Arsenic is a target constituent for the design of the proposed new water treatment plant, and the intention is to never exceed the effluent water quality (0.5 mg/l), which has been exceeded by the existing water treatment plant in the past (maximum observed concentration of 0.61 mg/l).
- As many as 43 of the 51 observations of arsenic in the bay (Table 1) were obtained from analytical methods with detection limits that are close or significantly higher than the water quality standard of that constituent (i.e., detection limits of 0.002, 0.02 and 0.3 mg/l, compared to a guideline for the protection of aquatic life of 0.005 mg/l).
- Many cases with these high detection limits reported observable concentrations, however these observations were near these limits, and they should be assigned a high uncertainty level.
- A total of 8 of 51 observations were obtained from analytical methods with a low detection limit, and provided arsenic concentrations between less than 0.0002 and 0.0075 mg/l (median of 0.00056), with 7 observations appreciably below the guideline for the protection of aquatic life (0.005 mg/l).
- To ensure a conservative assessment, the arsenic dilution ratio was therefore approximated at 100 to 1, based on the effluent quality criterion and water quality standard of that constituent, and assuming an ambient concentration in the bay that would be to the level of these 8 low observations.

Table 1: Water Quality Standards for Yellowknife Bay

Parameter	Unit	Regulatory Guidelines in the Ambient Environment			Ambient (Yellowknife Bay) Water Quality (a)				
		Drinking Water (RRNWT 1990)	Drinking Water (HC 2010)	Protection of Aquatic Life (CCME 2007)	Minimum	Median	Maximum	Total Number of Samples	Samples Below Detection Limits
Physical									
Total Suspended Solids	mg/L	-	-	-	1	**2.4**	39	13	3
Total Dissolved Solids	mg/L	500	**500**	-	<10	37	43	7	1
Major Ions									
Chloride	mg/L	250	**250**	-	0.9	1.9	6.4	36	0
Sodium	mg/L	-	**200**	-	1	2	5.5	29	6
Sulphate	mg/L	250	**500**	-	<5	<5	5	36	25
Nutrients									
Ammonia	mg/L	-	-	**1.51 (b)**	0.003	0.01	0.043	32	7
Cyanide									
Total Cyanide	mg/L	0.01	0.2	**0.005**	<0.001	<0.004	0.05	9	5
Total Metals									
Aluminium	mg/L	-	0.1	**0.1 (c)**	0.017	0.06	0.15	8	0
Arsenic	mg/L	0.05	0.01	0.005	<0.0002	**0.03**	0.4	51	26
Cadmium	mg/L	0.01	0.005	**0.009 (d)**	<0.00005	<0.002	0.2	48	41
Copper	mg/L	1	1	0.002 (d)	0.00084	**0.31**	2	48	24
Iron	mg/L	0.3	0.3	**0.3**	<0.02	<3	187	47	2
Lead	mg/L	0.05	0.01	0.001 (d)	<0.00005	**<0.2**	1.7	47	25
Manganese	mg/L	0.05	**0.05**	-	<0.005	<0.02	1.7	26	19
Mercury (Inorganic)	mg/L	-	0.001	0.000026	<0.00001	**<0.02**	0.1	48	36
Molybdenum	mg/L	-	-	**0.073**	0.000115	<0.01	<0.01	8	7
Nickel	mg/L	-	-	0.025	0.00052	**0.25**	1	48	27
Selenium	mg/L	0.01	0.01	**0.001**	<0.0005	<0.0005	<0.2	8	8
Uranium	mg/L	-	0.02	-	0.000246	**<0.5**	<0.5	3	2
Zinc	mg/L	5	5	0.03	0.004	**0.28**	<5	48	33

Parameter	Unit	Regulatory Guidelines in the Ambient Environment			Ambient (Yellowknife Bay) Water Quality (a)				
		Drinking Water (RRNWT 1990)	Drinking Water (HC 2010)	Protection of Aquatic Life (CCME 2007)	Minimum	Median	Maximum	Total Number of Samples	Samples Below Detection Limits
Organics									
Oil and Grease	mg/L	-	-	-	-	-	-	0	0
Radionuclides									
Radium-226	Bq/L	-	**0.5**	-	<0.005	0.005	0.006	8	0

(a) The sources of data are Moore et al. (1978), Jackson et al. (1996), Jackson (1998) and Golder (2008).

(b) Guideline calculated based on ambient water pH and temperature.

(c) Guideline calculated based on ambient water pH.

(d) Guidelines calculated based on ambient water hardness.

Table 2: Effluent Quality Criteria and Required Dilution Ration for the Effluent

Parameter	Unit	Regulatory Guidelines (Maximum Average Concentrations) at the End of Pipe		Proposed Water Treatment Plant Objectives	Existing Water Treatment Plant Discharge Water Quality (a)					Water Quality Standard (b)	Required Dilution (c)
		Metal Mining Effluent (MMER 2002)	Giant Water License N1L2-0043 (MVLWB 1998)		Minimum	Median	Maximum	Total Number of Samples	Samples Below Detection Limits		
Physical											
Total Suspended Solids	mg/L	15	15	**15**	<1	<1	27	50	35	2.4	53
Total Dissolved Solids	mg/L	-	-	-	1770	2230	**2410**	23	0	500	5
Major Ions											
Chloride	mg/L	-	-	-	156	221	**341**	10	0	250	1.4
Sodium	mg/L	-	-	-	89.4	107	**149**	36	0	200	Not required
Sulphate	mg/L	-	-	-	928	1160	**1260**	6	0	500	3
Nutrients											
Ammonia	mg/L	-	12	**12**	<0.005	0.024	0.059	14	6	1.51	8
Cyanide											
Total Cyanide	mg/L	1	0.8	1	<0.005	<0.005	**0.012**	38	25	0.005	3
Total Metals											
Aluminium	mg/L	-	-	-	0.0045	0.01	**0.31**	61	3	0.1	6
Arsenic	mg/L	0.5	0.5	**0.5**	0.21	0.32	0.61	112	0	0.03	100
Cadmium	mg/L	-	-	-	0.00005	<0.00025	**0.0005**	59	34	0.009	Not required
Copper	mg/L	0.3	0.3	**0.3**	0.0054	0.0093	0.042	69	2	0.31	Not required
Iron	mg/L	-	-	-	<0.01	0.019	**0.16**	61	12	0.3	Not required

Parameter	Unit	Regulatory Guidelines (Maximum Average Concentrations) at the End of Pipe		Proposed Water Treatment Plant Objectives	Existing Water Treatment Plant Discharge Water Quality (a)					Water Quality Standard (b)	Required Dilution (c)
		Metal Mining Effluent (MMER 2002)	Giant Water License N1L2-0043 (MVLWB 1998)		Minimum	Median	Maximum	Total Number of Samples	Samples Below Detection Limits		
Lead	mg/L	0.2	0.2	**0.2**	0.0001	<0.00025	0.007	59	29	<0.2	10
Manganese	mg/L	-	-	-	<0.005	0.0171	**0.5**	61	6	0.05	12
Mercury (Inorganic)	mg/L	-	-	-	<0.00001	<0.0002	**<0.0002**	34	34	<0.02	Not required
Molybdenum	mg/L	-	-	-	0.012	0.02	**0.031**	61	2	0.073	Not required
Nickel	mg/L	0.5	0.5	**0.5**	<0.01	0.047	0.1	69	2	0.25	10
Selenium	mg/L	-	-	-	0.0006	<0.005	**0.017**	59	23	0.001	22
Uranium	mg/L	-	-	-	0.0003	0.00085	**0.0061**	59	0	<0.5	Not required
Zinc	mg/L	0.5	0.2	**0.5**	<0.004	0.0065	0.071	69	1	0.28	8
Organics											
Oil and Grease	mg/L	-	-	**5**	<1	<1	<1	5	5	-	Not required
Radionuclides											
Radium-226	Bq/L	0.37	-	**0.37**	0.02	0.02	0.02	1	0	0.5	Not required

(a) The source of data is INAC (2011)

(b) Effluent water quality from Table 1.

(c) The required dilution is the greater of regulatory guidelines or 10% above measured background concentrations in Yellowknife Bay, whichever is more stringent.

3.0 DESIGN CRITERIA

Design of an effluent diffuser requires testing of several port configurations (i.e., number of ports, port diameter, port angle, space between ports, port geometry), and selecting a configuration that meet the required dilution ratio (i.e., 100 to 1, Section 2). The main design basis is then to achieve that dilution ratio so that constituent concentrations in the effluent plume, beyond the regulatory mixing zone, meet the water quality standards. The main design criterion for the diffuser ports is therefore the definition of the mixing zone and the dilution factor required.

The Northwest Territories provide guidance for the definition of mixing zones that is focused on wastewater effluent (NWTWB 1992). The water and effluent quality management policy of the Mackenzie Valley Land and Water Board (MVLWB 2011) further indicates that guidance on mixing zones are under development (i.e., not yet available). Size and shape of the mixing zone is established on a case by case basis and maximum limits vary among regions (provinces and states). The objective of this task in this project was to select a diffuser port configuration that minimizes the size of the mixing zone, while being bounded by the following limits:

- The mixing zone from one port must not exceed a radius of 66 m (200 feet), a general guideline set by EPA (1995);
- The mixing zone from one port must not exceed the radius of the near field area of the mixing model used (CORMIX in Section 4), since this radius is considered to correspond to the limit of application of that model (the near field area is where mixing is primarily influenced by the momentum of the effluent jet rather than ambient conditions and its outer boundary is located where the plume touches the water surface); and
- The region of the effluent plume from one port with a dilution ratio of 100 to 1 or less must not overlap with that same region from any other port.

The establishment of the characteristics of the diffuser ports and pipeline was guided by the design criteria summarized in Table 3.

Table 3: Diffuser Ports and Pipeline Design Criteria

Parameter	Criterion	Comments
Dilution required at boundary of mixing zone	100	As calculated for the parameters at this site (Table 2).
Mixing zone radius form one port	66 m or near field area (whichever is smaller)	Respectively a general guideline by EPA (1995) and the domain of application for the mixing model used for the project.
Overlapping of port effluent plume	No overlapping of effluent plume	Minimize dilution inefficiency resulting from overlapping plumes from the diffuser ports.
Average effluent discharge flow	26 and 17 l/s	Respectively, the short and long term average discharge flow from the water treatment plant.
Maximum effluent discharge flow	34 and 21 l/s	Respectively, the short and long term maximum discharge flow from the water treatment plant.
Diffuser port exit velocity	Between 6 to 10 m/s	Range of velocities to apply to the average and maximum effluent discharge flows to promote mixing with ambient waters.
Port height above bay bottom	1 m	Minimize entrainment of bottom sediment from the port jets.
Inland Pipeline Alignment	Shortest possible alignment	Limit material used for constructing the pipe and minimize maintenance.
	Near existing access road	Facilitate maintenance.
Submerged Pipeline Alignment	Following a down gradient route to the extent possible	Facilitate installation of the pipeline and minimizing formation of air pocket in the submerged portion of the pipeline.
Water velocity in the pipeline	Between 0.3 and 1.2 m/s	Provide sufficient velocity to minimize the occurrence of clogging while being sufficiently low to minimize internal wear and tear in the pipeline and minimize friction losses.
Air volume in the pipe for sizing ballast weight	50% of pipeline internal volume	A conservative assumption to calculate ballast weight that will be sufficiently high to maintain the submerged portion of the pipeline at the bottom of the bay.

4.0 EFFLUENT MIXING

4.1 Mixing Model

The CORMIX model system (Doneker and Jirka 2007) was used to provide numerical simulations of the mixing and dilution behaviour of the mine effluent in the near-field in Yellowknife Bay. CORMIX is one of the most extensively used models for predicting plume mixing and dilution of substances in surface waterbodies. This model has been used for conceptual design and analysis of effluent diffusers in other northern Canadian waterbodies. Ambient and effluent water characteristics required to implement the mixing model are presented in Sections 4.2 and 4.3, respectively. A multiport diffuser is recommended as the endpoint of the effluent outfall. Dilution results from the mixing model and the characteristics of the recommended diffuser configuration are respectively presented in Sections 4.4 and 4.5.

4.2 Characterization of Ambient Conditions

Ambient conditions (i.e., for Yellowknife Bay) are summarized in Table 4. Typically, for a given characteristic, a range of values is provided representing the possible conditions in the bay. Details on the information referenced to establish these characteristics are provided in Table 4 and discussed below.

Table 4: Summary of Yellowknife Bay Ambient Conditions

Characteristic	Adopted Values	Comment
Average Ambient Depth (m)	9.0 and 7.0	Respectively for the open water and ice cover periods. Derived from the bathymetry of the Bay (Figure 1), the observed water levels in the bay (Figure 2), and observed ice thickness in the bay. Average ambient depths are for the lowest water level observed in the bay (156.1 m), and the depth during the ice cover period account for a 2 m thick ice cover.
Wind Speed (km/h)	No wind, 16, 72	Represent cases of no wind, and observed average and maximum hourly wind at Yellowknife Airport meteorological station.
Average Ambient Velocity (m/s)	0.005, 0.07, 0.6	A range of velocities representing near stagnant conditions, an assumed average condition based on the hourly average wind speed, and an extreme case based on the observed hourly maximum wind speed.
Ambient Temperature (˚C)	Un-stratified: 4, 19 Stratified: 16, 19	Un-stratified: assigned temperatures during the ice cover and open water periods, respectively to provide the highest density differential between ambient and effluent waters. Stratified (at 5 m depth): assigned temperature in the lower and upper water layers in the bay to provide a high density differential between ambient and effluent waters and the highest observed temperature differential between water layers.
Ambient total Dissolved Solids (mg/L)	37	Median of observations in Yellowknife Bay (Table 1)
Ambient Total Suspended Solids (mg/L)	2.4	Median of observations in Yellowknife Bay (Table 1)
Water Density (kg/m^3)	Un-stratified: 1000.0, 998.4 Stratified: 999.0, 998.4	Calculated from water temperature, total dissolved solids and total suspended solids (Coles and Wells 2003), respectively for un-stratified ice cover and open water periods and for the stratified case during the open water period.
Manning's Coefficient	0.015	Assumed; typical value for waterbodies for lakes and bays.

The bathymetry of Yellowknife Bay in the region of the diffuser location is illustrated in Figure 1. The bathymetry contours in Figure 1 were derived from depth surveys undertaken in September 9, 10, 14, 15, 17, 19, 27 and 29, 2010. Surface water levels observed during the survey, (at Water Survey Canada station 07SB001. WSC 2011), varied between 156.26 and 156.33 m, with an average of 156. 3 m. Long term surface water level characteristics (i.e., from 1934 to 2009) in the bay are presented in Figure 2, and indicate that the minimum water level observed over this period was 156.1 m. Ambient depth at the proposed diffuser location may then be lower than 10 m, and an average ambient depth of 9 m (Table 4) was therefore considered in the model during the open water period (i.e., May to October). Under winter conditions, the ambient depth must be reduced to account for the presence of an ice cover on the bay. Ice thickness measurements in the bay, taken for this project on March 29 and 30, 2010, and obtained from the Canadian Ice Database (Lenormand et al. 2002) vary between 97 and 183 cm, for an average of 134 cm. A thickness of 200 cm was considered for this analysis, yielding an average ambient depth of 7 m (Table 4) during the ice cover period (i.e., November to April).

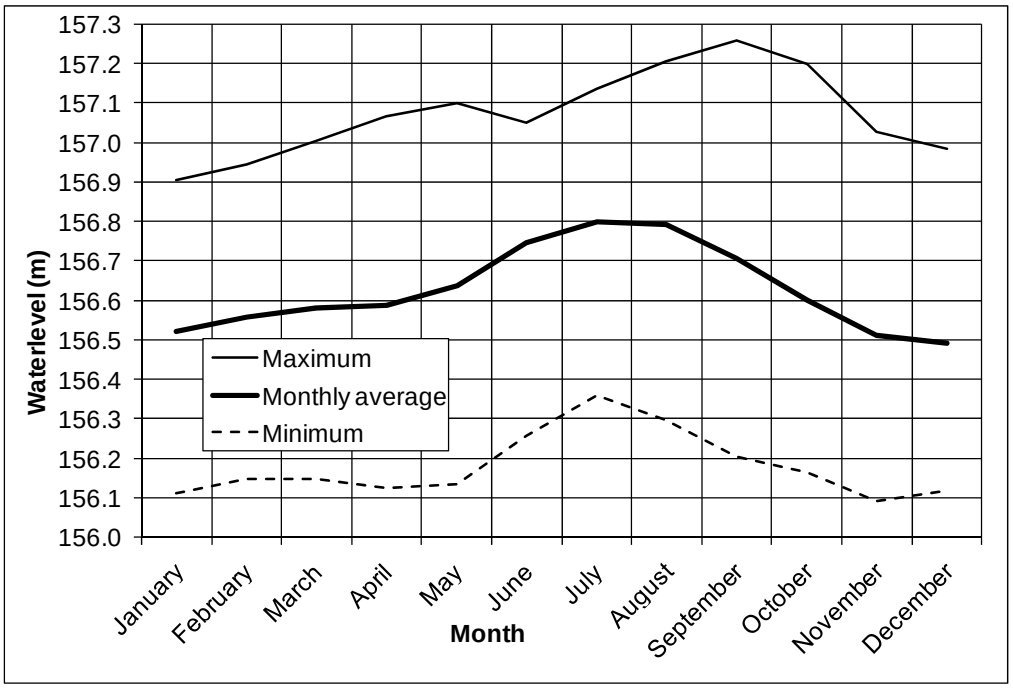


Figure 2: Surface Water Levels in Yellowknife Bay

Effluent mixing is dependent on ambient currents in Yellowknife Bay, which are expected to be driven mainly by wind conditions during the open water period. Hourly wind observations from 1953 to 2010, from Environment Canada meteorological station at Yellowknife Airport (EC 2011) were compiled to establish average and maximum speed (Table 5) as well as occurrences (Figure 3) according to major directions, during the open water period. Winds occur most often from the east (41% from NE, E and SE combined), with notable occurrences from the south (18%) and the north (15%). The average hourly wind speed of all directions combined is 16 km/h, while the maximum hourly wind speed was observed from the west at 72 km/h).

Table 5: Wind Speed Characteristics at Yellowknife Airport, from May to October

Direction	Average Hourly Wind Speed (km/h)	Maximum Observed Hourly Wind Speed (km/h)
North (N)	17.3	68
North East (NE)	15.2	64
East (E)	15.6	52
South East (SE)	14.9	56
South (S)	16.1	56
South West (SW)	12.0	51
West (W)	14.7	72
North West (NW)	17.4	64

Shear stress at the air-water interface theoretically leads to near water surface lake currents equal to approximately 3% of wind speed (Cole and Wells 2003). However, current velocities in the bay were estimated from 1) drogue tracking simulation studies (Hamilton et al. 1989); and 2) a rhodamine dye tracer study (Grainge 1963). Current velocities were estimated to be 0.6 to 0.7% of wind speed during the period of the dye tracer study, while velocities were calculated to vary between 0.35 to 2.6% of wind speed on the days the drogue tracking simulation studies was undertaken. During both studies, wind speeds were near the long term hourly average of 16 km/h at Yellowknife Airport. For the purpose of this study, the following range of current velocities was considered for the open water period:

- A near stagnant condition (i.e., velocity of 0.005 m/s) to represent a case of no wind (or under ice condition);
- An average velocity assumed as 1.5% (i.e., a mid percentage from the drogue tracking study) of the average hourly wind (i.e., velocity of 0.07 m/s); and
- A extreme velocity corresponding to 3% of the maximum hourly wind (0.6 m/s).

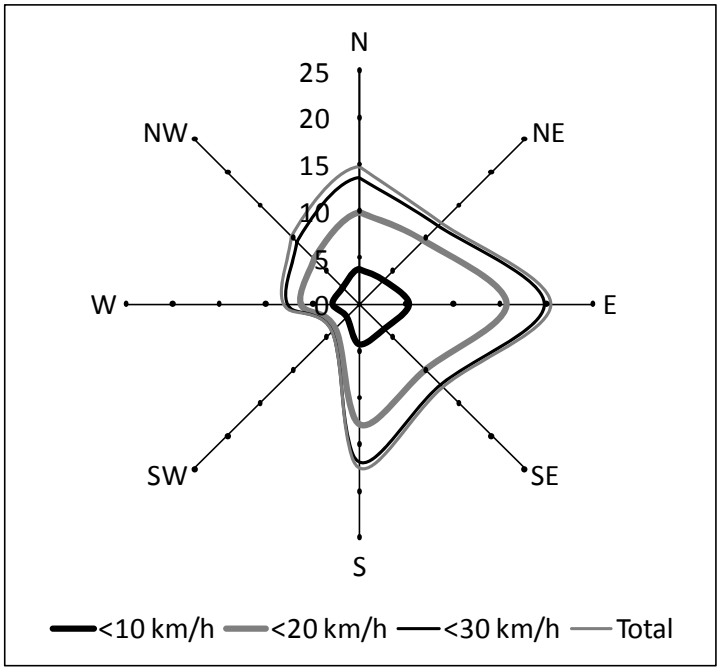


Figure 3: Wind Occurrence (in percent) in the major Directions, from May to October

During the ice cover period, winds are not expected to impact current velocities in the bay. Flows from the Yellowknife River are anticipated to provide a source of freshwater into the bay year round, and to ultimately convey the effluent toward Great Slave Lake. Flow characteristics compiled from observations taken at Water Survey Canada station 07SB002 (WSC 2011) on the Yellowknife River from 1939 to 2009 are illustrated in Figure 4. Flows typically initiate a rise in May at the start of the freshet until they reach their peak in June and July, then gradually decrease from August to April. Flows during the winter are relatively low and therefore the current velocity in the bay used in the mixing model for the ice cover period was the case of near stagnant conditions (i.e., 0.005 m/s).

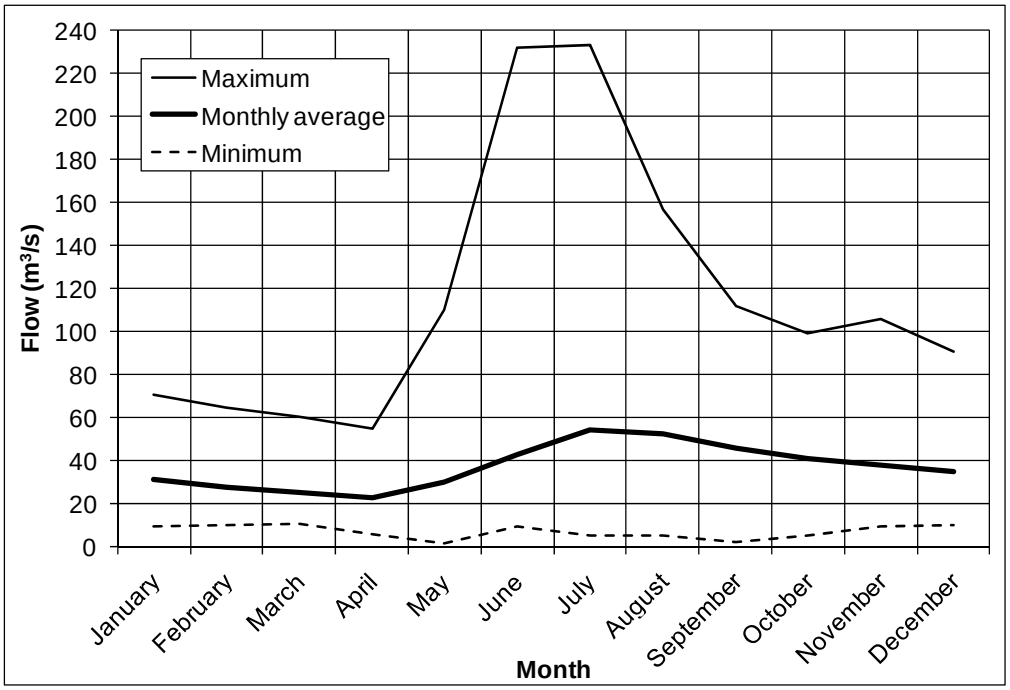


Figure 4: Flows from Yellowknife River

Water density affects mixing and is dependent on water temperature and concentration of total dissolved and suspended solids. Water temperature observations in Yellowknife Bay reported by Moore et al. (1978), Hamilton et al. (1989) and Golder (2009) vary between approximately 4 and 19°C during the open water period and 0 and 4°C during the ice cover period. Furthermore, observations in Hamilton et al. (1989) and Golder (2009) indicate a gradually decreasing temperature as a function of depth between July and August. The decrease was notably pronounced at depths between 4 and 6 m, indicating a thermocline at this depth, with a difference in temperature between 2 and 3°C. As part of this study, the following ambient water temperature cases were considered:

- Un-stratified water column during the ice cover period: a temperature of 4°C to provide the highest density differential between ambient and effluent waters;
- Un-stratified water column during the open water period: a temperature of 19°C to provide the highest density differential between ambient and effluent waters; and
- Stratified water column at a depth of 5 m during open water period: temperature of 16 and 19°C, respectively for the lower and upper water layers in the bay, providing a high density differential between ambient and effluent waters and the highest observed temperature difference between the upper and lower water layer.

Observed total dissolved and suspended solids in Yellowknife Bay were relatively low and would have little impact on water density. The median values for these two water quality parameters (i.e., 37 and 2 mg/l, respectively for total dissolved and suspended solids, Table 1) were considered to calculate ambient water density.

4.3 Characterisation of Effluent

Effluent characteristics are summarized in Table 6. Discharge rates were estimated from the expected treated water volumes, based on the expected volumes from all water sources directed to the water treatment plant. Short and long term discharge rates are respectively for the underground freezing and post underground freezing periods (Section 2.2.3). Observed water temperature of the influent to the existing water treatment plant varies between 2 and 11°C, with winter temperature not exceeding 8°C (B. Williamson, AECOM, pers. Comm., 2011). It is considered that a temperature of 9°C would represent the effluent water temperature providing the highest density differential between effluent and ambient conditions. The total dissolved and suspended solids levels presented in Table 6 respectively represent the maximum observed concentration from the existing water treatment plant and the maximum allowable effluent concentration from the proposed water treatment plant.

Table 6: Summary of Effluent Characteristics

Characteristic	Adopted Values	Comment
Discharge Rate (l/s)	34, 26, 21, 17	Respectively the short term maximum and average discharge rates and long term maximum and average discharge rates from the proposed water treatment plant (Table 3).
Discharge Temperature (˚C)	9	Within the range of temperature observed at the existing water treatment plant, and providing the highest density differential between ambient and effluent water for both the open water and ice cover periods.
Discharge Total Dissolved Solids (mg/L)	2400	Maximum observed concentration from the existing water treatment plant (Table 2).
Discharge Total Suspended Solids (mg/L)	15	Effluent quality criterion for the water quality parameters (Table 2).
Density (kg/m^3)	1001.7	Calculated from water temperature, total dissolved solids and total suspended solids (Coles and Wells 2003); (negatively buoyant plume in all cases).

4.4 Modelling Results

The design process for the diffuser consisted of the following:

1) Identifying the geometry of a port (diameter and angle) that would provide the required 100 to 1 dilution based on the characteristics of the effluent listed in Table 6, for all the combinations of ambient characteristics (i.e., depths, current velocities and temperatures) that can be realized from the values listed in Table 5. This step determined the fraction of the discharge that can pass through one port while achieving the required dilution.

2) Identifying the number of ports, with the geometry identified in the first step, required to pass the total effluent discharge and the distance between ports to prevent overlapping of plume jets from the ports.

The following diffuser port configurations were tested:

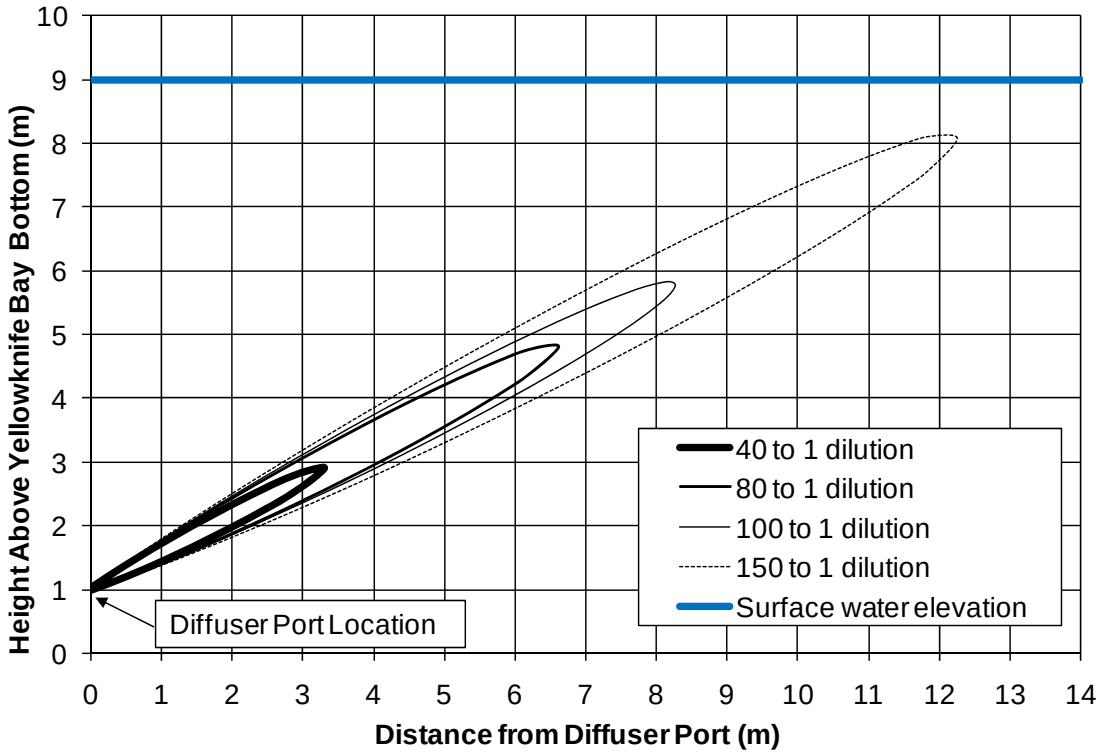
- Port diameters of 13, 19, 25 and 31 mm;
- Port angles of 90 (vertical), 45 and 30 degrees;
- Port exit velocities of 6 and 10 m/s (Table 3); and
- Co-flowing (effluent and current velocities in the same direction) and cross-flowing (effluent and current velocities at a 90-degree angle) scenarios.

The combination of the range of ambient characteristics and diffuser port configurations resulted in the analysis of over 336 test runs with the mixing models. Conclusions from this analysis are as follows:

- The ports were sized to meet the required dilution of 100 plus an accuracy allowance of 50% (dilution of 150) as stated in the Doneker and Jirka (2007).
- A vertical port (90˚ angle from the reservoir bottom) does not provide the required dilution ratio under near stagnant conditions (current velocity of 0.005 m/s), and therefore should be discarded as a configuration option for the diffuser.
- The 30˚ and 45˚ angled ports provide similar dilution ratios; however a 30˚ angle is preferred to minimize the interaction of the plume jet with ice at the bay surface during the ice cover period.
- Using larger port diameters yields larger discharge flow volumes from a single port, and larger flow volumes resulted in longer distance required to achieve the 150 to 1 dilution ratio. It is recommended to use a small diameter (i.e., 13 mm) to achieve the required dilution while minimizing contact with either the ice or thermocline interface.
- When no temperature stratification is present in the bay, the plume jet from a port is predicted to make contact with the water surface or the ice cover. Model predictions nevertheless indicate that mixing of the effluent with ambient water would achieve the 150 to 1 dilution before the plume makes contact with the water surface during the open water period (Figure 5a). During the ice cover period, it is predicted that the plume would make contact with the ice cover bottom (Figure 5b).
- The tested temperature stratification in the bay is predicted to constitute the equivalent of a barrier that would deflect the effluent plume from the diffuser port (Figure 6a). This deflection is however predicted to induce a lateral spreading of the plume (Figure 6b), allowing further dilution. The 150 to 1 effluent dilution isocontour would be in contact with the thermocline interface.
- Uncertainty should be considered on dilution predictions after a plume makes contact with a barrier or interface (i.e., ice cover in Figure 5a or thermocline in Figure 6). The near field region, which is the domain of validity of CORMIX, ends when the plume reaches an interface. The length of the contact is however relatively short. As a result it is proposed that the mixing zone be slightly higher than the near field area, consisting of an area with a radius of 15 m around each port. During the detail design phase, adjustment should be made to the port angle to minimize the length of contact with any interface.

- Prediction of effluent dispersion beyond the near-field is not possible with CORMIX. However some qualitative assessment is provided as follows: Outside the near-field mixing zone, mixing in the lake would be dependent on current velocity (driven by wind and waves) in the bay and the difference between ambient and effluent water densities. The negatively buoyant effluent (i.e., high effluent density compared to ambient water density) may create a zone of effluent along the bottom of the lake, where mixing would then occur gradually from lateral dispersion and vertical distribution.
- The maximum velocity of the effluent plume in contact with the ice cover bottom is predicted to be approximately 0.15 m/s. Thinning of the ice cover might occur, and should be confirmed during the diffuser detailed design phase. The thinning, if any, would be local and may be further minimized by adjusting the port angle (i.e., lower than 30°).

As a summary, a port with a diameter of 13 mm and angle from the bay bottom of 30° is predicted to achieve the required 100 to 1 effluent dilution, within a mixing zone with a 15 m radius, for the combinations of ambient characteristics tested. The largest width of the effluent plume area with a dilution ratio of 150 to 1 or less is approximately 0.75 m, which was considered in the determination of the distance between ports in Section 4.5.



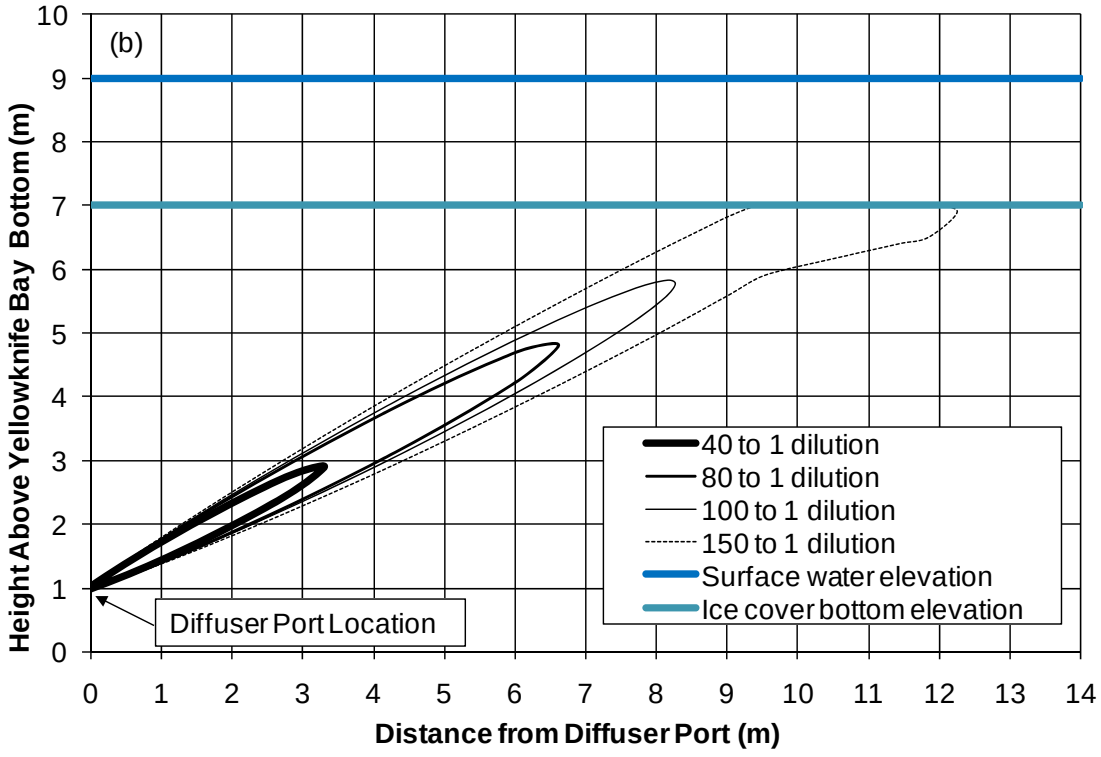
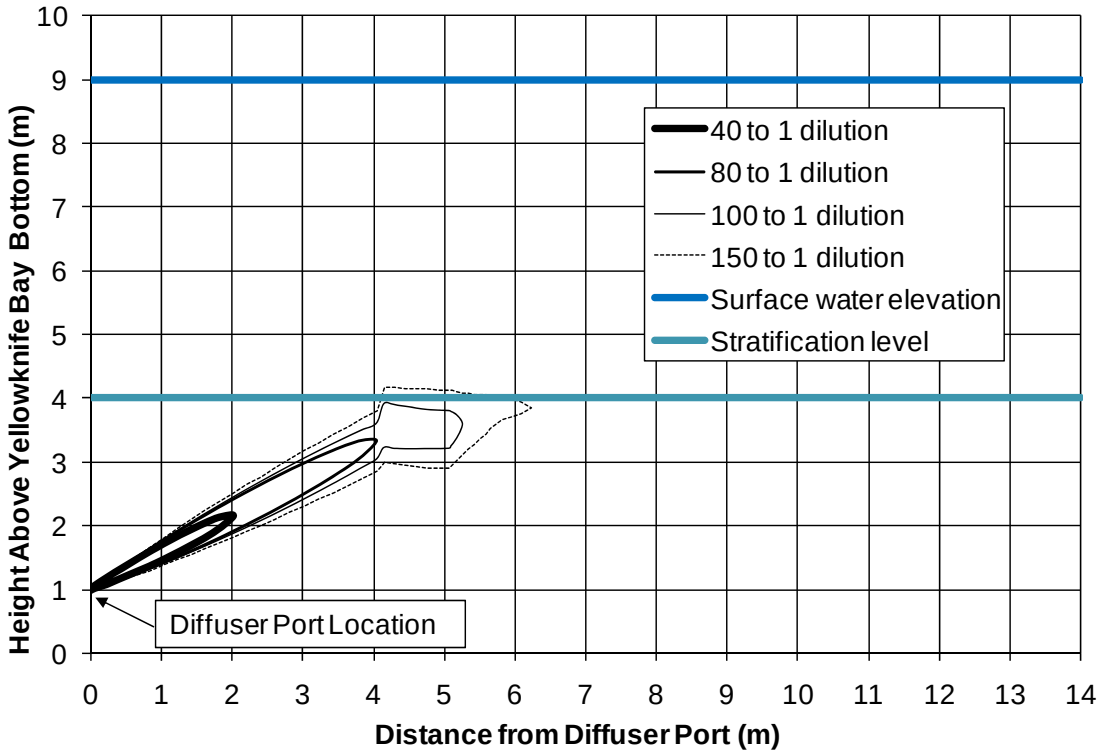


Figure 5: Effluent Dilution from a Single Port for an Un-Stratified Ambient Water Column: (a) Open Water and (b) Ice Cover Periods (worst ambient conditions, with near stagnant current)



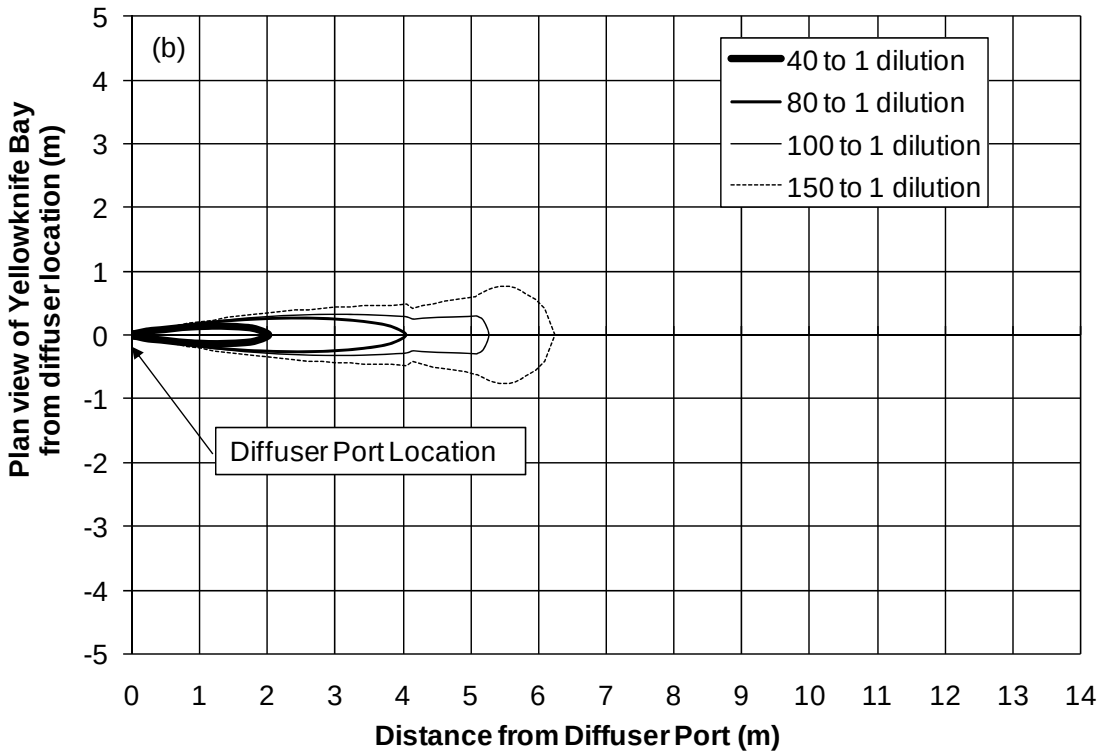
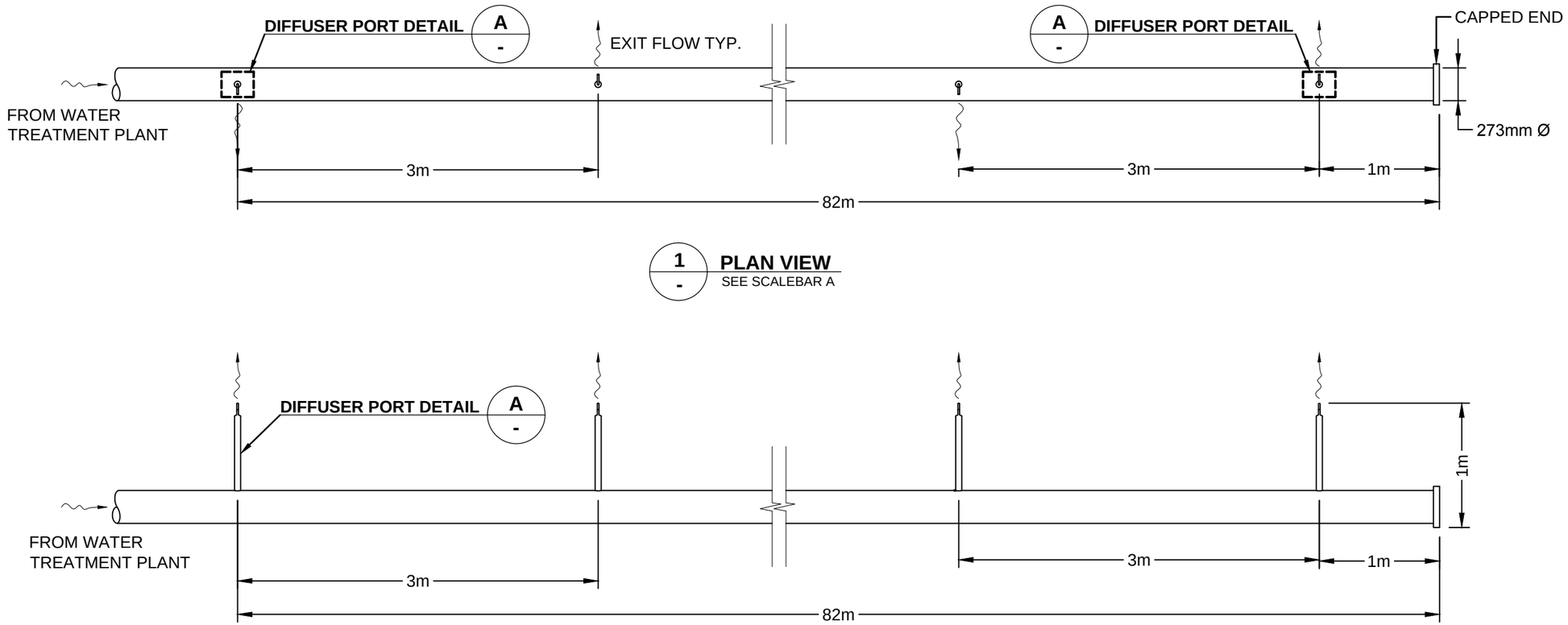


Figure 6: Effluent Dilution from a Single Port for a Stratified Ambient Water Column: (a) Profile and (b) Plan Views (worst ambient conditions, with near stagnant current)

4.5 Diffuser Port Configuration

Flow through a single 13 mm diameter port must range between 0.8 and 1.3 l/s in order to meet the design requirement of port exit velocity between 6 and 10 m/s (Table 4). A diffuser with 28 ports is recommended to discharge the short term effluent flows (i.e., average and maximum flow of 26 and 34 l/s, resulting in a flow per port of 0.9 and 1.2 l/s, respectively). Before the onset of long term conditions, several ports will have to be sealed during a maintenance operation with divers, in order to meet the design requirement on port exit velocity with the reduced flow of that operation period (i.e., average and maximum flow of 17 and 21 l/s). For long term conditions, the number of active ports should be reduced to 18 (i.e., flow per port of 0.8 and 1.2 l/s, respectively for average and maximum flow conditions).

The space between ports was established to minimize overlap of the effluent plume from each port, while minimizing the total length of the diffuser in order to minimize the total area of the mixing zone (i.e., the combined area of the mixing zone of each port). For preliminary design the distance between ports is proposed to be 3 m, equalling twice the largest width of the effluent plume area with a dilution ratio of 150 to 1 or less. The total length of the diffuser, from the first to the last port would therefore be 81 m, yielding a rectangular shaped mixing zone around the diffuser with a width of 30 m (i.e., the diameter of the mixing zone for one port) and a length of 111 m (i.e., the length of the diffuser plus the diameter of the mixing zone for one port on either end of the diffuser). In addition, it is recommended that ports discharge in alternate directions, as shown in Figure 7, to further minimize the occurrence of effluent plume overlaps.



1 - PLAN VIEW
SEE SCALEBAR A

2 - PROFILE VIEW
SEE SCALEBAR A

NOTE:
A TOTAL OF 28 PORTS ARE INCLUDED, SPACED 3 m APART.

A - DIFFUSER PORT DETAIL (28 PORTS TOTAL)
SEE SCALEBAR B

Public Works and Government Services Canada
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0	ISSUED WITH MEM-0001-R3	20111112
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A	ISSUED WITH MEM-0001-R0	20111107
Revision/ Revision	Description/Description	Date/Date

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT
GIANT MINE REMEDIATION PROJECT, NWT

WATER TREATMENT PLANT TASK NO. 10

Approved by/Approuve par
JAH

Designed by/Concept par
NL

Drawn by/Dessine par
JK

PWGSC Project Manager/Administrateur de Projets TPSGC
HENRY WESTERMANN

PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'ingénierie, TPSGC

Client/client
PWGSC

Drawing title/Titre du dessin

DIFFUSER CONFIGURATION

Project No./No. du projet	Sheet/ Feuille	Revision no./ La Révision no.
R.014204.318	**FIGURE 7** OF 7	**0**

Drawing File: N:\Bur-Graphics\Projects\2009\1427\09-1427-0006\Drafting\4000\Task 4100\60162479_R014204-318-MEM-0001-CF07-R0.dwg Layout:DIFFUSER CONFIGURATION Thursday, February 09, 2012 11:17:38 AM By: jkownacki

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Runs with CORMIX were undertaken to test the proposed diffuser configurations, for spaces between ports of 1.5, 3 and 6 m, and for ports discharging in the same direction or in alternate directions. Considering all combinations of ambient characteristics, a total of 42 model runs of multiport diffuser configuration were undertaken. Test runs with multiport diffusers indicated that CORMIX may overestimate dilution by 22% on average (Etemad-Shahidi and Azimi 2007). Dilution prediction made in this project for multiport diffuser configurations were therefore reduced by 22%. The required dilution is consistently predicted to occur within a shorter distance for configurations with ports discharging in alternate opposing direction than those discharging in the same direction. The dilution of 150 to 1 would not be achieved within a distance of 15 m from the port, with some of the combinations of ambient characteristics and with 1.5 m space between ports (i.e., cross flowing effluent with average to high current velocities). The dilution of 150 to 1 is predicted to be met within a distance of 15 m at all time for all combinations, with 3 and 6 m space between ports. The effluent dilution predicted for configurations with 3 m space between ports is relatively similar to that of configurations with 6 m space between ports.

The diffuser configuration consisting of 28 ports spaced 4 m apart and discharging in alternate directions is therefore considered reasonable for preliminary design and achieves the required dilution of 100 to 1. The summary of the diffuser port configuration is provided in Table 7. It is proposed that the diffuser be aligned in the east-west direction at the location shown in Figure 1; however this alignment and location must be confirmed during the detailed design phase, using the results of far field effluent dilution from a two- or three-dimensional hydrodynamic model. To maintain proper dilution, flow rate from the water treatment plant should be equal or more than 20 and 15 l/s, respectively for short and long term operation.

Table 7: Proposed Preliminary Diffuser Port Configuration

Parameter	Value
Length of Diffuser (m)	81
Number of Ports	28 (short term) and 18 (long term)
Discharge Pattern	Alternate opposing direction
Distance between pairs of ports (m)	3
Port Diameter (m)	0.013 (or 0.5 inch)
Angle of ports from the reservoir bottom (˚)	30
Height of ports from the reservoir bottom (m)	1
Minimum Discharge Flow (l/s)	20 (short term) and 15 (long term)

5.0 CONCLUSIONS

The diffuser proposed for the discharge of effluent from the Giant Mine new water treatment plant would have the following characteristics: 28 ports, spaced 3 m apart, raised 1 m above the Yellowknife Bay bottom, in series on a single pipeline and discharging in alternate opposing directions, with a diameter of 13 mm at the port exit. The diffuser ports would be connected to the water treatment plant using an HDPE pipeline. The effluent quality criteria and water quality standard of the ambient environment (i.e., Yellowknife Bay) were assessed to determine the effluent dilution ratio to be achieved by the diffuser. The most stringent ratio calculated was that for arsenic, at 100 to 1. Model predictions of effluent mixing characteristics in the bay indicate that the proposed diffuser configuration can achieve the required dilution ratio within a mixing zone set at a 15 m radius centered at each port. The configuration with 28 ports is valid for effluent flow expected in the short term operation of the water treatment plant. Effluent flow will be reduced for long term operation, and the number of active ports during that phase should be limited to 18, with all other ports being sealed.

Modelling predictions of effluent mixing characteristics was performed in the near field area of the diffuser. The fate of the effluent in the far field is dependent on the geometry of Yellowknife Bay and the flow and climate conditions affecting that body of water. The proposed diffuser location is assumed to be within the main channel of Yellowknife River within the bay, with the expectation that the flow momentum from the river, which discharges year-round, will convey the mixed effluent toward Great Slave Lake. As part of the detailed design phase for the diffuser, the location of the diffuser will be confirmed through the modelling of far field conditions in the bay, using a two- or three-dimensional hydrodynamic model. From that modelling effort, the diffuser location may be adjusted to minimize recirculation of the effluent within the bay.

As part of and as support to the detailed design phase of the diffuser, the following tasks are required:

- A geotechnical investigation of the inland pipeline alignment, to determine soil characteristics and presence of permafrost, in order to establish construction methods for a buried pipe;
- A geotechnical investigation of the submerged pipeline alignment to identify bedding characteristics, presence of fine sediment pocket and other obstacle to the placement of the pipe;
- A detailed hydraulic analysis of the pipeline to confirm pumping requirements and pipe sizes;
- Sampling of bay bottom sediment at the general location of the diffuser for an analysis of granular distribution and settling properties, in order to evaluate possible mobilization of particles from the diffuser jets;
- An inspection of shoreline conditions (topography, soil characteristics, and benthic and fish habitat) to confirm the location of the point of entry of the pipeline from the land to the bay;
- A survey of ice thickness in several areas of the Yellowknife Bay in the next winter to consolidate the current database of ice observations;
- Implementation of a hydrodynamic model of the bay, including the diffuser as a water source and all water supply intake (present or planned), to assess the fate of the Giant mine effluent in that waterbody;
- Monitoring of wind speed and direction near Yellowknife Bay, as a support to the hydrodynamic modelling effort, to confirm validity of wind measurements at Environment Canada Yellowknife Airport station;
- Monitoring of water quality in the bay on a seasonal basis for at least one year at several location in the bay, using analytical method with sufficiently low detection limits, to consolidate the database of ambient water quality;
- Limnological surveys on a seasonal basis for at least one year at several locations in the bay, for an assessment of the temperature, dissolved oxygen and conductivity profile as a function of depth (these data would serve in the calibration of the hydrodynamic model);
- At least two survey campaigns (i.e., during the open and ice cover periods) for the assessment of water current at several locations in the bay (this data would serve in the calibration of the hydrodynamic model); and

- A refined bathymetric survey in the general location of the diffuser and along the alignment of the diffuser pipeline, as a support for the design and hydrodynamic modelling effort.

GOLDER ASSOCIATES LTD.

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Associate, Water Resources Engineer

ORIGINAL SIGNED

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Principal

NL/JAH/keh/rs

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ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #11**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Alternatives North IR #05
Alternatives North IR #12
Review Board IR #07

Date of this Response

February 17, 2012

Request

Preamble

The Giant Mine Remediation Plan involves burying some hazardous wastes, covers on tailings, open pits, and other work that will render some areas of the mine site unfit for short and long-term use by humans. Although the Developers have described some measures to prevent or limit human access to such areas, there is little description on the role institutional land use controls may play in directing future land use. These may include tools available through the municipal, territorial and federal orders of government.

Question

1. Please provide a description of the various tools available for institutional land use controls for future land use at the Giant Mine.

2. Please provide some analysis of the advantages and disadvantages of each tool and how the Developers will decide which to pursue

Reference to the EA Terms of Reference

s.3.4.1 Economy

Summary

Implementation of the Giant Mine Remediation Plan (Remediation Plan) will make possible future uses of the site. Such future uses are not defined at the moment, except for the area around the frozen blocks and water treatment plant which will remain reserved permanently into the future. The remaining areas are lands held by the Commissioner of the Northwest Territories and are subject to land use/zoning controls set by the City of Yellowknife. Any potential future land use will need to consider existing land tenure arrangements and will be informed by the Remediation Plan, as approved. Further discussion with the City regarding future plans and uses (e.g. zoning considerations), along with input from interested parties (including traditional knowledge from Aboriginal groups) can better confirm what may be possible/not possible to protect the remediation work, and human health and the environment.

Response

One of the outcomes of remediating the site to protect human health and the environment is the potential for future uses. Such uses are yet to be determined, with the exception of the area containing the frozen block arsenic chambers and associated cooling systems, and the water management and treatment plant. This area, along with any land where open pits or the potential for subsidence remains post remediation, will remain reserved for the purposes of the project, permanently into the future. Institutional controls (e.g. physical and administrative controls) will be implemented.

The remaining areas of the site are lands held by the Commissioner of the Northwest Territories which are subject to land use/zoning controls set by the City of Yellowknife. The proponents cannot speak for what future land use controls will be in place for the remaining site area, whether land will be offered for sale, or other tenure, or whether such lands will be retained for public purposes, or a combination of both. Any existing land tenure arrangements (e.g. Waterfront and Townsite lease) will need to be considered also.

That said, such future land use controls will be informed by the Remediation Plan. The proponents have been clear that the site will be remediated to industrial standards – there may be some areas that achieve better than such standards due to the anticipated approach to certain project components. All of this informs what may be possible in the future.

In addition, the project design is at a stage that external input on future use interests could be considered and possibly integrated into the design components. As such we encourage further discussion with the City regarding future plans and uses, along with input from interested parties (including traditional knowledge from Aboriginal groups). Such continuing dialogue can better confirm what may be possible/not possible to protect the remediation work, and to protect human health and the environment.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #12**

Date Received

November 30, 2011

Linkage to October 2011 Technical Sessions

Technical Sessions Day Three transcripts, pp. 142-148 and 155-156.

Linkage to Other IRs (from Round I)

City of Yellowknife IR #01 Q5

Date of this Response

February 17, 2012

Request

Preamble

The City of Yellowknife has an interest in Giant Mine remediation flowing from a surface lease covering the old townsite area. In June 2006 the City developed a Giant Mine Lease Area Land/Water Use Plan filed with the Review Board in April 2008 (see http://www.reviewboard.ca/upload/project_document/EA0809-001_Giant%20Mine%20Lease%20Area%20Land-Water%20Use%20Plan%20OPTIMIZED_1209684298.pdf). Pages 107-109 of this Plan show proposed land uses including residential and commercial uses for the area covered by the lease and the adjacent shoreline.

Question

1. Please explain how the Developers considered the above Plan and proposed land uses in preparing the Developer's Assessment Report.

2. Please provide the estimated costs for the remediation of the City's lease area that would allow the proposed land uses to be achieved.

Reference to the EA Terms of Reference

s.3.4.1.7 Human Environment

Response 1

The intent of remediation on the Giant Mine site is to meet industrial standards. The Giant Mine Remediation Project Team (Project Team) reviewed the City's *Giant Mine Lease Area Land/Water Use Plan*, prior to the development of the Developers Assessment Report. This Plan was seen as conceptual. The Project Team is in discussions with the City to understand and consider the Plan in ongoing project design work.

Response 2

Recognizing that there are areas currently suitable for the desired land uses identified by the City, the current remediation option in the area of the town site is excavation to a depth of two (2) metres or bedrock, followed by replacement with clean fill. Final remediation status of the town site may achieve residential standards in some areas. As the Project Team moves toward design, ongoing dialogue with the City will occur to determine what incremental costs might be.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #14**

Date Received

November 30, 2011

Linkage to Other IRs (from Round II)

Fisheries and Oceans Canada #01, #02
Review Board #02, #03

Linkage to October 2011 Technical Session

Technical Session Day Three transcripts, pp. 83-84.

Date of this Response

February 17, 2012

Request

Preamble

Although the North Diversion Contingency for Baker Creek is at an early conceptual stage, the Developers undertook to provide additional information on it including a rough assessment of any potential reduction in arsenic loading to Back Bay. The response provided to Undertaking 5 does not include this information.

Question

Please provide an assessment, with quantitative figures where possible, of any changes in arsenic loadings to Back Bay as a result on the North Diversion Contingency compared to current levels and those anticipated with the implementation of the development.

Reference to DAR (relevant DAR Sections)

s.5.8 Baker Creek
s.7.1.2.1 Study Site Area
s.7.4.3 Aquatic Environment, Site Study Area

Reference to the EA Terms of Reference

s.3.2.4.9 Development Description

Summary

The North Diversion of Baker Creek is not currently being pursued as a contingency measure.

Response

The Giant Mine Remediation Project Team (Project Team) is no longer pursuing the North Diversion as a contingency for flooding risks of Baker Creek.

The North Diversion of Baker Creek was evaluated to determine if it was technically possible to divert water away from the Giant Mine site should an event occur that allowed water from Baker Creek to flood the mine. The risk of Baker Creek flooding the underground is one of the highest risks on the property until the Giant Mine Remediation Plan (Remediation Plan) is implemented on site. The technical feasibility of the North Diversion was assessed in September 2011 to address these high risks and heightened concerns arising from the subsidence at B1 adjacent to Baker Creek and the Creek changing course over the JoJo Lake tailings during the spring melt.

Some mitigation measures have been put in place during the fall of 2011 to reduce these risks, such as capping the JoJo Lake tailings, constructing a dyke between Baker Creek and subsidence at B1 and raising the road along reach 3 (C1 pit) of Baker Creek. With these measures in place, the Project Team still considers Baker Creek a high risk and to address these risks are doing a review of the risks associated with Baker Creek in the short term up until the final Remediation Plan is in place. This review may show that additional short term mitigation measures are required until implementation of the mitigation strategies found in the Remediation Plan.

This review is currently underway and an assessment of requirements for additional mitigation measures will occur in 2012 with support of Technical Experts. The Project Team is in the process of reviewing site risks and therefore do not have a firm date for the assessment of mitigation measures with Experts.

The Project Team has not done any additional work to advance the design of the North Diversion and is currently focusing on the risk review and assessment of all possible short term mitigation measures for Baker Creek. The Project Team will be pleased to share this information with the Mackenzie Valley Environmental Impact Review Board and the Parties to the Environmental Assessment prior to the Public Hearing.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #15**

Date Received

November 30, 2011

Linkage to October 2011 Technical Session

Technical Sessions Day Three transcripts, pp. 141

Date of this Response

February 17, 2012

Request

Preamble

The Developers position on the applicability of municipal approvals to the development was unclear as they stated that s. 98 determination under the Mackenzie Valley Resource Management Act was required. This was concluded on August 18, 2011 (see http://mvlwb.com/files/2011/07/City-of-Yellowknife-Determination-August-18-2011.pdf) and confirmed the City's authority to continue to issue development permits even for activities that may require a land use permit.

Question

1. Please confirm that it is the intention of the Developers to fully comply with all municipal by-laws in carrying out the development including any requirements for development, demolition and building permits.

2. Please provide a list of all municipal permits, licences and authorizations that will be required to apply for the development as required in the ToR s. 3.2.4.17.

Reference to the EA Terms of Reference

s. 3.2.2.3 Developer
s.3.2.4.17 Development Description

Response 1

As per the August 18, 2011 Joint Determination made pursuant to s. 98 of the Mackenzie Valley Resource Management Act, the City of Yellowknife regulates the use of land within its boundaries to the extent that the City's General Plan By-law No. 4315 and its Zoning By-law No. 4404, as amended from time to time, allow. The Giant Mine Remediation Project (Remediation Project) development falls within the City of Yellowknife's boundaries, and its use of land is therefore regulated by both City bylaws. The Giant Mine Remediation Project Team (Project Team) will comply with City regulatory requirements as applicable.

Response 2

The Project Team is working with the City to determine municipal by-law use of land requirements for the Remediation Project development, given the City's role as of August 18, 2011 as a regulator of the use of land within the City's boundaries. The Remediation Project development is regulated by the City's General Plan By-law No. 4315 and its Zoning By-law No. 4404, however details of municipal by-law use of land requirements have not yet been determined as the Project Team and City continue to share information to be able to establish these requirements.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #17**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Fisheries and Oceans Canada IR #01

Linkage to Other IRs (from Round I)

Review Board IR #12

Date of this Response

February 17, 2012

Request

Preamble

The Developers provided a good impromptu worst case scenario if water flooded the underground workings prior to completion of the frozen block method. Most parties and the Review Board representatives were of the view that this was a very useful exercise and may be helpful to compile for public communications.

Question

1. Please describe the worst case scenario for a failure at the mine site prior to completion of the frozen block method.

2. Please describe the environmental effects of the worst case scenario.

3. Please outline the public communications that would be made and by whom in the event of the worst case scenario.

4. Please describe what mitigation and contingency measures would be required in the worst case scenario and a timeline for their implementation.

Reference to DAR (relevant DAR Sections)

s. 10 Accidents and Malfunctions
s.7.1.3.2 Local Study Area

Reference to the EA Terms of Reference

s.3.2.5 Accidents and Malfunctions

Summary

As part of the first round of Information Requests (IR), a Failure Mode Effects Criticality Analysis (FMECA) Report was completed to address Review Board Round 1 IR #12. This report included FMECA analysis for a variety of different failure scenarios identified specifically for the Giant Mine site in both the short term (during implementation or the closure period) and long term (post-implementation or post-closure).

The October 2011 Technical Sessions following the first round of IRs included a presentation on risk. (Day 4, pp. 130 – 143, pp. 181 – 190, pp. 222-224, and pp. 249 – 254. Day 5, pp. 22). Specific scenarios were selected based on information tables proved in Appendix B of the FMECA Report. One of the scenarios presented was BCS-4, located in Appendix B under the Baker Creek System scenarios.

Scenario BCS-4 is a short term risk of the failure of the Baker Creek channel (component) at freshet which results in large inflows to the mine underground workings prior to the completion of the frozen chambers/stopes.

Upon discovery of the event, and based on the extent of information and knowledge we have, northern media would be alerted of the situation via an emailed public notice from Aboriginal Affairs and Northern Development Canada's (AANDC) Regional Director General, NT Region, and/or the Director of the Giant Mine Remediation Project (Remediation Project) via the Communications and Public Affairs Division.

Response 1

The worst case scenario prior to the completion of the frozen block is considered a loss of ground support or a bank of Baker Creek at or near C1 or A1, or A2 and possibly B1. The loss of ground support would allow the flow in Baker Creek to enter a pit which is connected to underground workings. The worst day scenario assumed the loss of ground support occurred during spring freshet or during a major rain storm onsite or over the Baker Creek catchment. The volume of water into mine resulting from freshet flows is noted on the table, and was 25 cubic meters per second for an anticipated period of several weeks. This volume of inflow to the mine is greater than the mine dewatering / pumping system can manage and would quickly start to flood the mine above the current operating water levels in the mine. This could result in an increase of arsenic concentration in the mine water and may result in the

Effluent Treatment Plant being unable to treat the mine water. In addition, this may result in a release of arsenic contaminated water to the environment because of a pumping capacity exceedance.

The complete sequence of component failures and potential consequences are located below in Table 1, these can also be found in scenario BCS-4, located in Appendix B of the FMECA Report under the Baker Creek System scenarios.

Table 1: BCS-4 Failure Scenario, Baker Creek Flood to Underground

Failure Type (Component Failure or Consequence)	Failure Sequence	Notes
Component Failure	Loss of ground support at C1 Pit and A2 Pit raise.	
Component Failure	Baker Creek loses channel integrity.	Occurs during freshet
Consequence	Large Inflows into mine underground workings. Insufficient pumping capacity.	Freshet flows are estimated at approximately 25 cubic meters per second.
Consequence	Arsenic concentrations increase from contact with arsenic residue outside of the chambers. Potential increase to 100 times current mine water arsenic concentrations.	Arsenic residue dissolving into a large volume of freshwater
Consequence	Mine water rises to surface and floods open pits with potential release to the environment.	Arsenic release to Baker Creek is estimated at 10 to 30 times the current concentration, which is 0.1 to 0.2 milligrams per liter.
Component Failure	Mine dewatering system is overloaded and fails. Loss of capacity to dewater the mine.	
Component Failure	Existing backfill support underground mine workings may become unstable.	

The consequence would be flooding of areas of the underground where the arsenic concentrations in the mine drainage ditches and sumps are very high and this would increase arsenic values or concentrations in the mine water, the extent of which is difficult to predict. The contact with arsenic residue or sludge outside of the chambers would potentially increase the concentrations in the mine water 100 times current mine water arsenic concentrations. The current water treatment plant may not be able to manage the high arsenic values and volume of mine water and treat the mine water successfully.

Further, the anticipation is that the flooding and damage to the creek bed or bank would not be repaired in a timely manner and the mine water would rise to the surface and to the rim of the open pits or to the elevation of Baker Creek. Mine water would then spill from the rim of A2 Pit and be released to the creek with water quality concentrations above current discharge limits. The creek bank would ultimately be repaired but the current water management system may not be able to manage the large volume of high arsenic water in a timely manner and additional volumes of contaminated water may be released if further storms occur as the system is repaired.

The flood could also cause further damage to the mine and the ability of the mine to treat high concentration arsenic impacted water as the backfill support for key sill pillars supporting the arsenic chambers may fail. This loss of support would impact the stability of the arsenic storage chambers and could result in a loss of arsenic from one of the arsenic storage chambers into the lower portion of the mine. This would require a redesign of the underground arsenic management plan and of the water management system along with a redesign of the proposed new water treatment plant.

Response 2

The scenarios assessed considered the consequences before and after the implementation of mitigation measures. As noted in the technical sessions, the consequence likelihood and severity of each failure scenario, before and after mitigation, was assessed as part of the FMECA analysis. The consequence severity was split into three categories:

a. Public Safety;

b. Environment; and

c. Cost.

Questions 2, asks specifically about the environmental consequences, prior to the implementation of mitigation measures, for this specific scenario. The likelihood of this scenario was rated at 3, which rates this scenario occurring at least once in every thirty years. The remediation program as presently scoped may require some 20 years plus years to complete. The environmental consequence of this scenario was rated as D, or a 'Major Consequence'. This is classified as an "impact on valued ecosystem component and medium-term impairment of ecosystem function". The combination of likelihood and severity give this scenario, prior to implementation of mitigation measures, a 'High' risk rating.

As mentioned in the technical sessions there is a number of unknowns for this scenario, including the following:

a. The capacity of the underground to hold a large volume of water discharged in to the mine in an uncontrolled manner;

b. The exact volume of arsenic residue located within the mine workings outside of the arsenic chambers; and

c. The mobility of the arsenic residue once submerged in water.

The complexities of the underground mine creates uncertainty of the movement of arsenic within water. However, it was estimated that to evaluate the impact to the environment, it should be assumed that the levels of arsenic in the underground mine water could be 100 times the current concentration. It is also assumed that this would correlate to approximately 30 times the current arsenic concentration in Baker Creek. If these assumptions are correct, the concentration of total arsenic in Baker Creek would be approximately 3 to 10 milligrams per liter. This would exceed the CCME guideline of 5 micrograms per liter of total arsenic. The timeframe for this release would be over several weeks.

The failure scenario is fairly comparable to a No Remediation scenario assessed and presented in the Appendix F of the 2006 Tier 2 Risk Assessment (Supporting Document N of the Giant Mine Remediation Plan dated July 2007). In that assessment it was assumed that treatment of mine water was discontinued and that the mine was allowed to flood and discharge untreated to Baker Creek on a continuous bases for ever. The resulting long-term effects on the average arsenic levels in the downstream receiving environment were 1.24 mg/L (1240 µg/L) in Baker Creek, 18.3 µg/L in Back Bay, 7.1 µg/L in North Yellowknife Bay and 1.9 µg/L in South Yellowknife Bay. These results demonstrate that the environmental implications in Baker Creek would be much more severe than in Back Bay and Yellowknife Bay. While the arsenic levels were predicted to exceed the Canadian water quality guideline in Back Bay and North Yellowknife Bay, aquatic species were not predicted to be at risk of adverse effects. However, for people in the study area who consume fish obtained from Yellowknife Bay the potential risks of incurring cancer in a life time were assessed to increase substantially. The far-field effects on Great Slave water quality of a sustained release of arsenic from the Giant Mine were interpreted by inference to be small (i.e. the arsenic level in the water column beyond Yellowknife Bay would be expected to remain well below the Canadian water quality guideline of 5 µg/L).

Response 3

Upon discovery of the event, and based on the extent of information and knowledge we have, northern media would be alerted of the situation via an emailed public notice. As well, discussions with the Yellowknives Dene First Nations, the City of Yellowknife, and the Government of the Northwest Territories, as well as appropriate regulators, would have been initiated.

The information would be communicated publically by AANDC Regional Director General, NT Region, and/or the Director of theRemediation Project via the Communications and Public Affairs Division.

Response 4

Mitigation measures which would address short and then long term issues related to this scenario, as listed in the FMECA report, include the following:

a. Conduct additional investigations in the next 1 to 2 years to confirm stability assessments at C1 Pit, A2 Pit and B1 Sinkhole area(previous and current conditions);

b. Implement monitoring program to allow for adaptive management of any change in current conditions;

c. Consider emergency flow diversion facilities or channels, if needed for long term mitigation on the mine property upstream of potential unstable areas at the C1 Pit, A2 Pit and B1 sinkhole to maintain surface flow to Yellowknife Bay and not onto the mine property;

d. Consider additional pumping and piping to increase capacity should emergency storage at the Northwest Pond be required. This would involve investigating the current mine dewatering system to evaluate the need to provide for a potential backup system or make the current pumping system flexible for high volume water inflow; and

e. Maintain the mine water level at the 750 level to utilize available storage in drifts and stopes.

The mine closure effort is currently evaluating the options to manage the creek and management plans are in place to respond if conditions indicate there is a risk to the creek. The measures include developing plans to address the scenarios identified. The timing to complete additional stability studies and develop schedules to implement the plans for the contingencies prior to the frozen block is by March 2013.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #18**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Alternatives North IR #25

Linkage to Other IRs (from Round I)

Review Board IR #12

Date of this Response

February 17, 2012

Request

Preamble

There was extensive discussion of the Failure Mode Effects Critical Analysis submitted by the Developers in fulfillment of Review Board IR #12 at the Technical Sessions. It appeared that the Developers were committing to a more collaborative approach with regard to future risk assessments so that local values and priorities would be better reflected.

Question

1. Please describe how the Developers see future risk assessment exercises working for the development.

2. Please describe how stakeholders would be involved and what timeframes would be used given that the Remediation Plan is based on perpetual care.

3. Describe how the precautionary principle and sustainability would be reflected in these future risk assessments.

Reference to the EA Terms of Reference

s.3.2.5 Accidents and Malfunctions

Response 1

As a part of its risk management program the Giant Mine Remediation Project Team (Project Team) undertakes Failure Modes Effects Critical Analyses (FMECA) on all elements of the proposed design. During the development of closure planning process the Project Team has and will continue to conduct a number of FMECAs as the design process evolves. The purpose of the FMECA is to assess potential failure scenarios associated with the remediation design and develop suitable mitigation where significant risk is identified. FMECA are conducted by subject matter experts in a workshop and recorded to produce a report. Please see the response to Review Board Round 1 IR #12 for more detail.

Response 2

Stakeholder participation in the risk assessment process will be determined through the development of the Environmental Management System.

Response 3

The precautionary principle in this application requires a conservative assessment of risks where uncertainty exists. As information and better data are accumulated uncertainty is reduced and more precision is possible. The assessment of risk in the FMECA process starts with the development of possible failure mode scenarios. This then leads to an assessment of consequence and likelihood and ultimately mitigative measures where an unacceptable level of risk exists. Leading subject matter experts, design engineers, the project technical advisor, site staff and departmental representatives inform the FMECA process. As stated in Response 2, key stakeholders will be included in the risk assessment process. The nature of the assessments is conservative where risks are overrated rather than underrated requiring further study to reduce the uncertainty in the assessment. This is documented in the FMECA. Due to the long-term nature of the remediation program sustainability of the remediation solutions are preferred over short-term solutions. This is factored in to design life considerations of the selected methods and materials.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #19**

Date Received

November 30, 2011

Linkage to Other IRs (from Round I)

Alternatives North IR #01 Q3

Date of this Response

February 17, 2012

Request

Preamble

The meeting summaries of the Oversight Committee are helpful in understanding the relationship between GNWT and AANDC and the evolution of the development. In the response to the above referenced first round IR, two meeting summaries were missing and it would be of some assistance to receive more recent summaries.

Question

1. Meeting summaries for the March 16 and December 3, 2009 meetings are missing from those provided in response to the above mentioned IR. Please provide copies of these missing meeting summaries.

2. Please provide copies of any more recent meeting summaries past the July 9, 2010 as submitted in response to the above mentioned IR.

3. Will the Developers continue to make meeting summaries for the Oversight Committee available to the public?

Reference to the EA Terms of Reference

s.3.2.2.4 Developer

Response 1

Please see the attached documents:
March 16, 2009, Oversight Committee Meeting Summary; and

December 3, 2009 Oversight Committee Meeting Summary.

Response 2

Please see the attached documents:
October 12, 2011, Oversight Committee Meeting Summary.

Response 3

The meeting summaries from the Oversight Committee will continue to be made public.

Giant Mine Oversight Committee Meeting

October 12th, 2011 at 1:15pm PM
Bellanca Building – 6th floor Boardroom

Meeting Participants:

Trish Merrithew-Mercredi– Chair	Gary Bohnet
Bev Chamberlain	Mike Aumond
Angela Rogers	Adrian Paradis
Mark Cronk	Ray Case

MEETING SUMMARY:

1. Approval of Agenda
   The Committee approved the agenda with the addition of Independent Monitoring.

2. Approval of minutes of last Oversight Meeting:
   The Committee approved the minutes for May 4th, 2011 – no changes were made.

3. Care and Maintenance Update
   . Tlicho LandTran has the new contract on site. The work is going well and everybody is co-operating so there's no issues.

4. Site Stability Update
   Short Term (Oct – Dec 2011): There are plans to raise the road along the C1 Pit to stop water flowing from Baker Creek into the pit during freshet.
   The JoJo Lake tailings work will begin in a few weeks when the tailings freeze allowing work to proceed on them.

   The Project is discussing options with the current contractor and with the new contractor on taking the conveyor and roaster flues down.

   Other short term activities are securing the tins on C Shaft doghouse and starting new investigations of the underground along B1 pit.

   Mid Term (Jan-Aug 2012) the Project is looking at investigations along the B1 Pit.

5. FOS Update
   The FOS is offline right now from the recent power outage. The Power Outage took out the fuses. Should be up and running again in 30 days. Freeze wall is 8-

11 metres now and the Design Team is learning from this. Next step is tied in with stability. Thirty four of the 40 freeze pipes are working.

6. EA Update

The Technical Sessions are next week. The Review Board has set the agenda around the 5 themes suggested by the Project. The Technical Sessions will be held in the Champagne Room. Daily updates will be provided to the Oversight Committee

7. Highway Update

A Public Meeting was held on September 1st, 2011. There were approximately 25 people present. There were no negative comments. Discussions are ongoing between ITI and DOT on the highway alignment through Fred Henne Park. Final engineering and design is underway and surveyors are currently onsite. The new alignment should be ready for traffic by end of 2012.

8. Independent Monitoring

Gary Bohnet advised that independent monitoring will come up next week during the Technical Sessions and the issue is being raised by MLA's.

9. Next Meeting

No scheduled date.

Meeting adjourned at 2:35pm

Summary of Giant Mine Oversight Committee Meeting
December 2, 2009 8:30 AM
Scotia Centre, 6th Floor Boardroom

In Attendance:

INAC
Trish Merrithew-Mercredi, Regional Director General
Bill Mitchell, Director, CARD
Martin Gavin, Manager, GMRP
Trish McFaull, Recorder

GNWT - ENR
Gary Bohnet, Deputy Minister
Ken Hall, Manager, Environmental Protection

GNWT – MACA
Sheila Bassi Kellett, Assistant Deputy Minister
Bev Chamberlin, Director, Lands Administration

PWGSC
Cheryl Bartell, Regional Director General, Western Region (via teleconference)
Mark Cronk, Senior Project Manager

Gary Bohnet chaired the meeting.

Review of Minutes of November 3, 2009 Meeting

Committee members to review minutes and provide comments.

Giant Mine Freeze Optimization Study – Status and Work Plan

An update on the Freeze Optimization Study was provided:

- The spill response plan for the site has been updated.
- The Water Resources Officer, INAC, NT Region has conducted inspections of the spill area.
- The spill area has been excavated and soil samples have been sent for analysis.
- The two feet deep excavated area has been backfilled.
- Drilling for the Study is currently being conducted on the site. The drilling should be complete in one week's time.
- The freeze plant and sub-station will be delivered to the site.
- The design for connecting the freeze pipes to the freeze plant is in process.

Report of Land Sub-Committee – Untenured Occupants

There was an update on the untenured occupants currently located on the site.

It was agreed that MACA would contact the companies regarding moving from the site.

Strategic Project Plan and Governance

A discussion was held on doing a strategic planning document.

INAC and GNWT agreed on the need to keep the Cooperation Agreement in place and that it was important not to make too many changes to the Cooperation Agreement.

Status of the Developer's Assessment Report – Timing of Submission

The Giant Mine Remediation Project Team received the draft Developer's Assessment Report from the consultant at midnight on November 30th. The Developer's Assessment Report should be submitted to the Review Board by the first of the fiscal year.

Independent Monitoring / Environmental Oversight

The Department of Environment and Natural Resources has received letters requesting independent monitoring and oversight for the Giant Mine Remediation project. INAC has received a request from Mr. Kevin O'Reilly, the City of Yellowknife and the Yellowknives Dene First Nation for funding.

Martin Gavin stated that the intent is to create a very transparent governance structure that addresses the needs of the government and public accountability..

Next Meeting

February 4, 2010, 1:00 PM - 8th Floor Boardroom, Bellanca Building

Summary of Giant Mine Oversight Committee Meeting – January 23, 2009

1. Approval of minutes from November 14, 2008

2. Review of Agenda

3. Environmental Assessment – Update

   - Scoping Decision received Dec 23, 2008 (copy provided)
   - INAC responded to the Board with two letters (copies provided)
   - Committee discussed the Board's RFP for technical experts
   - Currently gearing up with the Technical Advisor to respond to T of R.
   - T of R is expected by late spring/summer.

4. Report of Committee Reviewing Options for Increasing the Participation of the City and the YKDFN

   - The Task Team has prepared draft discussion paper but has not yet met to discuss the options outlined in the paper.
   - The Task Team will be meeting shortly and will provide recommendations to the Oversight Committee at their next meeting.

5. Municipal Services Agreement

   - During the Nov 14th Oversight Committee, the City proposed to forgo the outstanding property taxes and instead enter into a municipal services agreement.
   - INAC provided an update on discussions with the City.

6. Cooperation Agreement – Financial Contributions Schedule

   - The GNWT has provided $1.0M per year for the past three years towards the cost of the Project.
   - The GNWT's contribution in Year 4 (2008/09) of the Cooperation Agreement is $6.0M.
   - The yearly amount was increased in Year 4 and subsequent years to account for increased costs associated with implementation.
   - INAC acknowledges the receipt of the GNWT's contribution for Years 1, 2 and 3 of the Cooperation Agreement. Both parties agreed that the GNWT's payment for Year 4 will be delayed until implementation of the Project.

7. Report of the Land Management Working Committee

    - INAC provided and update on the status of 3rd parties currently using the site.

8. Communications

    - An update on recent communications was provided to the Committee.

9. GNWT Highway Re-alignment Project

    - The Review Board has recently decided that the GNWT Highway Re-alignment Project will not be included in the scope of the Giant Mine environmental assessment.
    - The Project Team thinks it is important to discuss the timing of the two projects.
    - INAC is prepared to consider ways to contribute the cost of the highway re-alignment which is currently included in the Remediation Plan (approx. $4M) towards the GNWT project if the GNWT's project timing complements the implementation of the Remediation Plan.

10. Next Meeting

    - Suggest that the Committee meet again in April.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #20**

Date Received

November 30, 2011

Linkage to Other IRs (from Round I)

Alternatives North IR #01
Yellowknives Dene First Nation IR #26

Date of this Response

February 17, 2012

Request

Preamble

It would be helpful to know exactly who the Responsible Ministers will be for the purposes of this Environmental Assessment. As GNWT Municipal and Community Affairs has some responsibilities as the owner of the surface lands covering Giant Mine, it is unclear whether this Minister will be a Responsible Minister for this Environmental Assessment. The same applies to the Minister of Natural Resources Canada who may have some responsibilities over licensing the storage and use of explosives at Giant Mine. NRCan also possesses valuable expertise with regard to permafrost and mineral processing technologies and it would have been helpful if this could be considered as part of this Environmental Assessment.

Question

Please confirm whether the GNWT Minister of Municipal and Community Affairs and the federal Minister of Natural Resources will serve as Responsible Ministers for the purpose of this Environmental Assessment.

Response

For the purpose of the Environmental Assessment neither the Government of the Northwest Territories (GNWT) Minister of Municipal and Community Affairs or the Federal Minister of Natural Resources Canada (NRCan) will serve as Responsible Ministers (RM).

The RM for the GNWT is the Minister of Environment and Natural Resources.

NRCan was consulted when the RMs were being established and NRCan declined being an RM.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #21**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Yellowknives Dene First Nation IR #02

Linkage to Other IRs (from Round I)

Alternatives North IR #01
Yellowknives Dene First Nation IR #24
North Slave Métis Alliance IR #02

Date of this Response

February 17, 2012

Request

Preamble

There has been substantive discussion and concerns raised regarding the inherently conflicting roles within Aboriginal Affairs and Northern Development Canada (AANDC). AANDC is the proponent for Giant Mine remediation, overall land and water steward (including inspection and enforcement), and has responsibilities for Aboriginal peoples and promotion of economic development. The Minister is responsible for signing off on water licences and is a Responsible Minister for this Environmental Assessment. AANDC has stated that it is committed to fairness, transparency and accountability in the context of the Giant Mine Remediation but has not provided any evidence to support this position.

Question

Please provide any written policies, directives or other guidance that has been provided to AANDC staff and managers regarding any separation of function and communications within the Department with regard to Giant Mine.

Reference to DAR (relevant DAR Sections)

s.1.7.2.

Summary

Aboriginal Affairs and Northern Development Canada (AANDC) does not have any formal written policies or directives with regards to the separation of function and communications within the Department related to the Giant Mine Remediation Project (Remediation Project). However, the *Mackenzie Valley Resource Management Act* (MVRMA) allows AANDC to have other roles in addition to the role of proponent throughout the Environmental Assessment (EA) and regulatory processes.

Response

AANDC does not have any formal written policies or directives with regards to the separation of function and communications within the Department related to the Remediation Project. However, the MVRMA allows AANDC to have other roles in addition to the role of proponent throughout the EA and regulatory processes. For example, in addition to proponent, roles contemplated by the MVRMA include the AANDC Minister coordinating post-EA decision-making. The MVRMA also sets out boundaries to make sure the AANDC Minister's actions are transparent. For example, as part of the EA decision-making process, the AANDC Minister is the coordinator of the Responsible Ministers (RMs) (Government of the Northwest Territories and other federal departments involved in the review) and those RMs must reach consensus on the outcome of the EA. The decision is then transmitted to the Mackenzie Valley Land and Water Board (MVLWB) and they proceed with the regulatory phase, including issuance of the permits/licences/ required to conduct the activity. This is all done in an open and transparent manner.

AANDC controls, manages and administers Crown lands in the Mackenzie Valley under the authority of the *Territorial Lands Act* (TLA) and the *Federal Real Property Act*. AANDC is also responsible for the administration, inspection, and enforcement requirements associated with renewable resources, non-renewable resources and related environmental legislation, including the MVRMA and the *Northwest Territories Waters Act* (NWTWA), elements of which are relevant to the Remediation Project.

AANDC inspectors are responsible for ensuring compliance with legislation, regulations and the terms and conditions of permits and licences issued by the MVLWB. These responsibilities are exercised by AANDC inspectors under the MVRMA, NWTWA, TLA, *Territorial Quarry Regulations*, and *the Northwest Territories and Nunavut Mining Regulations*.

The Giant Mine Remediation Project Team (Project Team) has applied to the MVLWB for a Water Licence (MV2007L8-0031). This will be the main regulatory instrument for the Remediation Project. The Project Team will be accountable for the terms and conditions of the Water Licence and any other permits relating to the Remediation Project

AANDC will continue to develop an Environmental Management System (EMS), including processes for monitoring, inspections, and audits. As indicated in the Developers Assessment Report and again at the October 2011 Technical Sessions, the proponents plan to establish a stakeholder EMS working group to provide stakeholder input. The final design of this EMS will consider the issues of roles and responsibilities.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #22**

Date Received

November 30, 2011

Linkage to October 2011 Technical Session

Technical Session Day Five transcripts pp. 85-91 and 93

Linkage to Other IRs (from Round I)

Review Board IR #27

Date of this Response

February 17, 2012

Request

Preamble

The Developers clearly indicated that they were undertaking an assessment of independent oversight bodies and experiences as part of the Developer's Assessment Report during the Scoping Hearing, in letters to parties to this Environmental Assessment, and in a Ministerial letter to a NWT Member of the Legislative Assembly. When the DAR was submitted, there was no information on its assessment of independent oversight and no proposals for such in the context of this development. The issue was raised during the Technical Sessions but there was no response from the Developers.

Question

Please explain why the Developers did not carry through with their commitment to cover independent oversight experience and case studies in the Developer's Assessment Report.

Reference to the EA Terms of Reference

s.3.2.2.4 Developer

Response

Chapter 14 of the Developers Assessment Report (DAR) establishes the blueprint for how environmental protection, regulatory responsibilities and monitoring will be managed throughout the implementation of the Giant Mine Remediation Plan (Remediation Plan) in a manner that is:

1. Adaptive
2. Objectives Based
3. Credible
4. Inclusive
5. Transparent
6. Cost Effective
7. Accountable

The Giant Mine Remediation Project Team (Project Team) is in the process of expanding on the approach laid out in Chapter 14 and is committed to working with the Parties to define the approach further. This applies to developing and implementing the Environmental Management System (EMS) and the Environmental Management Plans (EMPs) as described in Chapter 14 of the DAR. Through the EMS and EMPs the Project Team is committed to establishing criteria and to monitoring and evaluating environmental protection success and the meeting of regulatory responsibilities throughout the remediation of Giant Mine.

Engagement on the development of EMPs will be in the context of the larger consultation and engagement plan for the Giant Mine Remediation Project and will provide multiple avenues for Aboriginal groups and the public to participate. This will be accomplished through public sessions and workshops, and meetings with Aboriginal communities.

In addition to public sessions and community meetings, it is anticipated that primary engagement on the development of EMPs will be through workshops with an EMS working group composed of affected Aboriginal groups and interested parties.

The engagement is expected to be topic-focused; addressing, among other matters, objectives, criteria and research needs necessary for effective long-term environmental monitoring, assessment and response. Workshops will be structured to share and solicit input as well as validate progressive work in the development of EMPs.

As discussed at the technical sessions, the Project Team is committed to working with the Parties to improve the proposed monitoring of Giant Mine and will be actively involved in the Oversight Workshop hosted by the Yellowknives Dene First Nation and Alternatives North.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #23**

Date Received

November 30, 2011

Linkage to October 2011 Technical Session

Technical Session Undertaking #1 Response - Freeze Optimization Study Initial Findings

Linkage to Other IRs (from Round I)

Review Board IR #01
Alternatives North IR #18

Date of this Response

February 17, 2012

Request:

Preamble:

The Initial Findings report was submitted after the Technical Sessions were completed. It was clear that there is much interest in the Freeze Optimization Study as it will inform the design of the frozen block methods and there are other lessons learned from this pilot project. It may be helpful for the Developers to consider hosting a meeting on the Initial Findings report to allow for a better exchange of information.

Question:

1. Please provide a copy of the 2010a As-Built Report.

2. Given the difficulties associated with instrumentation reliability (see pg. 54, 3.5% of thermistors have already malfunctioned in less than a year) and data reliability (see Executive Summary and last SRK Draft Memo dated October 26, 2010), how do the Developers propose to ensure long-term monitoring capability and success?

3. The report provided does not cover any lessons learned from the overall FOS such as spill response, safety, project management, or other matters. Please provide a written response on lessons learned from the FOS.

4. The Developers state they are gaining clarity around thermal properties, and that they have developed 2D and 3D models. The 3D modelling is something EBA Engineering consultants for Alternatives North are looking for. As the 3D model is developed will it incorporate new information, and will there also be an effort to more rigorously model the energy balance at the ground surface?

5. It is noted that thermal diffusivity of the rock is higher than expected. This is beneficial for freezing, as the rock is freezing more quickly than estimated. However, this is potentially detrimental for thawing. Will the estimated durations for thawing in the event of system failure also be revised, in light of the findings from the FOS? Are there any other lessons learned from the FOS that have implications for the reversibility of the frozen blocks?

6. From both the installation phase and now the operating phase of the FOS, what is the impact on the estimated cost of implementation of the frozen block alternative on this development?

Reference to DAR (relevant DAR Sections):

S.6.2.9.1 Freeze Optimization Study

Reference to the EA Terms of Reference

S.3.3 Arsenic Containment

Summary

The Freeze Optimization Study (FOS) As-Built report contains detailed financial analysis of various instruments and techniques intended for project procurement decisions that cannot be posted to the Giant Mine Remediation Project Public Registry. Options for long-term monitoring will be re-evaluated in later stages of design. A summary list of lessons learned is provided below in Response 3.

The surface energy balance is important for both 2D and 3D modelling. The FOS included near surface instruments so that temperatures could be directly measured rather than estimated from modelling.

The higher thermal conductivity means that both freezing and deliberate thawing of the ground would be faster. But the rate of unintentional thawing in the event of a malfunction is determined by the annual heat balance and is therefore less affected by a higher thermal conductivity.

Response 1

The report referred to is "Giant Mine Freeze Optimization Study Interim As-Built Report", prepared by SRK Consulting (Canada) Inc. for Public Works & Government Services Canada. It was issued in August 2010 to the GMRPT. The FOS As-Built report provides an analysis of cost comparisons for various instruments and techniques throughout the study. Financial details intended to determine project procurement cannot be placed on the public Giant Mine Remediation Project Public Registry.

Response 2

In light of the rate of thermistors malfunctions, design criteria for instrumentation will be re-evaluated in future design phases. The re-evaluation will likely include service conditions, installation, maintenance/replacement requirements, instrument quality, data quality, and service life. Over the long term, instruments will need to be replaced.

Response 3

The FOS Initial Findings Report focuses on technical issues. The objectives of the study and how the FOS results have met each objective are presented in Table 9-1 of the FOS Initial Findings Report. The FOS is intended to provide insights into project procurement and delivery method but, as noted in Table 9-1, those topics were outside the scope of the initial report. The following list summarizes key lessons learned:

1. Surface pipe rack had cost and constructability issues resulting in longer than anticipated installation time. An alternative method of achieving a similar result needs to be considered. Lessons learned session identified the use of sleepers installed on controlled grade.

2. The fast track nature of the FOS construction combined with insufficient resources to stay on to of document control issues resulting in not all parties having the most recent construction documents.

3. Engineering activities need to be complete to a state where the design team's work can remain ahead of the construction activities where work is being delivered under a fast tracked delivery method. During the FOS construction, there were times engineering wasn't able to keep ahead of construction resulting in rework and delays.

4. Given the nature of the FOS project winter construction was challenging and expensive – the result was a 1/3 reduction in productivity. Impact needs to be considered for the design and implementation of the larger Freeze Program.

5. The fast track nature of the FOS project warranted a full engineering representative on site during construction, however, given the scale of the FOS only 1 discipline would be practical. This is not anticipated to be an issue during implementation of the larger Freeze Program.

6. Allowances need to be made for management of short term electrical loads as they relate to electrical utility demand charges. Failure to manage these short term loads can result in significantly higher utility costs.

7. More detailed specification information is required for the procurement of package freeze plants to ensure the required level of quality and consistency of control philosophy.

8. The dust poof was most likely an avoidable occurrence had there been a more complete understanding of drill logs and internal geometry of Chamber 10 (FOS). For the larger Freeze Program as-built Chamber information needs to be updated to the most complete and accurate state possible.

9. Thermistors beads (temperature sensors) were strapped to the exterior of the freeze pipe casing prior to installation in freeze hole in some cases these became detached during installation. Alternative methodology of sensor installation and / or sensor hardware needs to be considered for the larger Freeze Program.

10. The FOS reminded the project team of the unique Health and Safety challenges of an underground mining environment, highlighted the importance of well documented safe work procedures and the need for effective coordination of surface and underground activities.

11. Three drilling technologies were evaluated through the FOS construction and it was determined that down-hole hammer percussion drilling yielded the best value in terms of accuracy, production rate, and cost. Other methods explored included Mud Rotary and Diamond Drilling.

Lessons learned related to spill reporting, management, and monitoring are presented in the response to Alternatives North Round 1 Information Request #18.

Response 4

The parameter estimates and model calibration results presented in the FOS Initial Findings Report were derived entirely from 1D or 2D models. The 3D model of the FOS is not yet producing reliable results as efficiently as the simpler models.

In general, 3D models are less efficient than their simpler counterparts. In this case, the learning curve of the FOS team with the software used for the 3D modelling is responsible for some of the inefficiency. But the complexity of model inputs, the long run times, and the volume of outputs will continue to make 3D modelling less efficient. Therefore, the FOS team plans to rely more on 2D modelling for parameter estimation and calibration. Fully three-dimensional modelling may be useful later in the design process for examining ground freezing in complex geometries, like the system of crosscuts and draw points at the base of some of the arsenic containing stopes.

The energy balance at the ground surface, or in simpler terms the effects of ground surface temperatures, is important for both 2D and 3D modelling. The FOS team is well aware that there are more rigorous ways to characterize these effects but has so far not adopted those methods. Instead the FOS instrumentation includes shallow thermistors that allow near surface temperatures to be directly measured.

If the further design work indicates that modifications of the ground surface could be beneficial, for example as supplemental or contingency measures, a more rigorous examination of the surface energy balance would be required.

Response 5

The higher than expected thermal diffusivity does mean that freezing of the ground will be faster than expected. A deliberate thawing of the ground, i.e. as part of a plan to reverse the freezing, would also proceed faster.

However, the higher than expected thermal diffusivity does not mean that the system will be significantly more sensitive to unintentional thawing in the long term. The reason is that the rate of long-term thawing depends primarily on the annual heat balance. In order for the frozen blocks to thaw, the heat inputs to the ground each summer would need to exceed the heat removed each winter by the remaining thermosyphons. As long as a sufficient number of thermosyphons remain in operation, the overall heat balance will be negative. The increased thermal diffusivity could lead to surface temperatures propagating further into the rock each summer, but the overall negative heat balance will counteract that effect each winter.

Response 6

The higher thermal conductivity will in theory reduce the number of freeze pipes required, but many other factors need to be taken into account before a cost estimate is available.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #24**

Date Received

November 30, 2011

Linkage to Other IRs (Round II)

Review Board IR #01

Linkage to October 2011 Technical Session

Technical Session Undertaking #2 and #4 Responses – Contingencies for Frozen Block Failure.

Linkage to Other IRs (from Round I)

Review Board IR #03, #08, #12-15
Environment Canada IR #04, #06

Date of this Response

February 17, 2012

Request

Preamble

During the Technical Sessions, the Developers appeared to acknowledge that the frozen block method is a long-term, but not permanent solution. From the information provided in the Technical Sessions, and regardless of the details of the climate change assumptions made, it is reasonably foreseeable that passive thermosyphons, as presently arranged, will not be sufficient to maintain the frozen block probably in the second century following implementation.

Question

1. What is the plan or contingency in place for the eventuality that climate change will overtake the capacity to maintain the frozen blocks with thermosyphons?

2. The current plan appears to intentionally pass the burden of a solution on to future generations to grapple with. Is this consistent with the principle of sustainable development, and more specifically, inter-generational equity?

Reference to DAR (relevant DAR Sections)

s.6.2.9.4 Contingency Actions

Reference to the EA Terms of Reference

s.3.3 Arsenic Containment

Summary

The Giant Mine Remediation Project Team (Project Team) believes that the frozen block method represents the best option both for this and future generations. Previous documents (including Section 6.2.9.4 of the DAR, and Review Board Round 1 IR #03) have discussed contingencies for future maintenance of the frozen blocks.

Response 1

The Developer's Assessment Report (DAR) and the responses to previous information requests (Review Board Round 1 Information Request #03) have explained that the passive component of the freezing system is well capable of maintaining frozen conditions even under predictions of future global warming. Section 6.2.9.4 of the DAR discusses contingencies for the event of any unexpected thawing:

> "If monitoring during the long-term passive freeze maintenance phase indicates unexpected warming in or around the frozen blocks, the available contingency measures will include:
> - Investigate causes.
> - Replace defective components.
> - Modify the ground surface to reduce heat flux.
> - Install shallow thermosyphons to counteract the surface heat flux.
> - Install additional full-depth thermosyphons to counteract sideways or upwards heat flux.
>
> The chain of events analysis presented in Section 6.2.8.2 above indicates that there would also be opportunities to apply contingencies to components of the long-term water management system."

Response 2

In fact, the frozen block plan calls for a very significant expenditure by the current generation to minimize the environmental, human health and financial risks to future generations.

The Arsenic Trioxide Management Alternatives Project assessed all possible methods for dealing with the 237,000 tonnes of arsenic trioxide dust stored underground at Giant Mine, and concluded that the "frozen block" method provides the lowest risk to worker health and safety, and the lowest risk of short

term arsenic release. Over the long term, the frozen block method was found to present a "low" risk of future arsenic release. Although some of the other methods were found to provide a "very low" risk of arsenic release in the long term, they only did so at the cost of much higher short term risks.

The question of inter-generational equity needs to include a balanced consideration of short-term and long-term risks. Even if one accepts that only risks to future generations are important, one needs to accept that risks to present-day workers have significant implications for their children, and possibly for many future generations of their family. And arsenic's persistence in the environment means that releases in the short term could have significant implications for future generations living in the Yellowknife region. Taking those effects into account, the Project Team accepted the conclusions of the Technical Advisor and the Independent Peer Review Panel that the frozen block method is the best option for long-term management of the arsenic trioxide, both for this generation and future generations.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #25**

Date Received

November 30, 2011

Linkage to Other IRs (from Round II)

Alternatives North IR #18

Linkage to October 2011 Technical Session

Technical Session Undertaking #5 Response

Date of this Response

February 17, 2012

Request

Preamble

A risk assessment workshop is to be conducted in early 2012 on the B1 pit subsidence and Baker Creek icing events.

Question

1. Will interested stakeholders be involved in this session and will there be a report?

2. Will the report from this risk assessment be filed with the Review Board?

Reference to the EA Terms of Reference

s.3.2.5 Accidents and Malfunctions

Response

The Giant Mine Remediation Project Team's (Project Team) design engineer is preparing a report which will describe the analysis that was conducted and determine whether or not the risk profile has changed. Based on comments from meeting with the stakeholders during the October 2011 Technical Sessions, the Project Team committed to conduct a risk workshop at a future date. The scope and schedule for a workshop is still being developed and stakeholders will be notified as to the nature of the workshop and how stakeholders will be involved. Materials developed during the course of the workshop will be made available to the public. A revised Failure Modes Effects Criticality Analysis will be submitted to the Review Board should a change occur.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #26**

Date Received

November 30, 2011

Linkage to Other IRs (from Round I)

Alternatives North IR #12
Environment Canada IR #02

Date of this Response

February 17, 2012

Request

Preamble

New information is presented in the Tailings Cover Trials 2010 Data Summary. This is a helpful report but it also raises further questions about cover design.

Question

1. What are the next steps in the Tailings Cover Trial? Please provide a list of remaining tasks and a schedule for their completion.

2. How has the work to date advanced the cover design or assisted with identification of cover objectives and performance criteria?

Reference to DAR (relevant DAR Sections)

s. 5.5 Tailings and Sludge Containment Areas
s. 6.6 Tailings and Sludge

Reference to the EA Terms of Reference

s.2.1 Scope of Development

Summary

The first stage of tailings cover trials are complete and provided sufficient information to enable a preliminary design of the tailings cover system to be completed. Monitoring of the test plots will be continued, to provide additional information for the final design.

Monitoring data from the trials was incorporated into the design infiltration / seepage flow models used to design the cover system. The trials provided confirmation that a suitably performing cover system can be constructed from the materials on site. The trials did not provide any information that indicated that a change to the objectives and performance criteria in the Giant Mine Remediation Plan (Remediation Plan) or Developers Assessment Report (DAR) is required.

Response 1

The first stage of the tailings cover trials are complete, but the test plots will continue to be evaluated and monitored to collect more information that will be used for the final design of the tailings cover system. It is anticipated that additional information collected from the test plots will be used to further verify the preliminary design and may result in refinements to the final cover system design.

The remaining tasks to be completed related to the cover trials include:

- Test pitting /field investigations to evaluate the performance of the test pads, including investigation of potential separation or migration of material between layers, the performance of the geotextile, and the moisture condition of the layers.
- The surface of the test pads will be evaluated annually for the development and extent of surface cracks and for the extent or type of any vegetation.
- Re-commissioning the instrumentation each spring(instrumentation would be left in place, but data loggers are removed for the winter season)
- Monitoring the instrumentation and surveying the test pads. Monitoring and surveying will continue until final design is complete or until the test pad trials provide no new information for the design.
- Development of a Re-vegetation Plan

In terms of the schedule for remaining tasks to be completed related to the cover trials:

- Test pitting/field investigations to be completed in the summer of 2012;
- Evaluation of the surface of the test pads would be completed annually in the spring and fall of each year until final design is complete, starting in 2012;
- Re-installing instrumentation on the test pads in early spring of each year until final design is complete, starting in 2012;
- Surveying of the test pads – survey the pads monthly from June to October of each year starting in 2012 until final design is complete; and
- Monitoring of instrumentation in the test pads – automated data collection from May to October beginning in 2012 until final design is complete.

- Development of re-vegetation plan starting spring 2012 – multi-year program including field trials anticipated.

Response 2

The tailings cover trials provided an opportunity to evaluate potential cover systems using on-site borrow material, over a typical range in cover material layer thickness. The trials provided data that indicated that a suitable cover system can be constructed from the available materials on site. The information collected from the tailings cover trials was used for the preliminary design of the tailings cover; along with data collected from investigation programs on the tailings and borrow sources on site and other site data and information. The performance data of the material in each test plot, primarily consisting of settlement, volumetric water content and temperature, were used and incorporated into the unsaturated flow models, where applicable.

The trial plots had sufficient variation in material thickness to provide a reasonable understanding of future cover system performance. The data was also used to help determine that a geotextile is recommended between the rock layer and the soil layer above it.

The trials did not provide any information that indicated that a change to the objectives and performance criteria in the Remediation Plan or DAR is required.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #27**

Date Received

November 30, 2011

Linkage to October 2011 Technical Session

Technical Session Undertaking #10 Response - Arsenic Wetting Research and Plan.

Linkage to Other IRs (Round I)

Review Board IR #02

Date of this Response

February 17, 2012

Request

Preamble

It is unclear how the frozen block method will be implemented as the method and impacts from arsenic wetting is the subject of further research and planning. During the Technical Sessions the Developers were requested to provide information on this work that is crucial to the success of the frozen block method.

Question

1. Will the arsenic wetting research include an assessment of the feasibility and desirability of the frozen block method versus a frozen shell option?

2. What degree of saturation is necessary to carry out the frozen block method? Is wetting versus saturation sufficient?

3. It was our understanding that there will be an opportunity for interveners to have input into the trial and assessment. This is not spelled out in the response. What are the plans for consultation and review?

4. Given that this work is critical to the frozen block method and that the work is to be completed, AFTER the EA is completed, what assurances can the Developers provide now that the frozen block can be properly designed and implemented?

Reference to DAR (relevant DAR Sections)

s.6.2.6 Initial Freeze

Reference to the EA Terms of Reference

s.3.3 Arsenic Containment

Summary

The frozen block method was selected after a lengthy and public assessment process. As part of the ongoing engineering design process, the Giant Mine Remediation Project Team (Project Team) will examine the complexities, risks and costs of various wetting techniques.

The differences between wetting and saturation were discussed at length in a previous response. The dust does not need to be uniformly saturated.

Many technical details of the project will remain to be defined after the Environmental Assessment. The Project Team's objective is to resolve any concerns about environmental impacts in this phase. More of the engineering details should be available by the time of Water Licensing.

Response 1

The frozen block method was selected after a lengthy and public assessment process that included consideration of the frozen shell option. In fact, the frozen block and frozen shell options were initially thought of as two variants of a "ground freezing alternative", and both were found to offer low or very low risk at similar costs. The only difference between the two is the "wetting" step, which leads to the frozen block incorporating more ice than the frozen shell. At the conclusion of the assessment process, the Technical Advisor and the Independent Peer Review Panel recommended the frozen block variant because the additional ice was thought to make it more resistant to thawing over the long term.

However, although prior work has shown that the wetting step is feasible in principle, the Project Team is only now beginning a more detailed study of wetting methods and associated risk management costs. Should those studies identify other combinations or sequences of wetting and freezing that present cost or risk advantages in the short term, without impacting long-term performance, they will also be evaluated.

Response 2

The response to Review Board Round 1 Information Request #02 addressed a similar question, and more fully explained the distinction between "wetting" and "saturation". In brief, the dust does not need to be uniformly saturated in order to provide the additional thermal inertia that distinguishes a frozen block from a frozen shell. The response to Review Board IR#02 concluded with the statement "... these considerations are being taken into account in the later phases of design and will lead to a better definition of the 'wetting' or 'saturation' requirements".

The Project Team presented plans for the next steps of wetting studies in Technical Session Undertaking #10, submitted after the October 2011 Technical Session.

Response 3

In the Developers Assessment Report (DAR), and in more detail at the October 2011 Technical Session, the Project Team presented plans for stakeholder participation in the development of environmental management plans. The Project Team is committed to sharing information with interested parties on the progress of this effort.

Response 4

The information presented in the DAR and in responses to Review Board Round 1 Information Request #02 demonstrates that wetting of the dust is achievable in principle. The Water Licensing process is expected to include a more detailed consideration of engineering designs and implementation methods for many components of the proposed Remediation Plan. The Project Team anticipates that further details of the proposed sequence of freezing and wetting process, including any variants that remain under consideration, will be available by that time.

ROUND TWO INFORMATION REQUEST (IR) RESPONSE

EA No: 0809-001 **Information Request No: Alternatives North IR #28**

Date Received

November 30, 2011

Linkage to Other IRs (from Round I)

Review Board IR #12

Date of this Response

February 17, 2012

Request

Preamble

The revised wording to s. 2.1.2 still does not properly explain that the risk assessment is a valid method for assessment of any 100 year period following the successful implementation of the frozen block method.

Question

Can the Developers provide any further clarification?

Reference to DAR (relevant DAR Sections)

s.10 Accidents and Malfunctions

Reference to the EA Terms of Reference

s.3.2.5 Accidents and Malfunctions

Summary

Section 2.1.2 of the Failure Modes Effects Criticality Analysis (FMECA) report, was completed to address Review Board Round 1 Information Request #12. The FMECA effort defines short and long term risk and was used for the assessment of risk for the project beyond the completion of the frozen blocks. The risk assessment identified risks on the project that would continue after the

closure phase of the project is complete and sets the framework for understanding future risks. The process would be repeated once the construction is complete so that any lessons learned during the implementation could be included in a future FMECA analysis of key scenarios.

Response

Section 2.1.2 of the revised FMECA report includes the following wording:

> "The risk of events which could occur after steady state is achieved is defined as long term for the purpose of this assessment. This timeline begins after steady state is achieved and continues in perpetuity. However, the identification and assessment of these risks is limited to what the assessment team can envision for the next 100 years based on the current remediation plan. This 100 year period is the time in which the remedial components are expected to function within specified parameters with ongoing maintenance. This time frame does include low probability events, such as a 1 in 500 year rainfall event. If the remediation plan is changed, or at some future point a new remediation technology is implemented, the long term risks would require reassessment."

To further clarify:

- The term "steady state" as used here implies a long term constant condition that will exist after the blocks are fully frozen, the rest of the site remediated, and the long-term water treatment system in operation. The remediation plan includes all of the monitoring, inspection, maintenance and/or repairs needed to ensure that the steady state is indeed achieved and maintained over the long term.

- Under this definition of steady state, the risks faced by the project in the first 100 years would also be present in the next 100 years, or the following 100 years, or any other 100 year interval within the steady state period.

- The risks that we identified by assessing the first 100 years of steady state conditions therefore also represent the risks that the project would face at any future time.

- In fact, the restriction to the "first 100 years" could equally correctly have been expressed as "any 100-year interval in the steady state period". But our experience is that people do a better job assessing risks when they are asked to envisage a defined time period, so we adopted the simpler form.

By this definition, specifically for the frozen block, steady state would not be achieved until the arsenic chambers and stopes were frozen and after a period of adaptive management. As such, the long term timeline would not commence until steady state has been achieved, the project team anticipates this will take approximately 25 years after implementation commences.

The assessment team is limited by the unknowns of the future, and only has the ability to reasonably foresee for the next 100 years in terms of assessing risk. Assessing risk beyond 100 years would not give an accurate assessment of risks that may be present and would not include lessons learned. Updating and revising this risk assessment will be part of on-going project management.