UNDERTAKING RESPONSE

EA No: 0809-001 **Undertaking No: 3 and 9**

Date Received

Transcript: Day 3, pg. 179; and Day 4, pg. 15

Undertaking:

Undertaking 3: Day 2, Page 180, Line 10 to 14

"Giant Mine project team to provide information on what changes have been made to the [Developer's Assessment Report] DAR resulting in significant impacts."

Undertaking 9: Day 4, Page 15, Line 15 to 20

"For Giant Team to flag what they consider to be the important changes to design since the time that the DAR was written and then link it back to the transcript."

Response:

As explained by Lisa Dyer in the Technical Sessions (Day 2, Page 179, Line 3 to 17 and Day 4, Page 13, Line 4 to 14), the preliminary design is currently in progress and not yet complete. The additional detail shown below is a snapshot of where the preliminary design is today, and as the design is not complete these items may change in the future. In addition, these changes are more accurately described as a refinement or progression of the design as result of additional information, and does not change the conclusions in the DAR regarding significance.

The following is the current design thinking regarding the freeze, water, and surface preliminary designs for the Giant Mine Remediation project, and how that compares to the Developer Assessment Report (SRK, Oct 2010).

Design Variations from the Developers Assessment Report:

Freeze – Day 1

1. Day 1, Page 69, Lines 16 and 17: Developing new underground openings to the currently inaccessible bulkheads will reduce the need for remote plugs.

New development will be excavated to the currently inaccessible bulkheads, hopefully reducing the need for remote plugs.

2. Day 1, Page 70, Lines 2 to 21: Location of underground access drifts have changed.

   New underground development and rehabilitation of existing underground development is required for several reasons. First, we need to replace existing underground development that is no longer safe to use. For example, the use of C Shaft was recently lost for safety reasons.

   Secondly, we need to re-establish access to the currently inaccessible bulkheads to provide monitoring and provide for plug construction. We also need to provide access for drilling the horizontal freeze holes.

   And lastly, the existing surface portal that is used for underground access may become unusable in the future. For example, the UBC Portal at the base of B2 Pit may no longer be viable in the future; one potential remediation plan includes backfilling B2 Pit.

3. Day 1, Page 71, Lines 4 to 15: Selected lower arsenic drifts will be backfilled to limit movement of dust.

   Selected lower arsenic drifts will be backfilled to prevent the migration of arsenic dust from the arsenic chambers and stopes during wetting. The backfill that we propose to place in the lower arsenic drifts will not be placed tight to the back and therefore will not be watertight. However, the plugs will provide the ultimate check against dust migration. Many of these lower arsenic drifts may already be partially filled with arsenic dust now.

4. Day 1, Page 73, Lines 11 and 12: Upper arsenic drift plugs may not be required.

5. Day 1, Page 72, Lines 16 to 25 and Page 73, Line 1: Select non-arsenic stopes under critical surface elements (e.g. Baker Creek) may be backfilled subject to ongoing geotechnical assessment.

   Some near surface non-arsenic stopes that may underlie critical surface infrastructure, such as surface working areas, public roads, Baker Creek, etc., will be backfilled to enhance long-term stability. This progression in the design is subject to ongoing geotechnical investigations.

Water – Day 2

Baker Creek

1. Day 2, Page 50, Lines 11 to 25 and Page 60, Lines 1 to 9: Reach 3 Design Progression: Divert creek to the west in deep cut around a bedrock outcrop, approximately 100 m to 250 m west of C1 Pit.

Reach 3 of Baker Creek is a canal that goes through a rock cut, and in its current alignment presents risk for spillage into the underground. An embankment is currently being constructed to reduce this risk. There are existing limitations of space in this area as well as some uncertainty about foundation conditions.

The eastern route for Reach 3, as presented in the DAR, along the highway is the base case being considered, but should foundation conditions and/or flood risk in this area prove problematic, the alternative would be the western route

This design refinement or modification is moving Reach 3 to the west of the C1 Pit which would require a deep rock cut. The material which would be removed / excavated to construct this alignment would provide borrow material for other remediation activities at the site. This design refinement is currently under investigation.

2. Day 2, Page 61, Lines 5 to 25, Page 62, Lines 1 to 25, and Page 63, Lines 1 to 8: The feasibility of an off-site diversion of Baker Creek has now been evaluated as a contingency to provide a basis for an additional risk-based evaluation of diversion alternatives:

- Looking at diverting Baker Creek around the site to the north;
- Based on Digital Elevation Data from City of Yellowknife;
- Flood-only diversion was previously assessed by SRK;
- Fish-friendly diversion limited to 2% valley slope; and
- Multiple alternatives examined to minimize excavation volumes.

The contingency option of diverting Baker Creek to the north is being developed as a contingency only, and is not considered a variation to the design presented in the DAR at this time. This contingency option will provide details for remediation options comparison.

Currently, there is no fish passage above Baker Pond into Baker Creek. An existing waterfall and a very steep reach block fish passage in this area. At this time large-bodied fish from Great Slave Lake cannot make it further than Baker Pond.

Multiple diversion alternatives have been assessed; however, options are limited by topography. Existing constraints include the following:

- The Yellowknife city limits;
- The north end of the mine site;
- The northwest tailings pond;
- The Ingraham Trail (Highway 4);
- The Yellowknife River;
- Existing water intake in this area; and
- Baker Creek coming through lower Martin Lake and down to the south.

Some of the key water bodies include Baker Creek and Yellowknife Bay. Flow from Gar Lake through Trapper Lake, and through Shot Lake defines the route that could be feasible. To provide fish passage, taking advantage of existing topography, a number of alternatives have been assessed. This contingency planning is currently at the conceptual design phase and is not complete.

Groundwater

1. Day 2, Page 71, Lines 13 to 15: Continued review of a potential separate treatment segment specifically designed to treat high test water.

2. Day 2, Page 71, Lines 15 to 17: Mine access for personnel required if high test piping is retained.

3. Day 2, Page 71, Lines 17 to 19: Mine water level to be 20 m below 750 level for some time.

4. Day 2, Page 71, Lines 19 and 20: Future mine water level is under discussion.

WTP

1. Day 2, Page 81, Lines 8 to 11: Choice of oxidant.

   One of the design refinements is the use of potassium permanganate as an oxidant, which is more effective in cold water than hydrogen peroxide.

2. Day 2, Page 81, Lines 11 to 14: Additional liquid-solid separation steps.

   Another design refinement is the additional liquid solid separation steps to lower the solids concentration, and to lower the TSS concentration in the effluent, as we plan to use our treated water for chemical makeup.

3. Day 2, Page 81, Lines 15 and 16: Polymer addition to improve settling characteristics.

4. Day 2, Page 81, Lines 16 to 21: Treatment volumes.

   Additional details currently available have refined the treatment volume to the following:

   - 630 m^3 for the average, and 823,000 m^3 per year of peak in the short term; and
   - 405,000 m^3 per day, and 518,000 m^3 per year of peak in the long term.

5. Day 2, Page 81, Lines 22 to 25 and Page 82, Line 1: Arsenic concentrations.

   Additional details currently available have refined the short-term arsenic concentrations to the following:

- 76.8 mg/L as an average number, with 280 mg/L as the peak.
- In the long term, we expect that this should fall to approximately 2.9 mg/L.

Diffuser

1. Day 2, Page 83, Lines 5 to 16: The diffuser or outlet area was moved towards the river channel and is located in deeper water.

2. Day 2, Page 83, Lines 17 to 25 and Page 84, Lines 1 and 11: Additional details have been developed on the actual outlet ports and the general diffuser and diffuser line preliminary design.

Surface – Day 3

Open Pits

1. Day 3, Page 98, Lines 23 to 25 and Page 99, Lines 1 to 8: Backfilling of B2 Pit.

   The current design thinking includes backfilling of the B2 Pit, specifically on the east side. That design progression may improve the thermal insulation against Chamber 12 in this area. This option would require the closure of the B2 portal and the development of a new underground access. This option would reduce risks associated with water from Baker Creek entering the underground workings.

Soils

No variations at this time.

Tailings

No variations at this time.

Waste

1. Day 3, Page 125, Lines 5 to 25 and Page 126, Lines 1 to 3: The Central Tailings Pond area is being considered for the construction of a non-hazardous waste landfill.

   This design refinement is consistent with the DAR in that it includes a waste disposal location in an existing tailings pond, which is a previously disturbed area. The current design refinement uses the Central Pond area as the proposed location for the non-hazardous waste landfill. This location was chosen for a number of reasons including its central location and its proximity to

the majority of mine infrastructure. This location will limit haul distances and will reduce traffic crossings at Highway 4.

Definitions

As part of Undertaking 9, a request was put forward to the Giant Mine Remediation Team to provide definitions to terms presented within the technical sessions which had not previously been defined in the DAR. Many of these definitions focus around terms for the underground workings. A full list of definitions for these items has been appended to this letter as document number 313-UG-13-MEM-0006-Rev2_20111104, Glossary of Underground Terms and Schematic Drawings.

Additional definitions for items not previously included in the DAR are included below:

Autoclave: A remediation process which utilizes heat, steam and pressure to solidify material into a cohesive mass.

Anchor Ice: Ice anchored to the bed of the creek.

Bedrock Blowback Preventer: Controls pore water pressure in rock.

Elf Ice: Ice built up in a laminar fashion within the creek, but not connected to the bed of the creek.

Estuary: A partially enclosed body of water with one or more water inflow.

Geodetic: Refers to the science of measuring the earth, or survey measurements.

IDF: Intensity-Duration-Frequency Curves.

Orographic: Falls within the discipline of geomorphology and refers to the study of mountains and other elevations in terrain.

PCB: Polychlorinated Biphenyl.

Spalling: Slabs of rock approximately the size of a desk falling off a pit wall.

TDG: Transportation of Dangerous Goods.

Attachment

Additionally, please see attached glossary of underground terms and schematic drawings.

TECHNICAL MEMORANDUM

DATE	November 10, 2011	**PROJECT No.**	09-1427-0006/6000/6200
TO	Mark Cronk Public Works and Government Services Canada	**AECOM DOC. No.**	313-UG-13-MEM-0006-Rev4_20111110
		GAL DOC. No.	071
FROM	Darren Kennard	**EMAIL**	dkennard@golder.com

GLOSSARY OF UNDERGROUND TERMS AND SCHEMATIC DRAWINGS

The Giant Mine Remedial Action Plan (SRK, 2007) calls for the arsenic stopes and arsenic chambers to be remediated using the "frozen block" concept. The remediation involves adding water to the arsenic dust in the arsenic chambers and arsenic stopes and then freezing it, not necessarily in that order. Bulkheads were constructed during operations to isolate the dust in each chamber from other underground openings.

The following represents a glossary of underground terms and associated schematic drawings for future reference. An additional glossary of terms can be found in the "Giant Mine Remediation Project, Developer's Assessment Report" dated October 2010[1].

Figure 1 describes the existing underground situation and Figure 2 describes the planned pre-freezing remediation work. Arsenic chamber B-10 was used to illustrate the approach.

The following terminology and description of the current situation pictured in Figure 1 is outlined below.

- Underground Openings:
  - Development Openings (Development):
    - *Drift:*
      - Horizontal development opening excavated parallel to the strike of the orebody to provide mine access. Often part of the permanent infrastructure of the mine. Generally used for historical tracked mining generally used before the mid 1970's at Giant Mine.
    - *Cross-cut:*
      - Horizontal development opening excavated perpendicular to the strike of the orebody to provide mine access. Often part of the permanent infrastructure of the mine. Generally used for historical tracked mining.

[1] Indian and Northern Affairs Canada and Government of the Northwest Territories. 2010. Giant Mine Remediation Project, Developer's Assessment Report. Yellowknife, NWT.

- *Shaft:*
  - A vertical development opening excavated to provide mine access. Often part of the permanent infrastructure of the mine.
- *Ramp:*
  - Inclined development opening excavated to connect mine openings on different levels. Often part of the permanent infrastructure of the mine. Generally used for modern mechanized mining and at Giant mine often used to connect horizontal drifts used for historical tracked mining.
- *Portal:*
  - The point of connection between surface and underground development openings, or the entrance to underground.
- *Raise:*
  - A vertical to sub-vertical development opening excavated to provide mine access. Often used only during production but some form part of the permanent infrastructure of the mine.
- Other Development Openings:
  - Includes scram drifts, mill holes, man ways, ore passes, etc. Often part of the permanent infrastructure of the mine.

- Arsenic Development Openings:
  - *Upper Arsenic Drift*:
    - A former development drift that connects to the upper portion of an arsenic chamber or stope. The upper arsenic drifts are isolated from development openings and non-arsenic stopes with bulkheads that incorporate inspection hatches. These drifts were used to distribute arsenic dust to the arsenic stopes and chambers.
  - *Intermediate and Lower Arsenic Drift*:
    - A former development drift that connects to the lower portion of an arsenic chamber or stope. The connection between the lower arsenic drifts and the arsenic stope or chamber is often referred to as a draw point. The arsenic is contained within the drift by existing bulkheads. Lower arsenic drifts are partially or completely filled with arsenic dust.
  - Other Arsenic Contaminated Drifts:
    - Some drifts are contaminated with arsenic that are not contained by existing bulkheads. The contamination is primarily in the form of arsenic sludge of the floor or old arsenic dust distribution drifts.
  - *Arsenic Raise*:
    - A vertical or sub-vertical development opening connected to the arsenic stopes and chambers. The arsenic is contained within the raise by existing bulkheads. They are partially or completely filled with arsenic dust.

- Stopes: a large underground open space or cavity left after mineralized rock was extracted.
  - *Non-arsenic Stope:*
    - These may remain open or are backfilled with classified tailings or occasionally waste rock.
  - *Near Surface Non-arsenic Stope:*
    - A stope that is situated within 35 m of the surface or the bedrock / overburden contact where surface soils are present. These may remain open or are backfilled with classified tailings or occasionally waste rock.
  - *Arsenic Stope:*
    - Stopes that were partially filled with arsenic dust.
  - *Arsenic Chambers*: an underground excavation built specifically to store arsenic dust. They are partially filled with arsenic dust.
- *Bulkhead / Plug*:
  - A water-resistant seal used in a mine where a wall is constructed across a mine access opening. Existing bulkheads at Giant were constructed of concrete or cemented tailings structure installed in development openings that are connected to an arsenic chamber or arsenic stope to isolate arsenic dust. Similar structures are also often termed plugs. For the purposes of the preliminary design existing structures will be termed bulkheads and any planned for the future will be termed plugs.
- *Pillar:*
  - *A term used to describe un-mined rock left behind to support the back (roof) and ribs (walls) of an underground opening.*
    - *Crown pillar:*
      - *A rock pillar between to back (roof) of an underground opening and ground surface.*
    - *Rib pillar:*
      - *A rock pillar between the walls of horizontally adjacent underground openings.*
    - *Sill pillar:*
      - *A rock pillar between the walls of vertically adjacent underground openings.*
- *Overburden:*
  - *Weathered rock and/or soil overlying solid bedrock.*
- *Waste Rock:*
  - Rock material that is excavated as part of the mining process but contains no economic mineralization. It usually takes the form of cobbles with sizes varying from cm's in diameter to meters in diameter. It is commonly used for surface and underground construction and backfill in underground voids.

- Tailings:
  - Tailings are a mining waste product created after economically mineralized rock, or ore, is finely ground and processed into sand sized particles.
    - *Classified Tailings*: classified or de-watered tailings is created by reducing the high water content that often results from the milling process. The material is often used as backfill material and construction in the underground mine.
    - *Paste Tailings*: is a material can often be created from tailings by optimizing grain size distribution and water content to create a material that will not easily segregate during transport or pumping.
- *Backfill:*
  - Material used to refill an underground excavation or void. Typical backfill material includes waste rock, classified tailings, cemented paste tailings, etc.

Prior to flooding and freezing, the following underground activities will be carried out as shown in Figure 2 (not necessarily in this order):

1) Excavate horizontal freeze drift(s);
2) Backfill / stabilize potentially unstable non-arsenic stopes adjacent to arsenic stopes and chambers;
3) Excavate new development as needed to gain access for construction of plugs as needed;
4) Install lower arsenic drift plugs and arsenic raise plugs;
5) Backfill lower and upper arsenic drifts; and
6) Drill freeze holes.

The following terminology and explanation of the purpose of the various pre-freezing remedial activities is shown and described below.

- *Horizontal Freeze Drifts*:
  - New development openings are required to enable the drilling of horizontal drill holes under the arsenic stopes and chambers.
- *Non-arsenic Stope Backfill*:
  - Some non-arsenic stopes adjacent to arsenic stopes or arsenic chambers may exhibit instability in the long term. Some of these non-arsenic stopes are partially backfilled, some are fully open voids. These non-arsenic stopes will be backfilled (topped up) and/or stabilized to reduce the potential impact of any instability on the adjacent arsenic chambers and/or arsenic stopes.

- *Arsenic Drift Plugs*:
  - Drift plugs will be built to prevent arsenic dust from migrating from arsenic stopes and arsenic chambers. The arsenic drift plugs will be installed within the freeze pipe wall perimeter. The arsenic drift plugs will be designed to structurally withstand a full head of liquefied arsenic dust.
- *Arsenic Raise Plugs*:
  - As above for arsenic drift plugs.
- Arsenic Drift Backfill:
  - *Upper Arsenic Drift Backfill*:
    - Some form of backfill material will be placed in the upper arsenic drifts for long term safety and security reasons. It is not necessarily proposed to place the material tight to the back.
  - *Lower Arsenic Drift Backfill*:
    - Some form of backfill material will be placed in the lower arsenic drifts to limit migration of arsenic dust from the arsenic chamber or arsenic stope during the wetting process. It is not necessarily proposed to place the material tight to the back. The lower arsenic drifts may be partially, or in some isolated areas, fully filled with arsenic dust.
- *Freeze Pipe Wall*:
  - The perimeter created around the arsenic chamber and arsenic stopes when the vertical and horizontal freeze pipes are installed.

GOLDER ASSOCIATES LTD.

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Attachments: Figures 1 and 2

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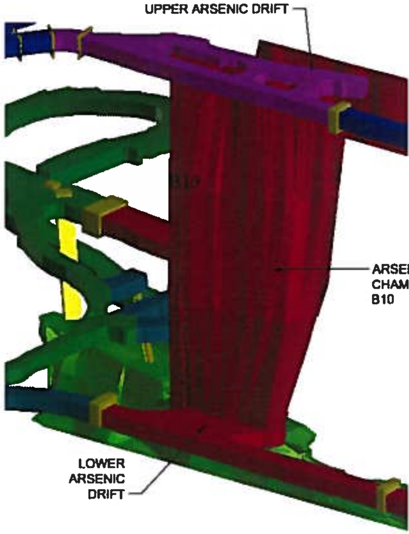
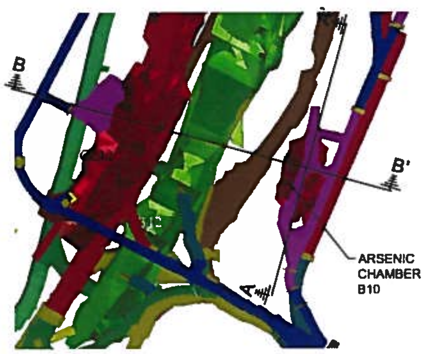
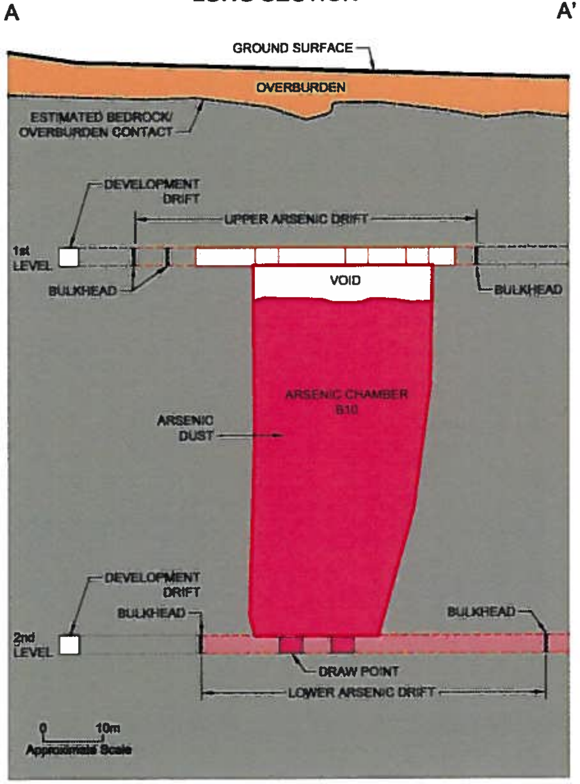
3-D ISOMETRIC



PLAN

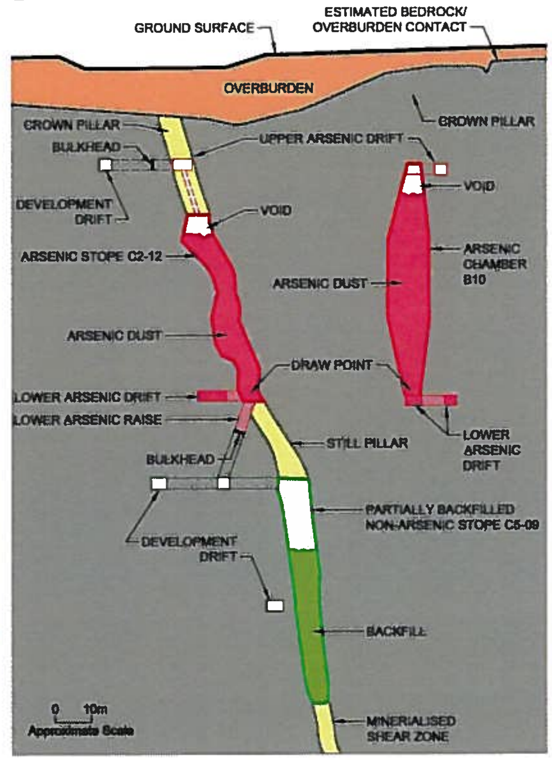


LONG SECTION



A
A'
GROUND SURFACE
OVERBURDEN
ESTIMATED BEDROCK/ OVERBURDEN CONTACT
DEVELOPMENT DRIFT
UPPER ARSENIC DRIFT
1st LEVEL
BULKHEAD
VOID
BULKHEAD
ARSENIC CHAMBER B10
ARSENIC DUST
DEVELOPMENT DRIFT
BULKHEAD
BULKHEAD
2nd LEVEL
DRAW POINT
LOWER ARSENIC DRIFT
0 10m
Approximate Scale

CROSS-SECTION



B
B'
GROUND SURFACE
ESTIMATED BEDROCK/ OVERBURDEN CONTACT
OVERBURDEN
CROWN PILLAR
BULKHEAD
UPPER ARSENIC DRIFT
CROWN PILLAR
VOID
DEVELOPMENT DRIFT
VOID
ARSENIC STOPE C2-12
ARSENIC CHAMBER B10
ARSENIC DUST
ARSENIC DUST
DRAW POINT
LOWER ARSENIC DRIFT
LOWER ARSENIC RAISE
STILL PILLAR
LOWER ARSENIC DRIFT
BULKHEAD
PARTIALLY BACKFILLED NON-ARSENIC STOPE C5-09
DEVELOPMENT DRIFT
BACKFILL
0 10m
Approximate Scale
MINERALISED SHEAR ZONE

NOTE:
SCHEMATIC DIAGRAM ONLY, SOME ELEMENTS ARE ADDED FOR GENERAL DESCRIPTION.

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

PRELIMINARY
NOT FOR CONSTRUCTION

DO NOT SCALE DRAWINGS

Revision/Révision	Description/Description	Date/Date
4	ISSUED FOR REVIEW	11/11/10

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT
GIANT MINE REMEDIATION PROJECT, NWT

UNDERGROUND TASK No. 13

Approved by/Approuvé par: DTK
Designed by/Concept par: DTK
Drawn by/Dessiné par: JK
PWGSC Project Manager/Administrateur de Projets TPSGC: DAVE COLBOURNE
PWGSC, Architectural and Engineering Resources Manager/Ressources Architectural et de Directeur d'ingénierie, TPSGC
Client/client: PWGSC

Drawing title/Titre du dessin

SCHEMATIC OF EXISTING UNDERGROUND SITUATION

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.313	FIGURE 1 OF 2	4

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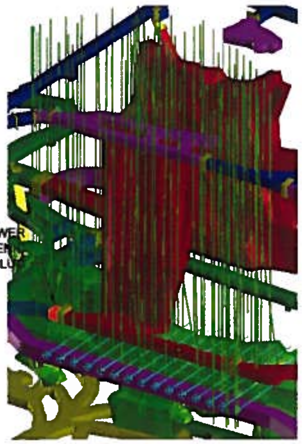
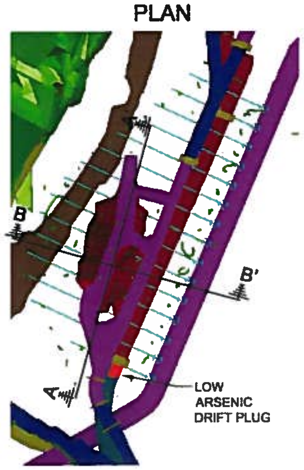
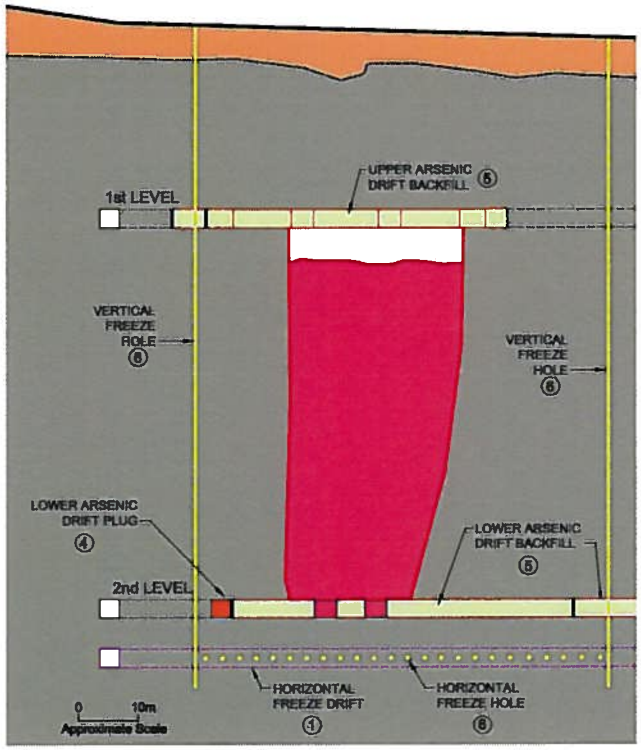
3-D ISOMETRIC



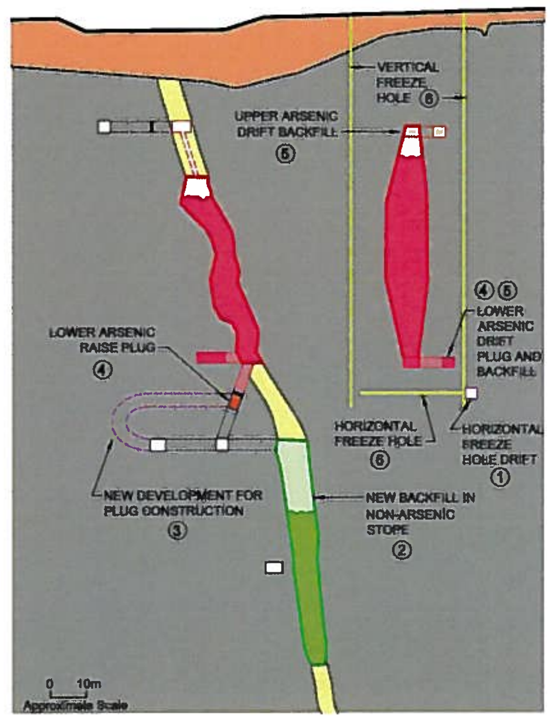
PLAN



LONG SECTION



CROSS-SECTION


B
B'
VERTICAL
FREEZE
HOLE ⑥
UPPER ARSENIC
DRIFT BACKFILL
⑤
LOWER ARSENIC
RAISE PLUG
④
④⑤
LOWER
ARSENIC
DRIFT
PLUG AND
BACKFILL
HORIZONTAL
FREEZE HOLE
⑥
HORIZONTAL
FREEZE
HOLE DRIFT
①
NEW DEVELOPMENT FOR
PLUG CONSTRUCTION
③
NEW BACKFILL IN
NON-ARSENIC
STOPE
②
0 10m
Approximate Scale

REMEDIATION STEPS PRIOR TO FREEZING (EXAMPLE CHAMBER B10)*

① EXCAVATE HORIZONTAL FREEZE HOLE DRIFT
② BACKFILL/STABILIZE POTENTIALLY UNSTABLE NON-ARSENIC STOPES ADJACENT TO ARSENIC STOPES AND CHAMBERS
③ EXCAVATE NEW DEVELOPMENT TO GAIN ACCESS FOR PLUG CONSTRUCTION
④ INSTALL LOWER ARSENIC DRIFT PLUGS AND ARSENIC RAISE PLUGS
⑤ BACKFILL LOWER AND UPPER ARSENIC DRIFTS
⑥ DRILL FREEZE HOLES

* WORK FLOW NOT NECESSARILY IN THIS ORDER

NOTE:
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PUBLIC WORKS
GOVERNMENT SERVICES
CANADA

Project title/Titre du projet

GIANT MINE
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GIANT MINE REMEDIATION PROJECT, NWT

UNDERGROUND
TASK No. 13

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PWGSC, Architectural and Engineering Resources Manager/Gestionnaire Ressources Architecturales et de Directeur d'ingénierie, TPSGC
Client/client: PWGSC

Drawing title/Titre du dessin

PRE-FREEZE SCHEMATIC OF UNDERGROUND REMEDIATION STEPS

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.313	FIGURE 2 OF 2	4

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