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GIANT MINE REMEDIATION PROJECT

Overview Information for Advanced Remediation Stabilization Activities

Submitted to:

Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 1S6

Attention: Brad Thompson, P.Eng.

REPORT

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1.0 INTRODUCTION

The stability of certain underground mining excavations at the Giant Mine Remediation Project (Giant Mine) is of concern to Aboriginal Affairs and Northern Development Canada (AANDC) as their failure would lead to physical surface hazards, compromise the ongoing and planned remediation work, and the release of arsenic trioxide into the mine and/or the environment. Specific arsenic containing and non-arsenic containing stopes have been prioritized as mitigation targets and some of these are the subject of the work outlined in this tender documentation. The proposed work is described in detail in the tender documentation for the Interim Underground Stabilization Activities (IUSA). A general description of work included in the IUSA includes:

- Providing support to pillars by backfilling stope voids with cemented paste tailings (paste);
- Construction of barricades or fill fences necessary to contain the paste within the void(s) to be backfilled; and
- Installation of a monitoring system used to assess the level of paste in the void(s) to be backfilled and to assess if paste is leaking from known exits from the void(s) to be backfilled.

Previous stope mitigation stages were carried out in 2013 and the information gathered during those efforts will be made available to proponents of the ongoing IUSA mitigation effort.

1.1 Intended Use of This Document

The document provides general background information on the mine itself and the objectives of the backfilling program. Conceptual mitigation plans that form the basis for the tender proponents approach to the work are described. It provides a description of the key available IUSA Project mine geometry information which includes a digital three-dimensional model and related two dimensional drawings. Other potential useful support information is provided as appendices. Further information is available from PWGSC and the care and maintenance contractor of the Giant Mine.

Drawings related to the overall site and drawings specific to the particular stopes targeted for mitigation during the IUSA Project are included to guide bidders in assessing the needs of the project. The drawings and the included support information identifies, and in some cases quantifies, uncertainty in the mine geometry information that could pose various risks during the work.

Conceptual mitigation plans which outline one possible approach to backfilling the stope voids in question are provided as a guideline and a starting point for the successful proponent to develop their detailed backfilling work plan once the work is awarded. These plans are in part, based on experience gained during underground void backfilling work executed in late 2013. These conceptual mitigation plans include an initial assessment of underground accessibility, a description of the void to be backfilled, identify known points where paste backfill could leak from the stope void, and include information that can be used to determine where fill barricades and monitoring to check for leaks could be installed by the proponent.

2.0 BACKGROUND

Giant Mine is an inactive gold mine located approximately 5 km north of the centre of Yellowknife, Northwest Territories (the Site). Historically, the mine produced gold from 1948 until 1999, after which stewardship was transferred to the Department of Indian and Northern Affairs Canada (INAC) – now Aboriginal Affairs and Northern Development Canada (AANDC). INAC immediately transferred management to Miramar Giant Mine Ltd. (MGML), which ceased all ore processing activities at the Site but continued to mine and transport ore to the neighbouring Con Mine for processing until 2004. All mining activities ceased in July 2004, after which INAC reassumed stewardship and the Deton'Cho/Nuna Joint Venture (DCNJV) was retained to operate and maintain the Site in compliance with current regulations. This group is termed the care and maintenance (C&M) contractor.

The Site is subject to the jurisdictional authority of both the territorial and the federal government. Both governments entered into a Cooperation Agreement for the Giant Mine Remediation Project on March 15, 2005. This agreement established that both parties would implement a care and maintenance plan for the site that protects human health, public safety and the environment.

The Site is considered to include the lands within the boundaries of former Lease L3668T (currently designated reserve R662T). Two affected areas located outside this lease are also included as part of the Site: (i) the Giant Mine town site, and (ii) an area of historical tailings deposition along the north shore of Yellowknife Bay.

A remediation plan for the Site was prepared for INAC by its Technical Advisor and reviewed by an Independent Review Panel (SRK 2007). The Government of the Northwest Territories also contributed to the development and finalization of the plan. The 2007 Remediation Plan (RAP) (SRK 2007) provides a detailed description of current conditions at the Site, details of the proposed remediation activities, an assessment of post remediation conditions, and a monitoring plan and schedule. The findings of the environmental assessment (EA) of the implementation of the RAP are provided in the Developers Assessment Report (DAR) (INAC 2010).

The Giant Mine Remediation Project (the Project) involves the implementation of the RAP to stabilize the Site, isolate contaminants from the environment, and establish safe site conditions that allow for the restoration of ecological processes.

As a precursor to the implementation of the RAP, risks around the underground stability need to be mitigated. This mitigation is mostly centered on the potential effects of instability of the underground workings that could lead to water entering the mine and interacting with stored arsenic, and/or create physical hazards on surface and underground. Over the last few years engineering assessments of these risks have been completed and in 2013 the priority sequence of underground areas that required attention to mitigate the highest risks were completed. A collection of approximately eight (8) stope complexes were identified as needing attention.

During the fall of 2013 backfill activities at the B1-18 stope complex were initiated. While the B-18 stope area was identified as a high risk it was also chosen as a testing ground to identify the challenges and opportunities for future construction activities on the remaining at risk stopes. Refer to **Appendix 1** for a collection of lessons learned during the B1-18 backfill program. Also included in **Appendix 1** is an example of the step-by-step work plan used for planning and implementation of the backfilling of the B1-18 Stope complex. The technical information described in this document reflects the work, required to plan and execute the B-18 stope backfilling work.

3.0 GENERAL PROGRAM OBJECTIVES

The general objective of this program is to mitigate the identified risks of underground stability in four (4) stope complexes (including some residual work to be carried out at the B1-18 stope complex) at the Giant Mine with the specific goals of:

1) Backfilling the defined individual voids within a specific stope complex with paste (i.e., tailings, water, and binder) to a defined level (fullness criteria) with a specified strength (uniaxial compressive strength).

2) Complete the backfill program by March 31, 2016.

4.0 DESCRIPTION OF WORK

The physical work detailed in the tender document specifications to achieve the program objectives, include the following site activities (not necessarily in order). Other work required to support these physical activities is outlined in the tender specification document.

- Excavate and process tailings from any of the south, central, and north tailings ponds to produce paste of sufficient quantity to meet the required material specification.
- Deliver processed tailings to the various paste production areas.
- Execute infill drilling of required backfill delivery boreholes (i.e. most boreholes will be in place).
- Determine required upgrades to underground ground control system and required infrastructure (to be completed by C&M contractor) required to support underground activities.
- Design and install conventional or remote (via boreholes) barricades to contain paste in the voids targeted to be backfilled at known leakage points.
- Design, install, and operate any required underground paste delivery slick lines (pipelines).
- Design, install, and operate an underground backfill monitoring system to measure the level of paste in the targeted void to be backfilled and to monitor possible leakage points.
- Design and construct required surface pads and liners required for paste delivery areas.
- Mix paste from tailings, water, and binder.
- Execute QC testing of the paste material to ensure it meets the material specification.
- Inject paste into existing boreholes to backfill voids to a level outlined in the specifications.
- Verify that voids are full to determined level.
- Restore tailings excavation areas.

Other tasks associated with development of Health, Safety, and Environment plans and emergency preparedness planning are outlined in detail in the tender documentation.

5.0 OVERALL SITE DESCRIPTION

The Giant Mine has structures, ground development, and natural barriers. **Drawing Package 1** shows a key plan of the Giant Mine site and an overall plan of the site which includes: various surface infrastructure elements; natural and administrative boundaries; a depiction of the location of some of the underground mine workings; and the location of the stope complexes to be backfilled (described below).

6.0 STOPE AREAS TO BE BACKFILLED AND PRIORITY SEQUENCE

Stope voids in a total of four (4) areas require backfilling during the Interim Underground Stabilization Activities as outlined in the table below. The total volume of backfill required is 39,000 m^3 with approximate void volumes for each individual stope area listed in Table 1. Additional detail on the voids to be backfilled is included in the stope description spread sheet (**Appendix 2)**.

The stopes are to be backfilled in the order shown in Table 1.

Table 1: Advanced Remediation Areas to Be Backfilled in Priority Sequence

Stope Complex	Approximate Total Void Volume in Stope Complex (m^3)
B1-18 Stope Complex	**2,000**
B3-06 Stope Complex	**5,000**
A3-70 Stope	**13,000**
B3-10 Mid Complex	**19,000**

Note that the B1-18 stope complex has been partially backfilled but some additional work will be required to complete the work in 2014.

The majority of work on the first two stope complexes (e.g. B1-18 and B3-06) must be completed prior to initiation of backfilling of the remaining stope complexes.

7.0 UNDERGROUND ACCESS MAPS

Development of the conceptual mitigation plans were influenced significantly by which portions of the underground openings may, and which may not, currently be safely accessed for inspection, survey, or construction work. **Drawing Package 2** outlines the areas of the underground associated with the IUSA Project that were assessed by Golder using the following broad categories which reflect increasing ground control hazards:

- Development that is an active main travel-ways currently maintained by the C&M contractor.
- Development that is not currently maintained by the C&M contractor but may require only minimal rehabilitation to allow future work.
- Areas with some ground control hazards that would require rehabilitation for work to be carried out and are assumed suitable for limited access under significant control (e.g. surveying).
- Areas with significant ground control hazards that would require significant rehabilitation for work to be carried out and are assumed suitable only for controlled inspection by highly qualified personnel.

The Giant Mine made use of level plans and Figure 1 shows the relative depths of the various levels and their relation to each other. The majority of the backfilling required is near 1st, 2nd, and 3rd levels, but connections to lower portions of the mine exist.

All underground development shown on the level plans that are not marked with the four broad categories should be assumed to be inaccessible or have not been assessed.

Note that these maps were developed for planning purposes only and do not represent a comprehensive ground support assessment. Underground access by the proponent for inspection, survey, and future work is to be carried out under the direction of the Mine Manager. The current C&M contractor will provide guidance on the suitability of various underground activities in specific areas.

8.0 UNDERGROUND INFRASTRUCTURE

Mine ventilation drawings including the location of main escape ways, refuge stations, and emergency egress are available from the current C&M contractor. Limited documentation exists to describe the condition of other underground infrastructure including:

- Power distribution;
- Communication; and
- Mine services (compressed air and water).

Detailed information on these items may be available from the current C&M contractor if required by the proponent.

9.0 GIANT MINE GEOMETRY INFORMATION - BACKGROUND

The current state of the underground environment has not been comprehensively described. Important mine geometry information is currently referenced to several different coordinate systems. Historical 2D mine geometry information is shown in both the Imperial mine engineering (IMENG) and Imperial mine geometry (IMGEO) coordinate systems. The current project mine geometry system is termed the Giant Mine Remediation Project (GMRP) coordinate system which is in metric but does not conform to conventional UTM Nad 83 convention. Additional information on these coordinate systems is available upon request.

The primary tool for description of the geometry of the underground excavations is a digital three-dimensional model. The current and latest version of the 3D model makes use of GEMCOM's, Surpac mine design and visualisation software. This 3D digital mine model will be provided to the proponents. The model also includes a comprehensive borehole database that includes the paste delivery and observation boreholes that will be in place prior to starting the work.

Two-dimensional level plan drawings of the mine workings, vertical cross-sections, and vertical longitudinal sections form an important description of the geometry of the underground excavations. Various example 2D mine drawings are included with the tender package for the benefit of the proponent and are meant to accompany the 3D digital mine model.

It was not possible, nor will it be possible to verify that the 3D digital model and the 2D drawings included in the tender package are a complete, true, and accurate representation of the underground openings present at the mine site.

There are many sub-vertical raises, ore-passes, timbered man-ways, etc. that connect levels and form conduits for paste to leave some of the stope voids that are targeted to be filled. These should be considered in the detailed mitigation plans that will need to be developed by the proponent.

Efforts to better understand the geometry of the mine excavations, the position of existing backfill in the stopes, and the interconnectedness of various underground excavations are ongoing and the proponent will be provided with such information as it is obtained.

10.0 STOPE COMPLEX DESCRIPTIONS

The following sections provide a stope-by-stope description of the geometry of the various voids comprising the stope complex and identifying any unique challenges specific to the individual stope areas. These unique characteristics and challenges have been used in preparation of conceptual mitigation plans (described in Section 11) which are intended to provide a starting point for the proponent to develop their detailed work plans for each stope areas.

Appendix 2 provides a spreadsheet table that describes each stope complex in terms of the assumed or measured volume of the various voids that comprise the stope complex to be backfilled. This table also identifies the data source(s) used for the volume estimates and a perceived relative confidence in the void volume estimate. This confidence level is partly based on the experience of backfilling the B1-18 stope complex. Lastly, the stope description spreadsheet also includes an estimate of the number of barricades required to contain the volume of the voids listed as described in the conceptual mitigation plans. Stope backfilling success criteria which describe the required level and profile of paste in the individual voids of each stope complex in question, are also included in Appendix 2.

Drawing Packages for each stope area have been developed with the aim of providing the proponents with a set of comprehensive engineering drawings to be used for development of a detailed backfilling plan and implementation of that plan. The drawings sets include the following information for each stope complex area:

- 2D Level plans for 1st, 2nd, 3rd, and sometimes 4th level including tracked haulages, inclined ramps and sub-vertical raises, ore-passes, manways, and chutes, arsenic bulkheads, open-pits, etc., (up to 4 drawings).
- Surface infrastructure such as public highways, mine access roadways, power lines, water courses, property boundaries, etc., superimposed on the individual level plans (up to 4 drawings).
- Ortho-photo of the area superimposed on the level plan / infrastructure drawings (up to 4 drawings).
- Planned or completed drilling (borehole collars, traces, and anticipated void breakthrough points) associated with the backfilling superimposed onto: 1) all level plans; 2) level plans and surface infrastructure; and 3) level plans, infrastructure, and ortho-photo (3 drawings).
- Crown pillar or sill pillar thickness contour drawing (1 drawing).
- Plan showing location of vertical cross-sections and longitudinal sections for the area (1 drawing). Two types of vertical section are shown:
  - Vertical cross sections including a scan of Yellowknife Giant Gold Mines geological cross-sections, slices of the 3D digital model components, and planned or completed drilling (many drawings).
  - Longitudinal sections including slices of the 3D digital model components, and planned or completed drilling (many drawings).

The vertical sections are spaced according to the old mine Imperial system, or every 25 feet, but are in metric in the GMRP system.

The 2D level plans shown represent updated versions of previous versions developed for the start of the remediation project. These were updated using information present in digital scans of historical hand-drafted engineering level plans which are the most accurate and comprehensive mine geometry information available. These scans are available to the proponent from PWGSC if required.

The 3D digital model is critical to understanding the geometry of the voids to be backfilled and will be a key component of the proponent's development of detailed work plans for each stope area.

10.1 B1-18 Stope Complex

Drawing Package 3 includes the 2D drawings developed to support the ongoing backfilling of the B1-18 stope complex to support the crown pillar for reference purposes only.

These drawings formed the basis for communication between various engineering and contracting parties working on the 2013 B1-18 stope complex backfilling project which is envisaged to be similar to the work outlined in this tender package.

The remaining work necessary to complete the backfilling of this stope is outlined in **Conceptual Mitigation Plan 1 – B1-18 Stope Complex.**

The remaining work to be carried out at the B1-18 complex includes blocking off one drift and pumping paste into several remaining boreholes.

10.2 B3-06 Stope Complex

Drawing Package 4 includes a 2D drawing package for the B3-06 stope complex. Details discussed herein are also outlined in the presentation of **Conceptual Mitigation Plan 2 - B3-06 Stope Complex.**

The mitigation is aimed at providing support to the sill pillar (also termed a crown pillar) between the B3-06 South / Upper stope void and the overlying B2-08 arsenic stope.

The geometry of the sill pillar is complex owing to the presence of lateral arsenic filled development openings sub-vertical raises, and the complex nature of the B3-06 South Upper stope void which forms two separate limbs in the south of the stope which are connected in the northern portion. The B3-06 South stope void is partly backfilled with waste rock, and possibly other unknown materials, to a level between 0m and 4m from the back of the stope.

Entry of personnel to the eastern limb of the B3-06 South / Upper stope, although possible through the B3-06 Access decline off 2nd level, is not advised at this time due to the sill pillar stability concerns, the lack of ground support in the back and walls of the stope and the possibility of the movement of rock fill present in stope. Additional geotechnical stability assessments of the stability of the overall stope span and the backfill and possible ground support installation work would be required for man-entry to the area. At this time the conceptual mitigation plan (Section 11) includes only remote placement of backfill into the stope through boreholes drilled from the underground.

Lower arsenic barricades #10, #11, and #12 are present in sub-vertical raises connecting the B3-06 South / Upper stope void to arsenic stope B2-08 above. The backfill placed in this stope void must include relatively tight filling (as tight as possible) of the void to where it intersects the bottom of the arsenic bulkhead raise(s). Ideally some paste is placed in the arsenic raises themselves under the arsenic bulkheads.

Paste could be delivered via boreholes drilled from nearby underground openings that are designed to intersect the high point of the voids. Observation boreholes will also be drilled at the bottom of the arsenic raises which could serve as a method to add some paste just below the arsenic bulkheads after the voids are deemed full. A surface paste delivery borehole could supply paste to the general area and an underground slick line with manifolds to the various underground paste delivery boreholes might be required.

The B3-06 South / Upper stope void is likely connected to underlying openings via timbered man ways, mill-holes, and raises to development openings on the 3rd level below it that are currently inaccessible for inspection or work. This area is termed the B3-06 South / Lower Development. It is unknown if these potential connections are open or not.

Additional boreholes will be drilled to observe if paste placed in the B3-06 South / Upper stope void flows to lower elevations via these probable exit points or through the backfill itself. If paste exits the B3-06 South /Upper stope void, either the paste max design would likely need to be changed and/or remotely placed barricades could be installed in the B3-06 South / Lower Development area.

Possible connections also exist to a much larger void below and to the north of the B3-06 South / Upper stope voids. This void is named the B3-06 North / Lower (B3-02 stope) void. If paste leaks to this void extensive and difficult barricade construction would likely be required. At this time it is assumed backfilling of this large void in this area is not required but additional borehole investigations to assess this potential are ongoing.

Connections between the B3-06 North / Lower (B3-02) stope and 4th level may exist as some raises are shown in the historical mine plans but these are not obvious in the information available.

10.3 A3-70 Stope

Drawing Package 5 includes 2D drawings for the A3-70 Stope area. Details discussed herein are also outlined in the presentation of **Conceptual Mitigation Plan 3 – A3-70 Stope.**

A3-70 stope lies directly beneath Baker Creek in an area between Highway 4 and a mine access road on the rim of A1 open pit.

The underground in the A3-70 stope is currently inaccessible for underground inspection.

Borehole cavity scans carried out in surface boreholes drilled into void show that it is partly backfilled from between and 4m and 25m from the back of the stope with unknown material.

The available information suggests that there are only two possible exits from the void, the upper access in the southern portion of the stope and a service raise in the middle of the stope. It is anticipated that the service raise is full of backfill given the bottom-up cut-and-fill mining approach evidenced in the historical engineered level plans.

The surface area above the A3-70 stope is environmentally sensitive given its location relative to Baker Creek and boreholes will be drilled at relatively shallow angles.

Once the known exit points are blocked paste can be placed into the void via the boreholes drilled from surface.

10.4 B3-10 Mid (B2-02, B2-04, B2-18, B3-10) Stope Complex

Drawing Package 6 includes 2D drawings for the B3-10 Mid (comprised of B2-02, B2-04, B2-18, and B3-10 stopes) stope complex. Details discussed herein are also outlined in the presentation of **Conceptual Mitigation Plan 4 – B3-10 Mid Complex.**

The B3-10 Mid Stope Complex is located adjacent to and under arsenic stope B2-12/13/14 and is comprised of several interconnected stope voids which have multiple name descriptors. The void shape in this area is complicated as the voids are partly backfilled with rock fill and other unknown materials, multiple remnant pillars are present and sub-vertical raises, manways, and mill holes that connect various level and sub-levels exist.

Sloughage from hangingwalls, pillar loading, working-ground noises, and degradation of hangingwall support (timber stulls) has been noted in this area over the last several years. This deteriorating stability situation in a stope immediately adjacent to arsenic stope B2-12/13/14 has led to the decision to backfill it. Also, arsenic stope B2-12/13/14 will also be backfilled and all lower arsenic bulkheads need to be reinforced prior to this occurring. Backfilling the B3-10 Mid complex has the added benefit of providing support to lower arsenic bulkheads #34 and #35.

Access to the B3-10 Mid stope is difficult and a full assessment of the void shape is ongoing through a drilling and borehole cavity monitoring survey program.

Multiple raises that connect the B3-10 Mid stopes on 2nd level and intermediate levels between 2nd and 3rd level exist to 3rd and possibly 4th level. Monitoring of accessible entrances to the B3-10 stope where paste could leak out of the targeted voids above is possible but no access to 4th level is available to the best of Golder's knowledge.

11.0 CONCEPTUAL MITIGATION PLANS

During backfilling of the B1-18 stope complex, a series of PowerPoint presentations depicting the step-by-step process to backfilling the area were developed. This working Conceptual Mitigation Plan is included **Drawing Package 3** for reference.

Conceptual mitigation plans have also been developed for all four stope areas to be backfilled, including:

- **Conceptual Mitigation Plan 1** – B1-18 Stope Complex remaining work;
- **Conceptual Mitigation Plan 2** - B3-06 Stope Complex;
- **Conceptual Mitigation Plan 3** – A3-70 Stope; and
- **Conceptual Mitigation Plan 4** – B3-06 Stope Complex.

Key information in these conceptual mitigation plans includes:

- A summary of the underground access maps (outlined in detail in **Drawing Package 2**) for the area.
- An outline of the void targeted to be backfilled on 2D level plans and in isometric images of the 3D model including areas where paste backfill could leak from the targeted void.
- Points where paste containment (e.g. bulkhead, barricade, or fill fence) should or could be installed for various reasons including:
  - Known target void exit points that ***must*** be blocked to keep paste from leaking into critical mine infrastructure areas (e.g. access ramps, ventilation shafts, etc.).
  - Known target void exit points that were used to constrain the volume of the void (and thereby the paste required to fill it) that *can likely be* made accessible for construction of paste containment.
  - Known target void exit points that were used to constrain the volume of the void (and thereby the paste required to fill it) that *can likely not be* made accessible for construction of paste containment.
- Boreholes drilled for various purposes including:
  - Boreholes for delivery of paste backfill into the high point of the targeted voids.
  - Boreholes for monitoring of paste movement from inaccessible known exit points from the targeted void and/or placement of remote fill containment barricades.
  - Boreholes for: observation of paste movement in the void, secondary or contingency paste backfill placement, or to allow air movement in restricted voids (breather holes).
- Required monitoring points in underground openings where paste leakage might report to for:
  - Accessible underground openings; and
  - Non-accessible underground openings.

Monitoring will also be required at every fill fence location to assess barricade performance (e.g. leakage).

The conceptual mitigation planning process to support the drilling assumes that the paste profile will be flat in order to fulfil the performance criteria for each individual void in the various stope complexes (see stope description spreadsheet in **Appendix 2**).

The proponent may not necessarily build fill containment at the exact locations indicated in the conceptual mitigation plans as their own assessment of the situation may lead to a different approach. However, the void volumes shown or listed for each particular stope complex are constrained by the points shown in the conceptual mitigation plans. These volumes will be used, in part, to determine payment for paste delivered.

During the B1-18 stope backfilling work, fill fences comprised of a combination of waste rock and timber were used to contain fill and were constructed where development openings intersected targeted stope voids. These structures were not designed to hold at high heads resulting from large paste pours. Rather they were intended to allow small lifts of 1.0 to 1.5 m of paste which cured prior to raising the fill fence prior to the next pour. The paste was allowed to cure prior to entry of personnel adjacent to or below the fill fence. The proponent may choose an alternative approach to short fill fences to allow high rate placement of backfill. All fill barricades or bulkheads installed by the proponent intended to carry a significant load imparted by non-cured paste will need to be designed by a professional engineer with an NWT designation.

As paste leakage from the voids may still occur after all known exit points are blocked, monitoring is required in both accessible and inaccessible underground locations to assess if and where leakage is occurring so that a strategy to deal with it can be developed.

Additional boreholes may be required to deal with leakage or when unforeseen issues arise.

Note that the mine geometry information shown in the **Conceptual Mitigation Plans** is schematic. Scaled engineering drawings described in the **Drawing Packages** (Section 11) and the digital 3D model will be used by the proponent to develop detailed execution plans for the work upon award.

12.0 ADDITIONAL INFORMATION

The following section identifies additional useful information that was collected, created, or implemented during the field activities that occurred during the fall of 2013. Each section corresponds to an appendix at the end of the document.

12.1 Drillhole Design Criteria

Refer to **Appendix 3.** This memo provides the types and specifications for drillholes. It identifies by type of borehole the diameter drilled, casing requirements for both overburden and rock.

12.2 Paste Trial Report

Refer to **Appendix 4.** This appendix contains several documents that comprise factual information related to the paste test work carried out over two separate periods: October 2013; and December 2013. It includes lab test results, field paste results for strength, flow and mixes tested. Also included are the test results of the various binder tests completed on site.

12.3 Foam Test Report

Refer to **Appendix 5.** Expanding foam was tested to evaluate its usefulness as a product for building remote barricades. This appendix contains the results and recommendations that were a product of the foam test that occurred in November of 2013.

12.4 Tailings Characterization

Refer to **Appendix 6**. This appendix includes various documents that describe the tailings, including the following information:

- A description of geotechnical work carried out on the Giant Mine tailings in the summer of 2013, part a;
- A laboratory testing report for samples collected in the south tailings pond;
- A description of geotechnical work carried out on the Giant Mine tailings in the summer of 2013, part b;
- A laboratory testing report for samples collected in the south and central tailings pond;
- A description of geotechnical work carried out on the Giant Mine tailings in the summer of 2013, part c;
- A description of Phase 1 of the tailings characterization study in 2011;
- A description of Phase 2 of the tailings characterization study in 2012; and
- A collection of photographs of the South Tailings Pond prior to and after the 2013 B1-18 backfilling work.

The information includes a map that indicates where tailings can possibly be excavated from, lab results on the material constituents, a map showing where samples were taken for a test pitting program and memos explaining the results of two separate sampling programs.

12.5 Land Use Plan

Refer to **Appendix 7**. The end land use is explained in this document. This document regulates how work can occur on the site and is enforced by the land use inspector. This could be useful in modifying mitigation plans depending on the geotechnical risks identified.

12.6 Water Licence Submittal

Refer to **Appendix 8**. The water licence regulates the use and interaction with water resources on site. These regulations could be constraints to production while completing paste backfill activities.

12.7 Map of Available Roads

Refer to **Appendix 9** for a surface map that shows roads which are available to the proponent.

12.8 Tailings Pond Drainage Map

Refer to **Appendix 10** for a plan of the tailings ponds showing general drainage that must be maintained during and after tailings are excavated for making paste.

12.9 B1-18 On-Site Paste Testing

Refer to **Appendix 11.** This appendix includes a report describing all the paste testing carried out, including paste geochemistry, as part of the quality control program during the fall of 2013 for reference purposes.

12.10 Paste Production As-Constructed Drawings

Refer to **Appendix 12.** This appendix includes drawings of as-constructed items related to the delivery of paste during the B1-18 stope backfilling work including:

- A paste flow sheet;
- A paste production equipment layout drawing;
- An underground piping diagram;
- A modified Sea-can nozzle; and
- Paste trial layouts 1 and 2.

13.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Hugh Carter, M.Sc., PMP
Mining Project Manager

ORIGINAL SIGNED

Darren Kennard, M.Sc., P.Eng. (BC)
Associate, Senior Geotechnical Engineer

HC/DTK/ja/md/kp

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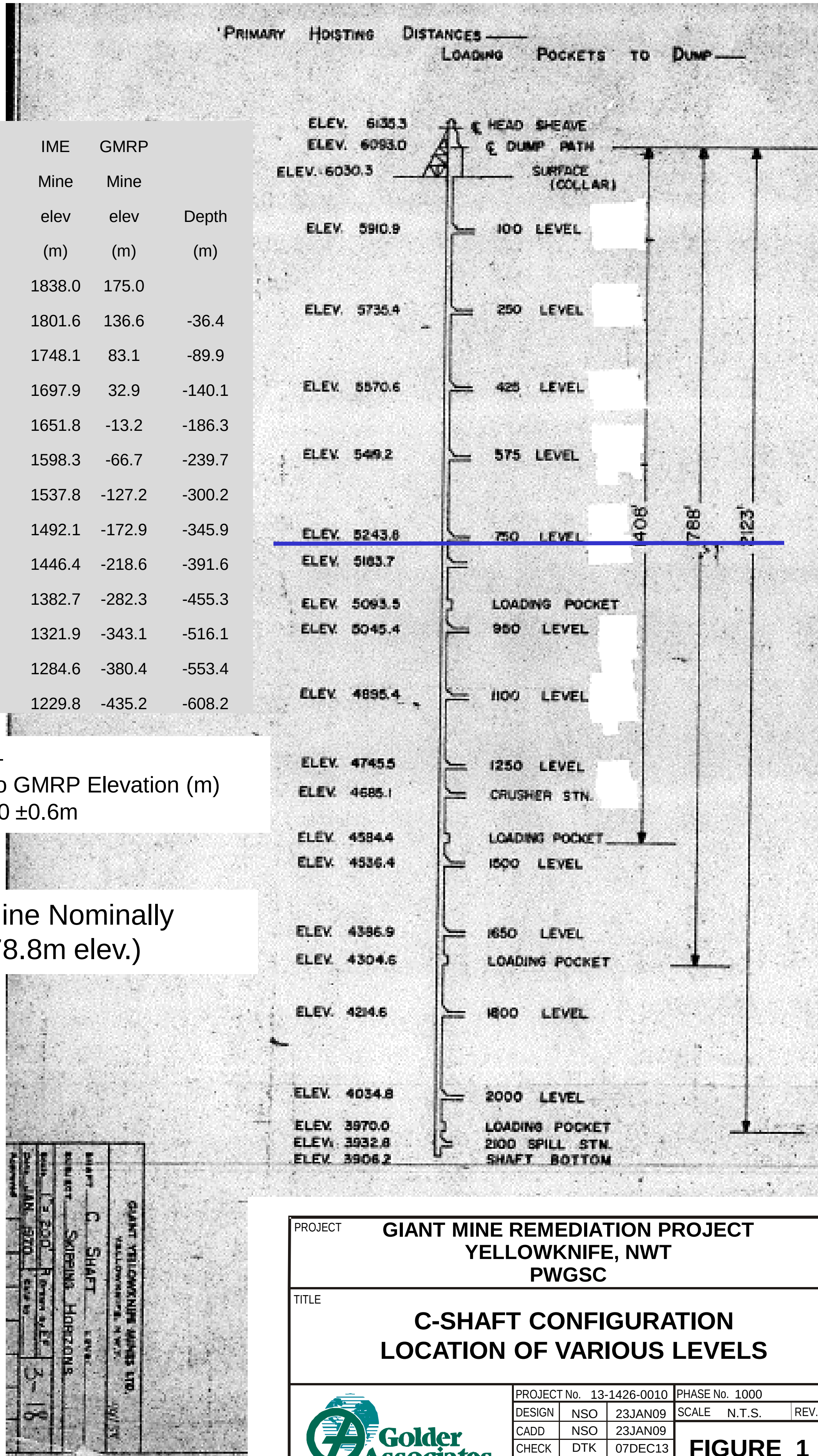
		IME Mine elev (ft.)	IME Mine elev (m)	GMRP Mine elev (m)	Depth (m)
surface	surface	6030.3	1838.0	175.0	
100	1st	5910.9	1801.6	136.6	-36.4
250	2nd	5735.4	1748.1	83.1	-89.9
425	3rd	5570.6	1697.9	32.9	-140.1
575	4th	5419.2	1651.8	-13.2	-186.3
750	5th	5243.8	1598.3	-66.7	-239.7
950		5045.4	1537.8	-127.2	-300.2
1100		4895.4	1492.1	-172.9	-345.9
1250		4745.5	1446.4	-218.6	-391.6
1500		4536.4	1382.7	-282.3	-455.3
1650		4336.9	1321.9	-343.1	-516.1
1800		4214.6	1284.6	-380.4	-553.4
2000		4034.8	1229.8	-435.2	-608.2

Simple Conversion –
Mine Elevation (ft.) to GMRP Elevation (m)
= (Z*0.3048)-1665.00 ±0.6m

Water level in Mine Nominally
5204 ft. elev. (-78.8m elev.)



PROJECT	GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, NWT PWGSC
TITLE	C-SHAFT CONFIGURATION LOCATION OF VARIOUS LEVELS

Golder Associates

PROJECT No.	13-1426-0010		PHASE No. 1000
DESIGN	NSO	23JAN09	SCALE N.T.S. REV. 0
CADD	NSO	23JAN09	FIGURE 1
CHECK	DTK	07DEC13	
REVIEW	DTK	21DEC14	

APPENDIX 1

B1-18 Lessons Learned in Paste Production

January 28, 2014 Reference No. 1314260010-074-L-Rev0-5000

Brad Thompson
Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 1S6

2013 B1-18 STOPE COMPLEX BACKFILL PROJECT - LESSONS LEARNED

Dear Mr. Thompson,

This letter represents a collection of the key technical and logistical "lessons learned" compiled by Golder during our involvement in the paste backfilling of the B1-18 stope complex that was completed between the beginning of October and is ongoing to date. The intent of this document is to provide PWGSC, and potentially any future stakeholders, with a reference to the challenges and unexpected events that were encountered during these activities to bear in mind when developing the procurement approach for similar future work. The document only identifies the lessons learned and does not provide any root cause analyses. If further explanation or clarity is required, enquiries should be directed to the Golder.

LESSONS LEARNED

1) Main questions answered:

- Remotely placed barricades can be constructed using high cement content paste delivered placed via accurately drilled boreholes.
- High slump lightly cemented paste delivered via widely spaced boreholes can be used to fill voids with a relatively flat backfill profile.
- Relatively lightly cemented paste (e.g. 2% cement by weight) made with Giant mine tailings gains strength quickly and the UCS normally exceeds 100 kPa within 1 day with 2% cement by weight.
- Paste can be made and placed in boreholes in cold temperatures.

2) Design and planning details can't be tightly constrained ahead of time as the problem changes during project implementation (actual backfilling) and it is problematic to approximate quantities and schedule accurately ahead of time.

- More up-front planning/investigation time would have eliminated some (but not all) of the changes to the work plan that were required due to uncertainty regarding the geometry of the voids to be filled at the B1-18 stope complex.
- Many areas are/will critical to the backfilling process may be inaccessible for workers to install barricades and cameras or to inspect the underground to assess backfill progress.
- The potential for "paste leakage" in all stope complexes is present and impossible to quantify fully.
- For example, at approximately 80% complete for mitigating the risk at stope complex B1-18 the confidence in design was only at approximately ±20% for the remainder of the work required.
- The data used for planning is/will be variable in its reliability.
    - The paste placement sequence changed on an almost daily basis for the B1-18 stope complex depending on the conditions encountered during the previous day.
    - The conceptual mitigation plan for stope complex B1-18 changed significantly from inception to completion. The majority of changes came in the form of additional boreholes, additional barricades, and camera placements.
    - Some exit voids were sealed much sooner than expected and others that were anticipated to seal quickly have yet to do so at the B1-18 stope complex.

3) Working in cold/winter conditions poses production risks.

- Tailings temperature could be a limiting factor – and the fluctuations can be extreme (observed -11 to +8).
- After the initial onset of cold weather, non-frozen tailings could be sourced by first removing the top frozen crust but this was limited as colder temperatures set in.
- Water temperature could play a large role in production due to the variation in tailings temperatures.
- Borehole cameras and computers were very useful but in cold weather conditions: expect extra time for set-up; availability and performance to decrease with decreasing temperatures.
- Frozen tailings and ice lenses in the tailings can affect the paste production volumes and frozen lumps of various sizes may need to be screened.
- Temperature monitors need to be able / suited to operate in -40C conditions.
- Additional equipment could require shelters and heaters to operate. Expect that these would be required if carrying out work in the cold/winter conditions.
- Multiple ways of adding heat to the tailings during mixing of paste could be beneficial. Planning and options would be beneficial when pouring in cold/winter conditions.

- Freezing of equipment (truck beds, loader buckets etc.) is likely when working in cold/winter conditions.
- The storage of tailings in the available facilities should be timed appropriately when/if working during cold months: e.g., tailings storage facilities required keep tailings from freezing need to be constructed prior to the onset of cold.

4) Tailings material could be variable depending on seasonality and heavy machinery traffic.

- Early investigations revealed that the tailings could support heavy traffic as the saturated material was encountered between 2 and 4 m below the tailings surface.
- Heavy equipment traffic on the tailings ponds appears to draw water closer to the tailings surface, possibly due to a wicking action.
- Apparent wicking action appears to reduce the bearing capacity of the tailings surface – equipment will begin to sink in to the tailings with repeated traffic.
- Pushing of tailings with a dozer helps to break the material up, but also appears to cause this wicking action, reducing the depth that the dozer can excavate without sinking into the tailings.
- Excavation of tailings with an excavator causes fewer disturbances to the tailings and allows large debris to be selectively removed and the tailings to be separated by material characteristics, if required.

5) The grain size and consistency of tailings was more variable than the initial field tests (test pitting observations) indicated for the area excavated for the supply of tailings for the B1-18 work.

- The early investigation to assess source material for the B1-18 stope work was the south and central tailings ponds – widely spaced test pit were dug and limited grain-size analysis laboratory testing was carried out due to schedule constraints.
- The tailings are more variable than information from the early investigation programs indicated. The grain size, moisture content and relative density of the tailings changes both laterally and vertically over short distances.
- Little information has been collected in previous investigation programs on the relative density or consistency of the tailings. This information would be useful to assess the likelihood of the tailings to break apart when excavated.
- With additional moisture content encountered in the fall (relative to the initial investigations in summer) the fine grained lenses encountered in the tailings tended to clump up during excavation and handling and without additional mechanical breakage these clumps are problematic.
- Good source material was “scavenged” and other material was discarded or not excavated as the volume required for 2013 was limited and in future much more of the material will be required.

6) Inconsistency in tailings material led to challenges with processing the tailings and mixing the paste.

- When using Reimer trucks to produce paste the tailings have to be relatively “free flowing” and cannot contain chunks of material that do not easily break apart when handled – unless the tailings are mechanically processed to break up any chunks.
- A significant portion of the tailings will likely require mechanical processing before it can be directly used in Reimer type trucks in order to improve efficiency and maximise production – the clumps that will block the built in grizzlies on the trucks need to be broken up.
- Tailings with similar grain size have different suitability for direct use in Reimer trucks depending on their relative density and moisture content.
- Depending on the amount of mixing and processing of the tailings is planned prior to paste production, visual assessment of the tailings during excavation will help to determine what amount of mixing or processing is required.

7) Inconsistency in paste material led to challenges with management of backfilling underground.

- Subtle changes in the character of the tailings feed material and inconstancy of material flow during paste mixing (constant metered addition of water and cement with a potentially inconsistent rate of addition of tailings by the excavator operator) caused variability in the behaviour of the material underground leading to challenges with managing the backfill sequencing.

8) Handling and working with the tailings can be a limiting factor for paste production and depending on the task may pose a health and safety hazard.

- Unknown debris is buried within the tailings; this can include metal, wood, plastics and other items.
- There is the potential for small metal debris of the size to potentially damage mixing and pumping equipment, if not screened out.
- Mechanical screening/processing of the tailings is effective at screening out debris down to a few inches in size.
- Screening of tailings to break up lumps is only partially effective, as wetter and finer grained tailings are expected to plug the screens or be rejected when other methods could allow these tailings to be used for paste production.
- Screening of frozen tailings is only partially effective at screening out frozen lumps – some frozen lumps will pass through the smallest screen.
- The tailings contain crystalline silica and metals (including arsenic).
- The clays found in the tailings if unblended cannot be used in the mixer trucks.
- There is sufficient dust generated due to tailings excavation and paste production activities that worker exposure control programs are recommended for workers working in close proximity to these areas. The details of the programs will depend on the types of activities and the duration and proximity of workers to the activities.
- Laboratory testing of the tailings components and samples air monitoring data collected on workers working near the excavation and paste production activities is available.

9) Physical site, material movement and equipment logistics all contributed to lower than estimated paste production for the B1-18 stope complex.

- Space constraints limited the set-up orientations (mixer trucks/excavator). Buildings, fences, utility locates, natural barriers, environmental buffers, and general site infrastructure made site planning and layout challenging and limited available equipment that could be used for production.
- Surge hopper was not particularly effective in feeding the mixer truck once a second truck was eliminated from the production equipment roster.
- Managing multiple processes/activities is common and should be expected. This requires an organized site and proper management.
- “Just in time” delivery of tailings to the mixing trucks was not effective and was a limiting factor of production for B1-18 paste delivery.
- Tailings material was lost at each stage of the process and this lost amount needs to be accounted for when producing the paste.
- Flushing procedures were a challenge at the start with lack of resources (welding flanges etc.) and not understanding the intent behind doing air flushes and not water.

10) Underground monitoring using fixed cameras and borehole cameras can have significant impact (positive or negative) on paste production and ability to understand if success criteria have been met.

- Underground and borehole cameras were critical to the management of the backfill process, particularly in areas where fill volumes were not constrained and “exit voids” that could not be fully characterised existed.
- Scales in the camera purview identifying a height of back will assist in evaluating whether success criteria has been met.
- The infrared functionality of fixed cameras is a very useful tool, but signal quality suffered due to the long lengths of transmission cable necessary to get out to the UBC portal. A coax based system will likely not be practical for future, deeper areas.
- Fixed underground cameras were reliable and more useful than borehole cameras and observation holes for the B1-18 stope complex.
- The borehole cameras used at B1-18 required significant light to provide useful images. Getting good light down holes will likely be a challenge. Disposable lighting options such as high intensity glow sticks would improve the use of borehole cameras.
- A reliable Underground-to-Surface communication system is a must as work progresses to deeper areas of the mine.
- A wireless monitoring system (i.e., wireless camera feed) that could be distributed over the internet would be an efficient and cost effective way of monitoring paste backfill.
- Sequencing of monitoring devices on a day-to-day basis, and anticipating where other monitoring should be will reduce downtime when pouring.
- Multiple and spare borehole cameras that are easily used and moved will reduce downtime when pouring.

11) Drilling is a high schedule risk activity due to the tight specification requirements, the proximity to arsenic stopes, and the production limitations that could be realised by having to drill new holes.

- Paste production was constrained at B1-18 stope due to delays in drilling production boreholes.
- Expect last minute design changes to borehole locations and the addition of borehole during backfilling due to unexpected behaviour. Communication with the driller on this at the beginning is crucial.
- Having a proven and actionable methodology to ensure drilling will satisfy the specifications will limit the amount of redrilling.
- Having the appropriate drill for the type of hole will limit the amount of deviation and potential for hole abandonment and redrilling.

12) Various other factors need to be considered to have a successful paste campaign.

- Limitation on water usage (current water license) will likely be a constraint going forward.
- Paste strength and completion criteria assessment would improve if the lab program included different curing conditions to mimic site and underground.
- Paste strength and completion criteria assessment would improve if the lab program included in-situ coring of deposits to test against lab results.
- Develop material standards to be followed and communicate to all parties involved.
- The use of expanding foam underground for construction of barricades (through boreholes or not) should be further investigated.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Hugh Carter, M.Sc., PMP
Project Manager

ORIGINAL SIGNED

Darren Kennard, P.Eng. (BC)
Associate, Geotechnical Engineer

HC/DTK/ja/kp

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1-18 stope void(s) backfilling underground implementation plan

Working implementation plan

Revision 8 – Nov 19, 2013

Golder Associates

Key points of implementation plan

- No work and limited man access in stoping areas (wide spans and high backs)
  - adding extra surface drillholes for pumping paste into stoping areas
  - Using fixed underground and borehole cameras to manage the backfill process
- Simple, non-engineered paste fill barricades which act as formwork for cemented paste
  - management of paste design (cement content and slump) and filling rate (limit fill pour heights)
  - Administrative controls on personnel access under or near non-cured paste

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PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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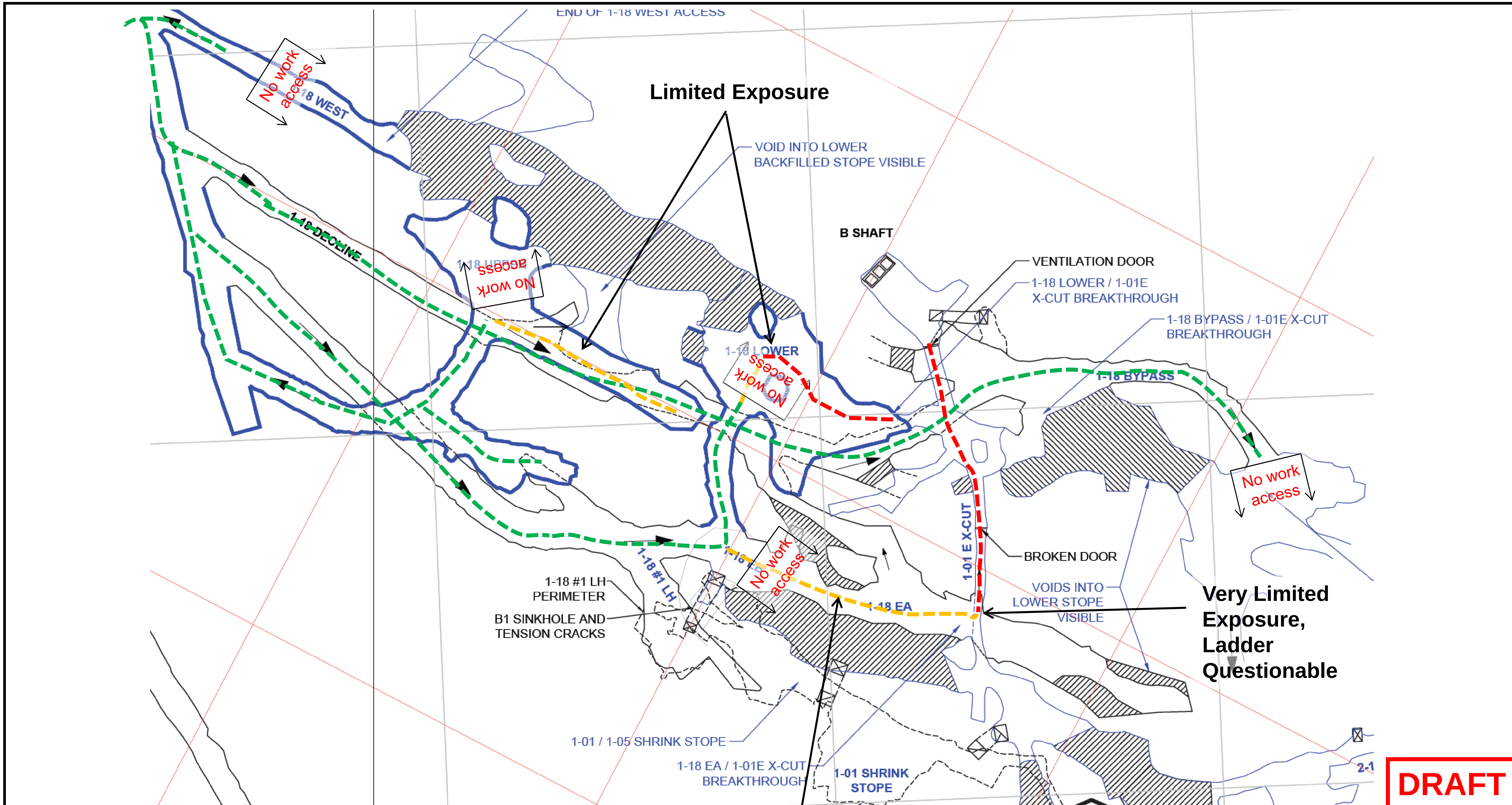

Main travel way / work areas

Inspection and survey areas

Inspection only areas

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Underground Access (Sept. 30, 2013)

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000	
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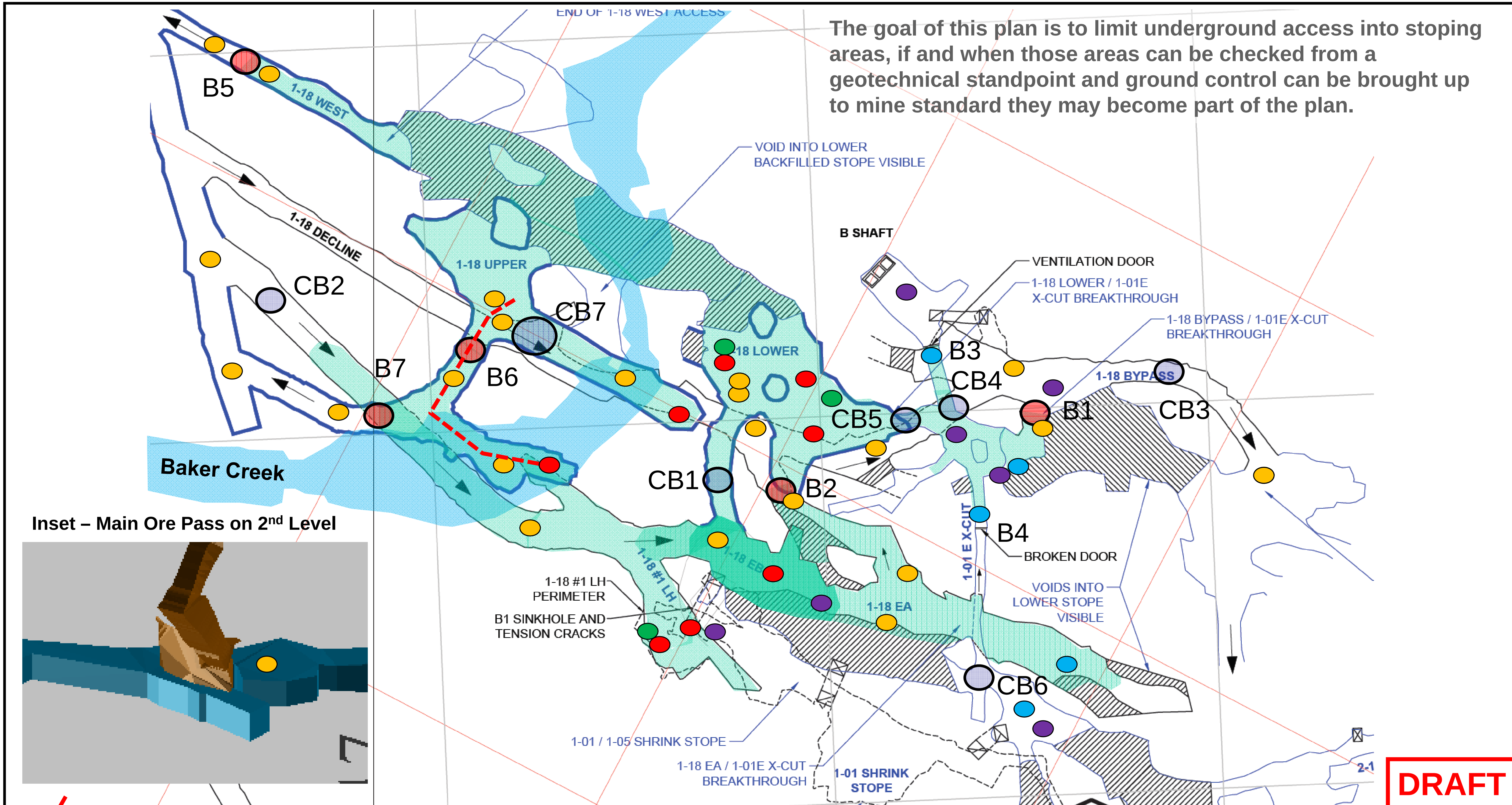
The goal of this plan is to limit underground access into stoping areas, if and when those areas can be checked from a geotechnical standpoint and ground control can be brought up to mine standard they may become part of the plan.



Inset – Main Ore Pass on 2nd Level

Underground paste delivery pipe

Conventional barricade

Contingency barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

2012 Geotechnical boreholes

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – All Components Shown

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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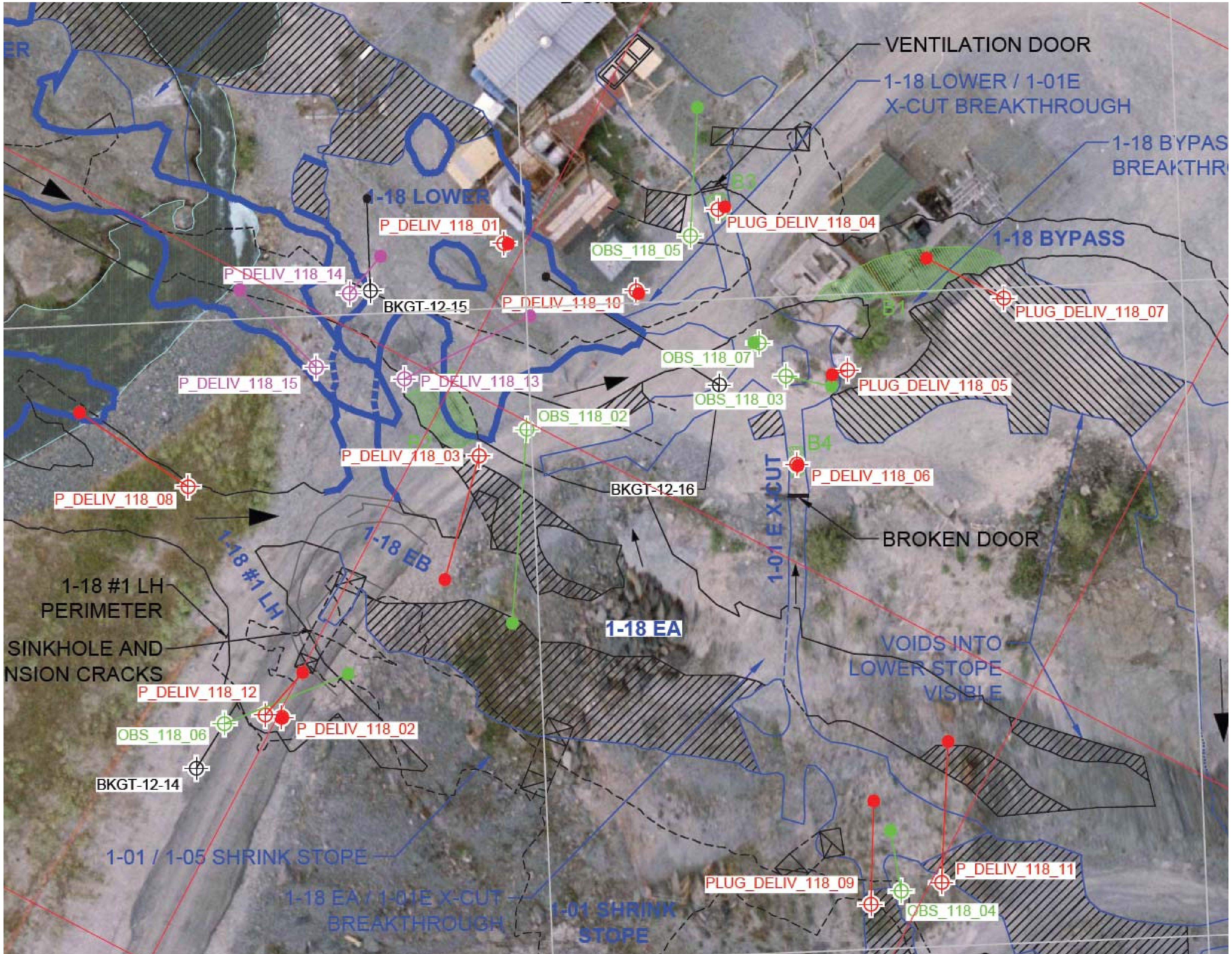

P_Deliv_118_01 — 2013 DRILLED BOREHOLES - 200mm HOLES DIA.

OBS_118_01 — 2013 DRILLED BOREHOLES - 96.1mm HOLES DIA.

P_Deliv_118_14 — 2013 PLANNED BOREHOLES - 200mm HOLES DIA.

BKGT_12_15 — 2012 GEOTECHNICAL DRILLING

DRAFT

PROJECT	**PWGSC** **GIANT MINE INTERIM U/G STABILIZATION PROJECT** **YELLOWKNIFE, NWT**
TITLE	**B1-18 Stope** **Borehole Plan (November 19, 2013)**

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
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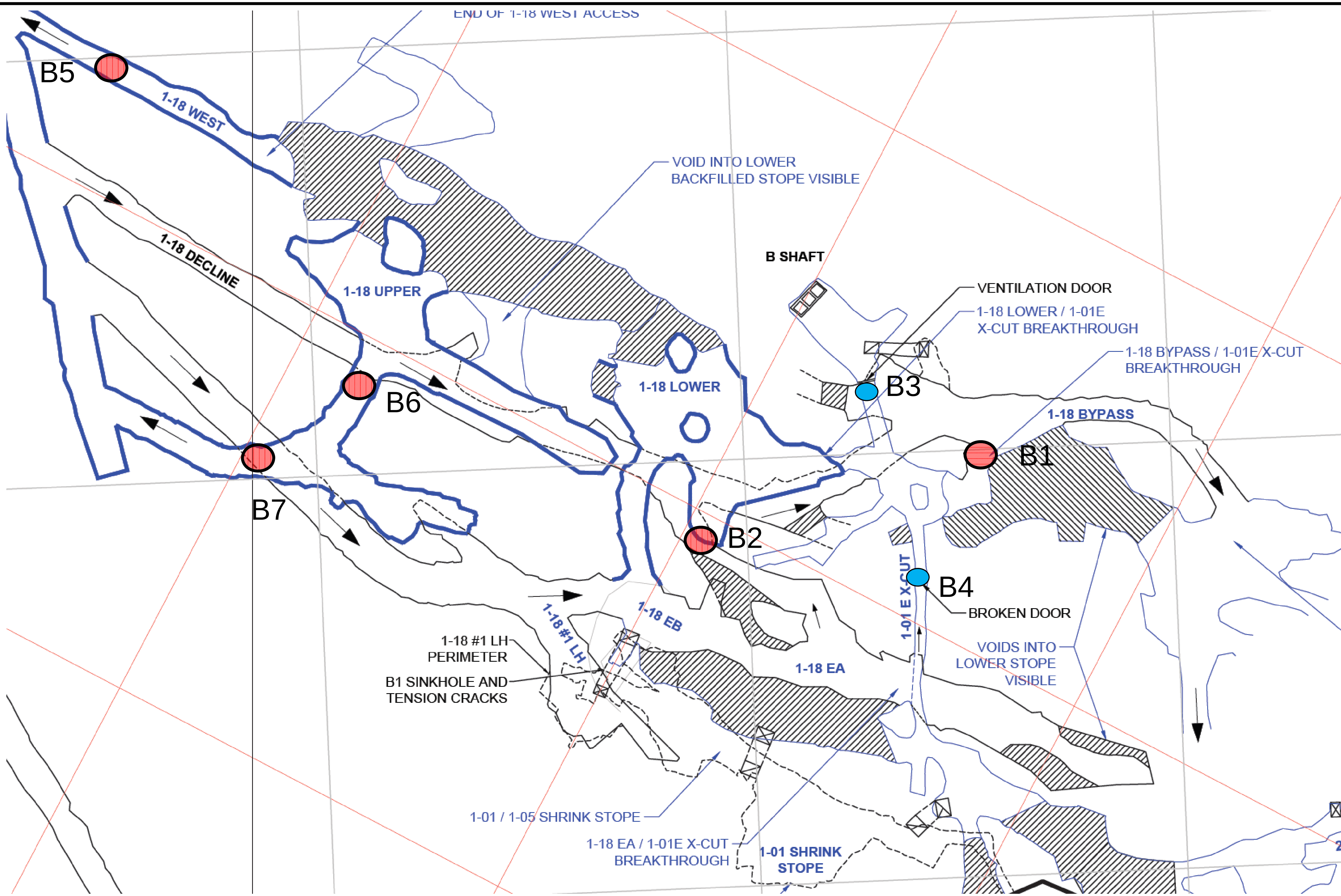

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Conventional barricade

Borehole low slump paste barricade / foam

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Fill Barricade Locations

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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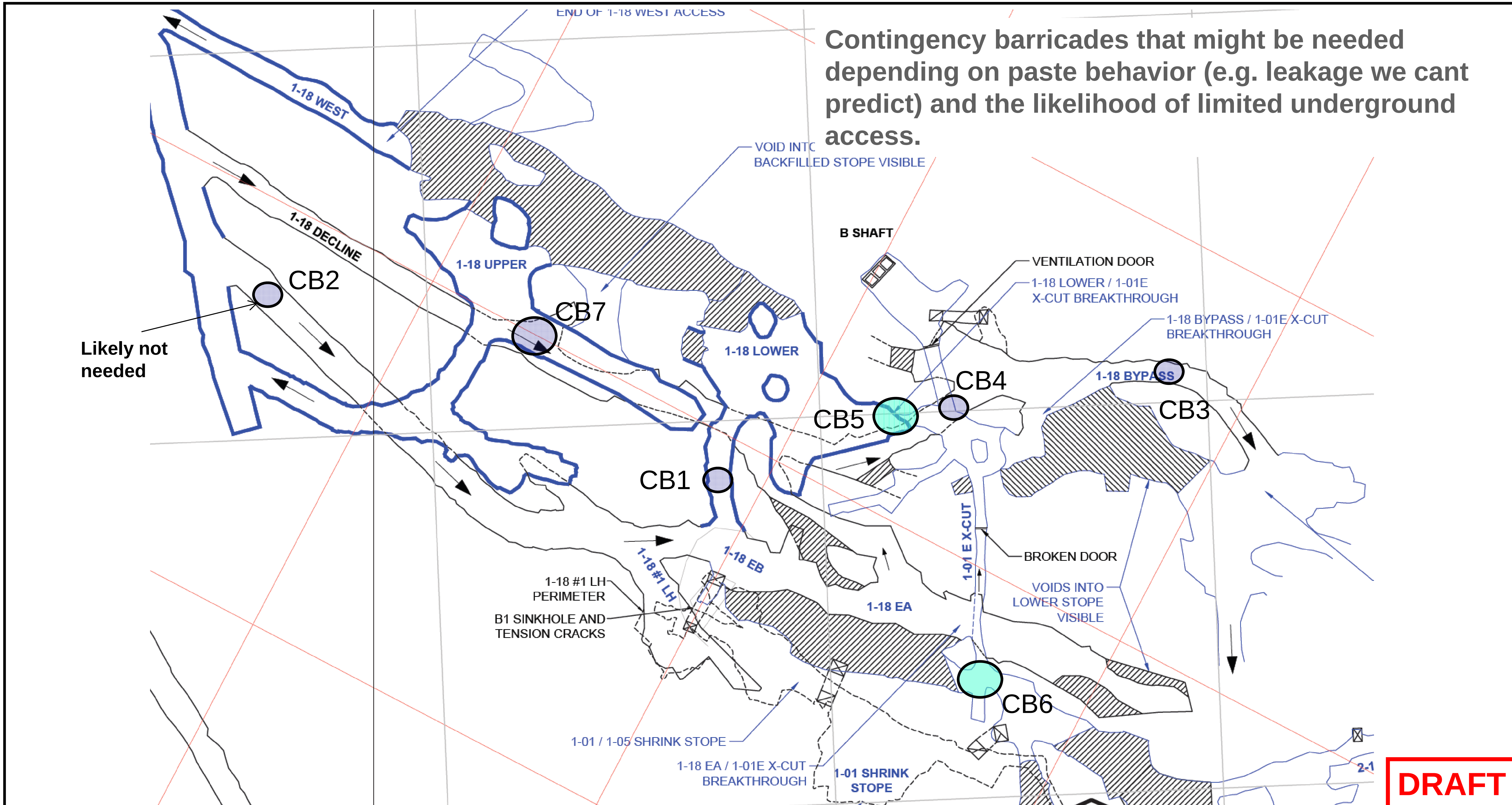
Contingency barricades that might be needed depending on paste behavior (e.g. leakage we cant predict) and the likelihood of limited underground access.



Contingency conventional barricade likely required if cannot keep paste from exiting 1-18 EA stope or barricade #1

Contingency borehole barricade likely required if cannot keep paste from exiting 1-18 EA stope

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Contingency Fill Barricade Locations

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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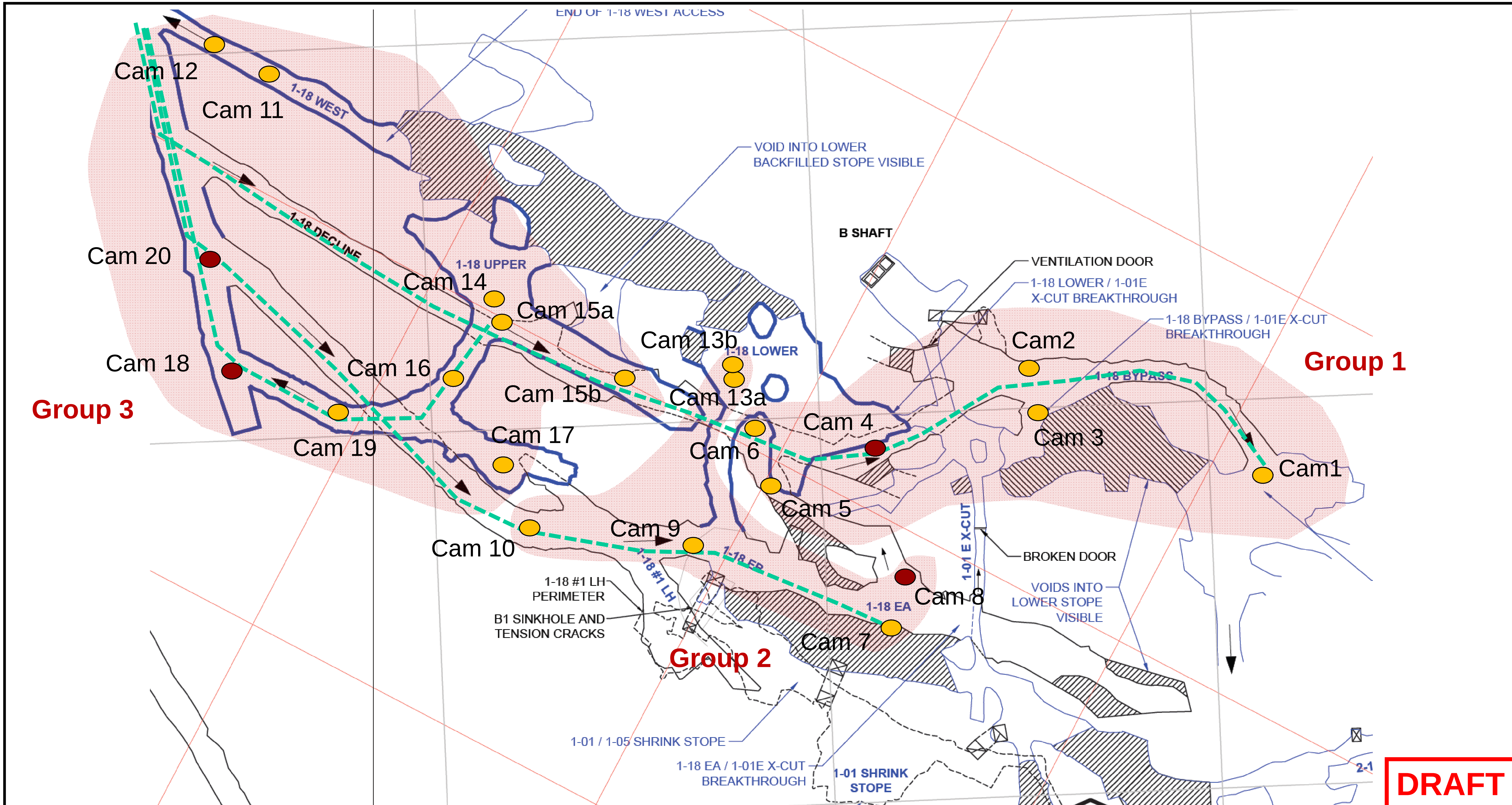

U/G monitoring camera installed in-person - Critical

U/G monitoring camera installed in-person - Secondary

Main power supply (1 per Group)

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Camera Locations

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
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REVIEW				

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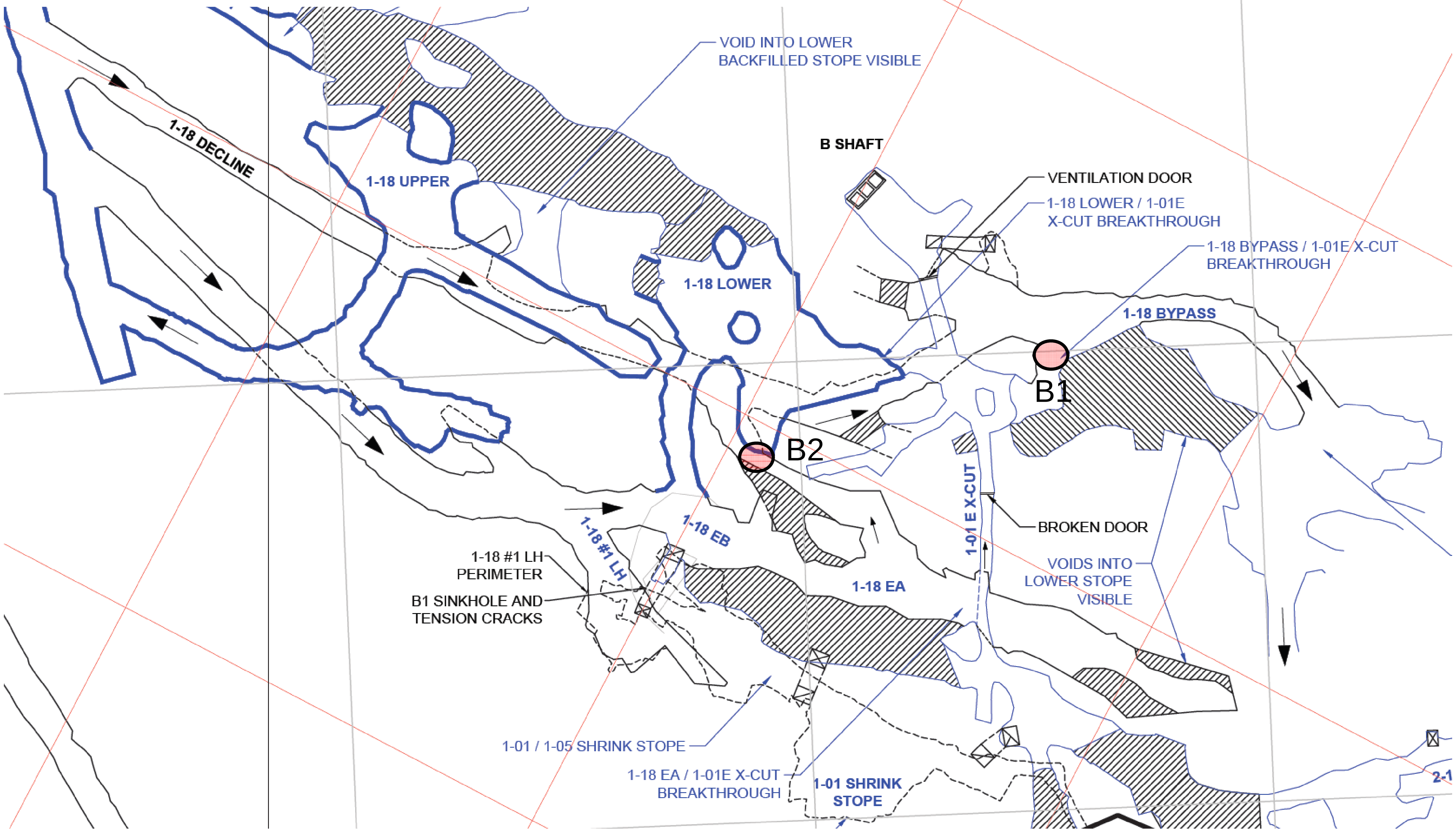
- Need to get the lowest points in the system tightened up first.
- **Step 1 - Build barricade B1 and B2**



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- **Underground paste delivery pipe**
- **Conventional barricade**
- **Sub-vertical primary fill delivery surface hole**
- **U/G monitoring camera installed in-person**
- **Borehole camera monitoring / secondary paste fill hole(s)**
- **Borehole low slump or foam barricade**

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 1

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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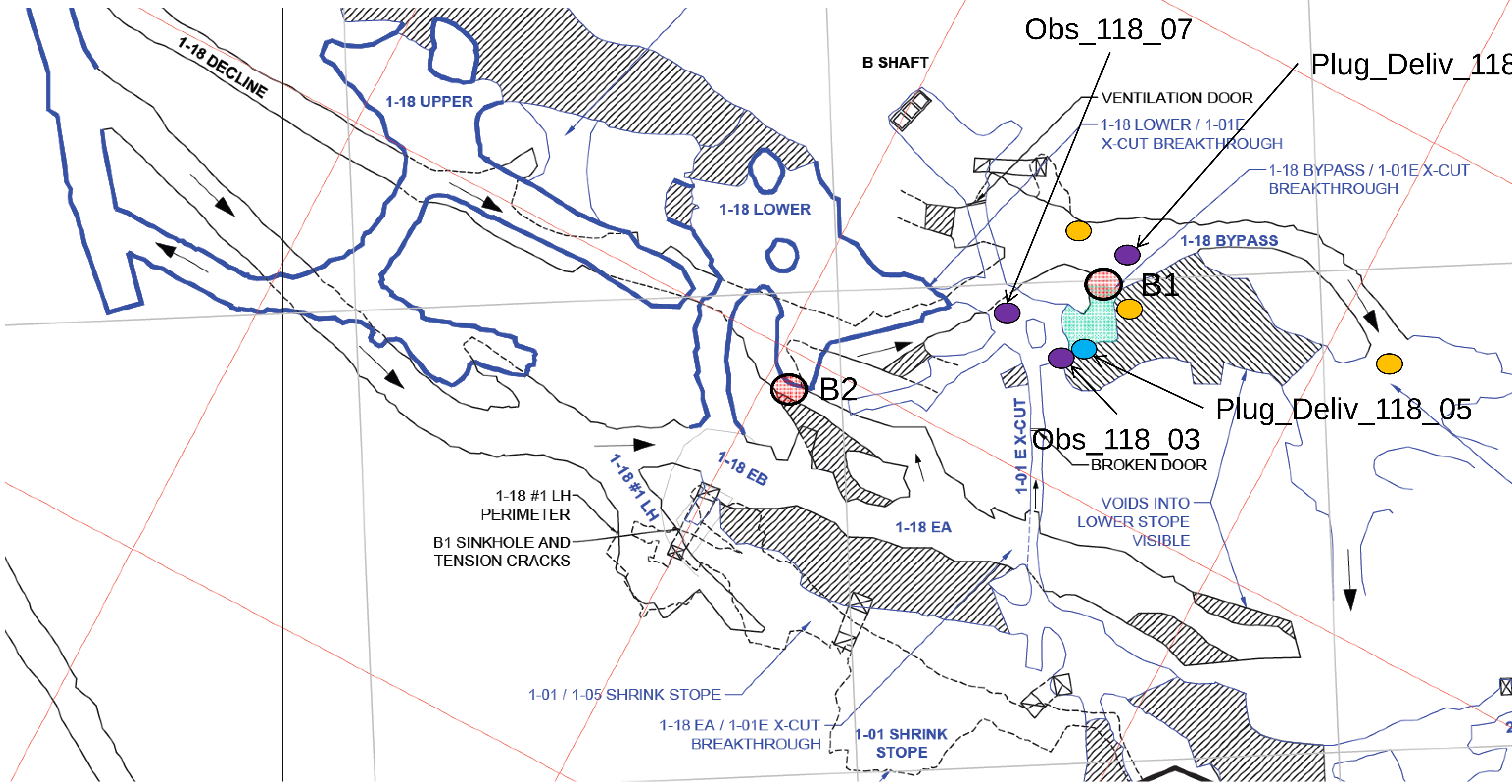
- Need to get the lowest points in the system tightened up first.
- **Step 2 - Inject low slump paste first, then possibly high slump paste into 118_05 to get fill behind the barricade**, observe from Obs_118_03, Obs_118_07, D_118_07 and fixed cameras in the underground.



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- **Underground paste delivery pipe**
- **Conventional barricade**
- **Sub-vertical primary fill delivery surface hole**
- **U/G monitoring camera installed in-person**
- **Borehole camera monitoring / secondary paste fill hole(s)**
- **Borehole low slump or foam barricade**

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 2

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
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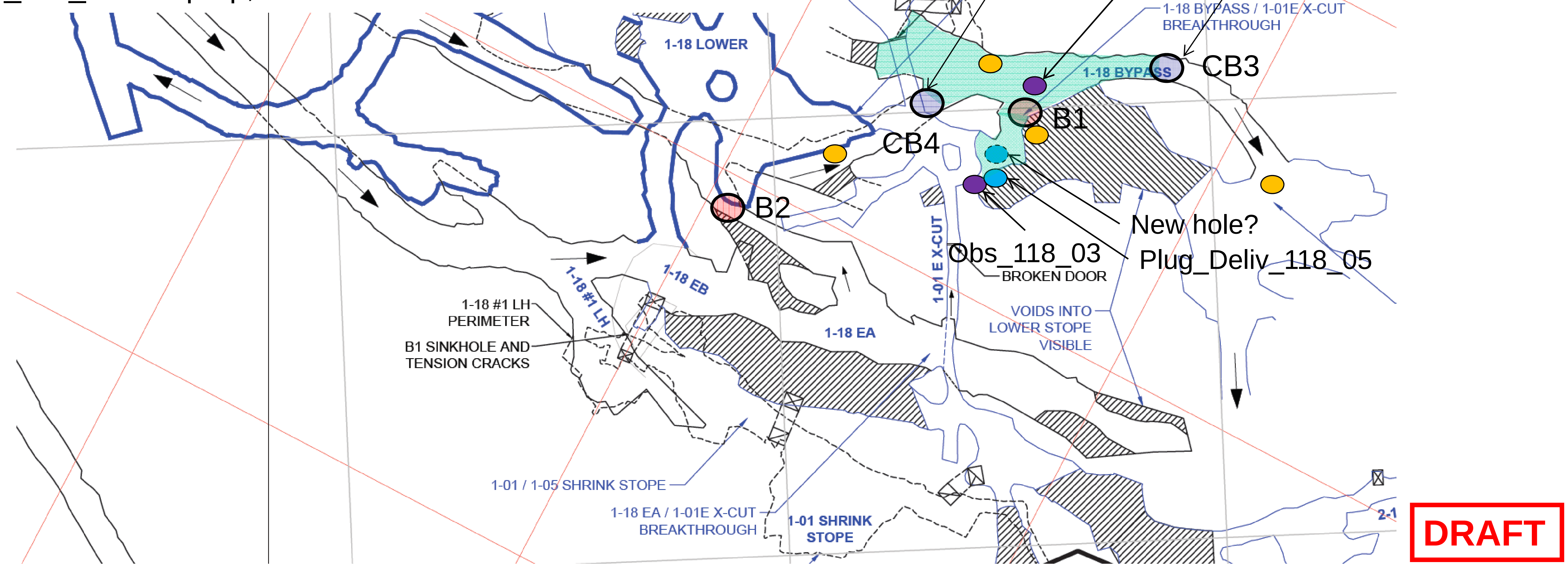
- **Step 2 Contingency -** If Barricade B1 does not work, we may need to build one or two additional contingency barricades in 1-18 bypass and fill the whole 1-18 bypass with high slump paste from D_118_07 but this could cause issues for mine services (power, air, water) and ventilation so this is to be avoided.
- **Step 2 Contingency -** If P_Deliv_118_05 is plugged or the paste cant reach the 1-01 track drift, we may have to use Obs_118_03 to top-up, or drill a new hole.



Underground paste delivery pipe

Conventional barricade

Contingency barricade

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	**PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT**
TITLE	**B1-18 Stope Backfill Plan – Step 2 - Contingency**

PROJECT No.	10-1426-0010	PHASE No.	1000
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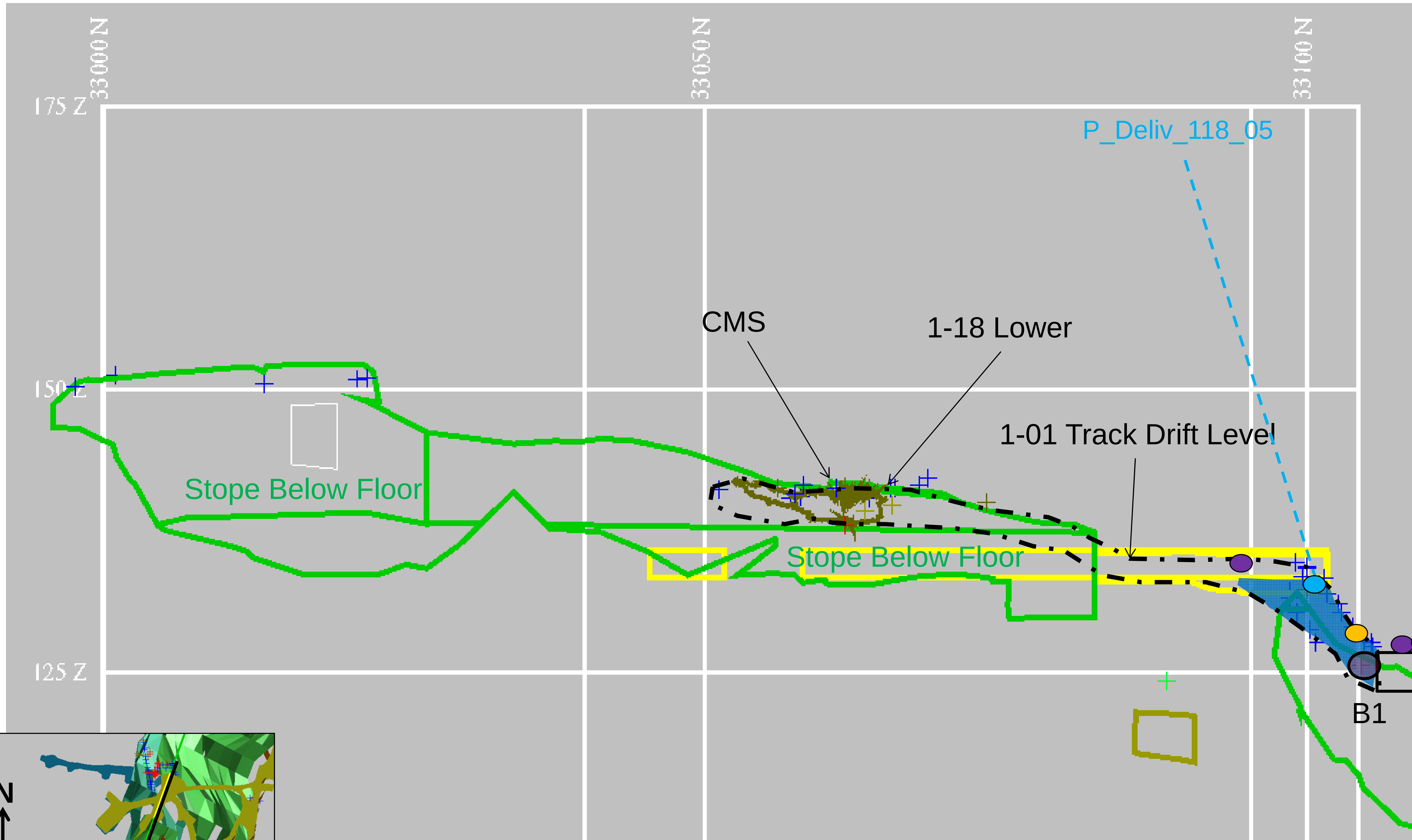

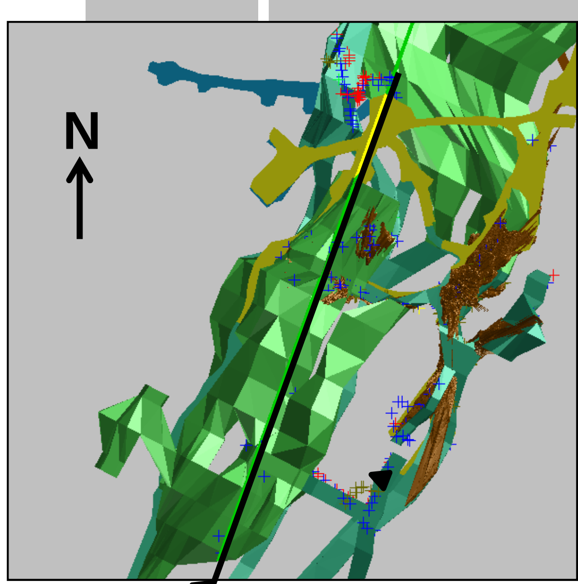

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Approx. Void shape

Low slump paste

Observation hole

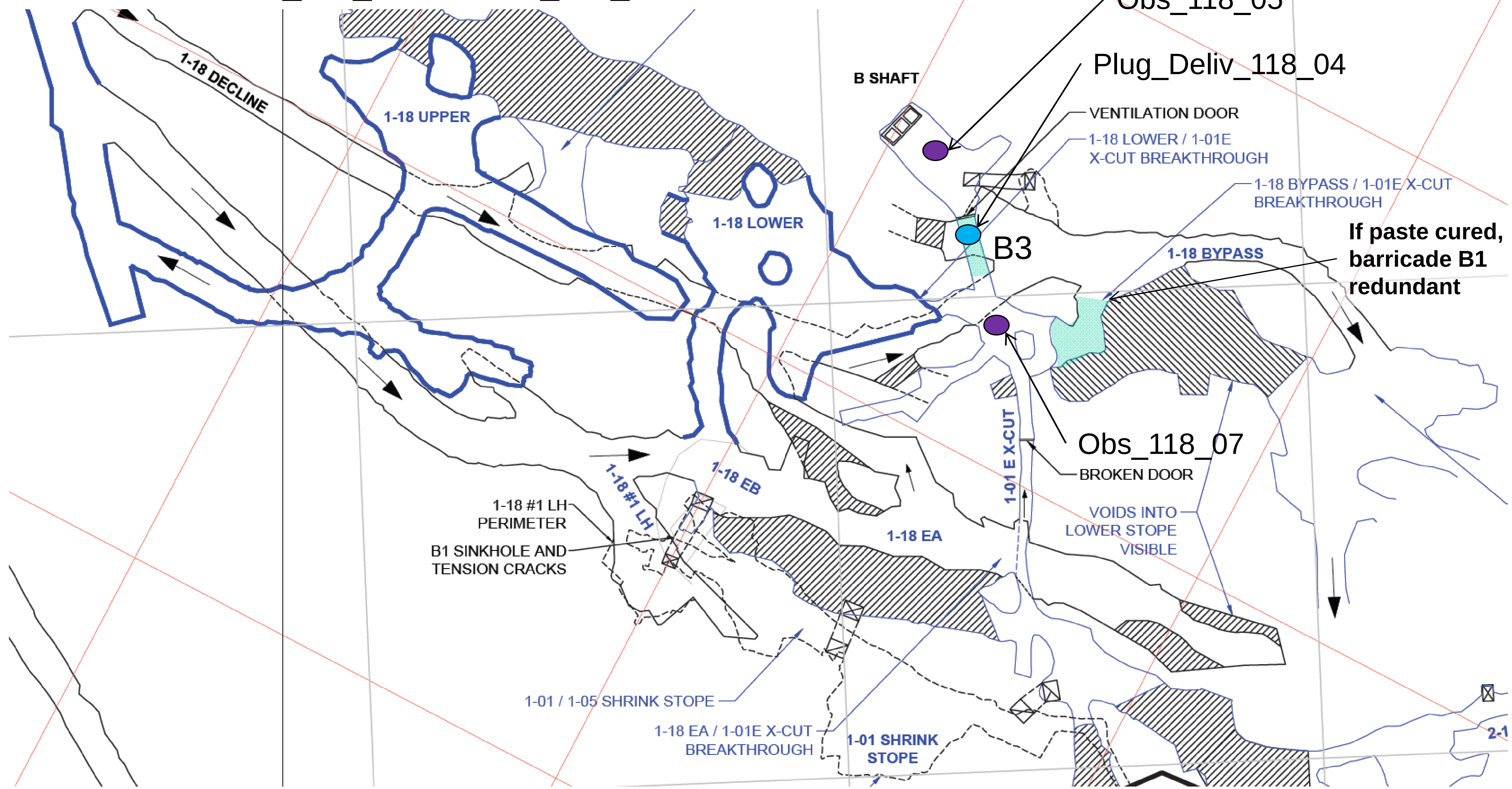
Delivery hole

Observation camera

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Step 2

Golder Associates				
PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13	Page 12	
REVIEW				

- **Step 3 - Build borehole barricade B3 using low slump paste and/or foam injected into D_118_04 so that paste cannot get into the B Shaft from later stages**
- Observe leaks from Obs_118_07 and Obs_118_05.



DRAFT

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

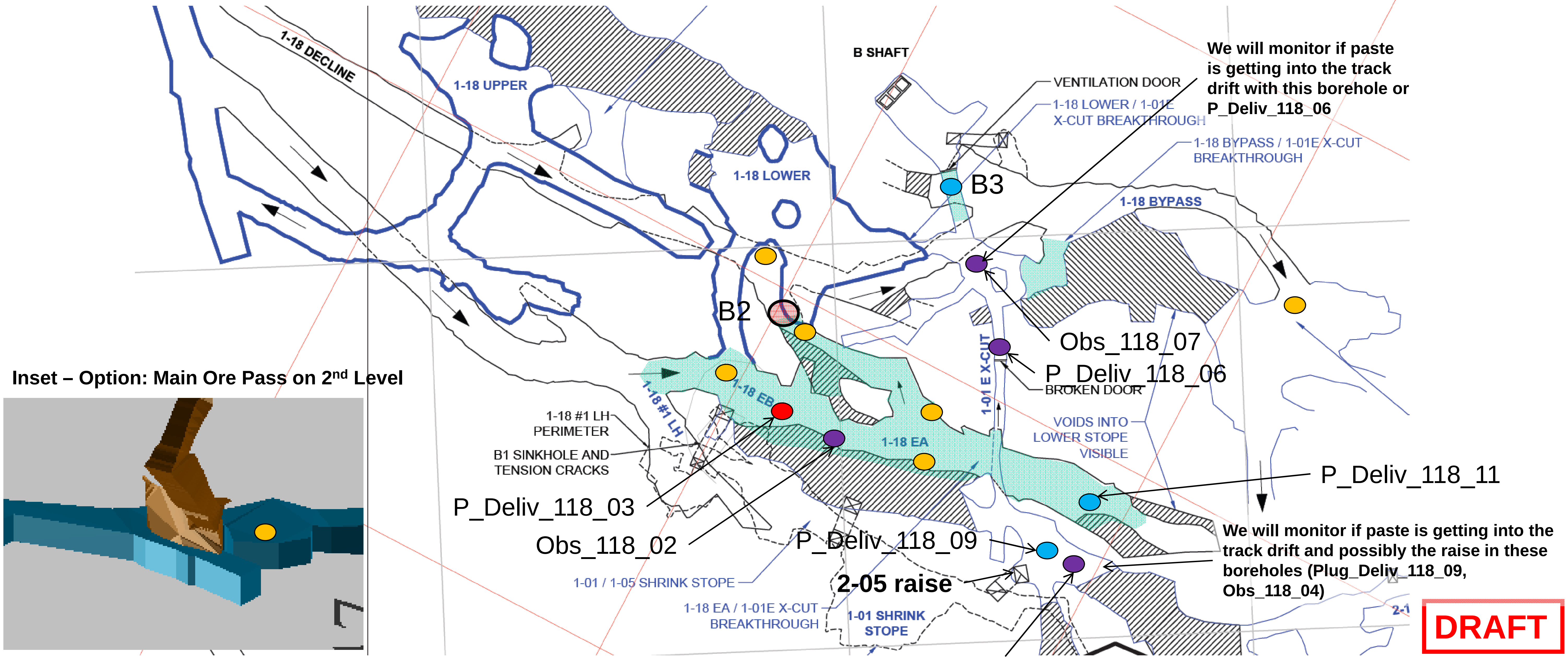
U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT		
TITLE	B1-18 Stope Backfill Plan – Step 3		
Golder Associates	PROJECT No. 10-1426-0010	PHASE No. 1000	
	DESIGN DTK 24SEP13	SCALE N.T.S.	REV. A
	CADD DTK/FM 04OCT13	Page 13	
	CHECK DTK/FM 29OCT13		
	REVIEW		

- **Step 4 -** Start backfilling 1-18 EA from surface borehole D_118_03 with high slump paste.
- If this paste cant get to the north, we could also inject in D_118_11, Obs_118_02 and eventually D_118_06 later.
- We will use high slump paste to fill the lowest area up until the point where we think it is spilling out down the 2-05 raise, then stop and determine the next step.



Inset – Option: Main Ore Pass on 2nd Level

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

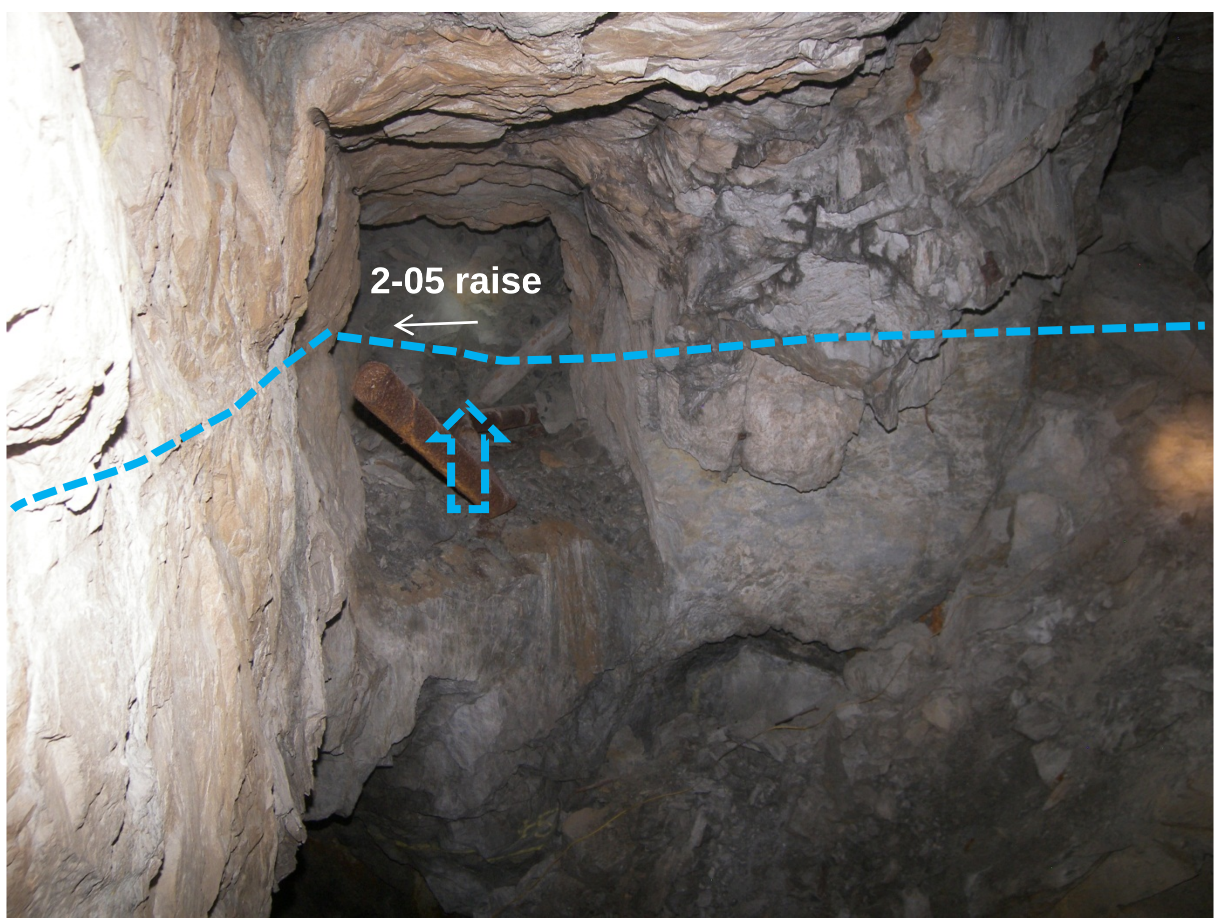
PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 4

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13	Page 14	
REVIEW				

FILE: \\golder.gds\gal\burnaby\Active_2013\1426\13-1426-0010 Giant Mining Support Services\1000 - MSS-003 Detailed Planning



- Start backfilling 1-18 EA from surface boreholes
- Because we cant safely access the 2-05 raise area, we will use high slump paste to fill the lowest area up until the point where we think it is spilling out down the raise.
- We can get the fill into the northern portion of 1-18 EA where it goes under the track drift as seen in the photos
- Once the fill gets to the point of the blue line, it can spill down the track drift and we will need to stop pumping and let the paste setup.
- We will also have to have cameras on the 2nd level where the ore pass is intersected to check for paste entering the raise.

DRAFT

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT			
TITLE	B1-18 Stope Backfill Plan – Step 4			
PROJECT No.	10-1426-0010	PHASE No.	1000	
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
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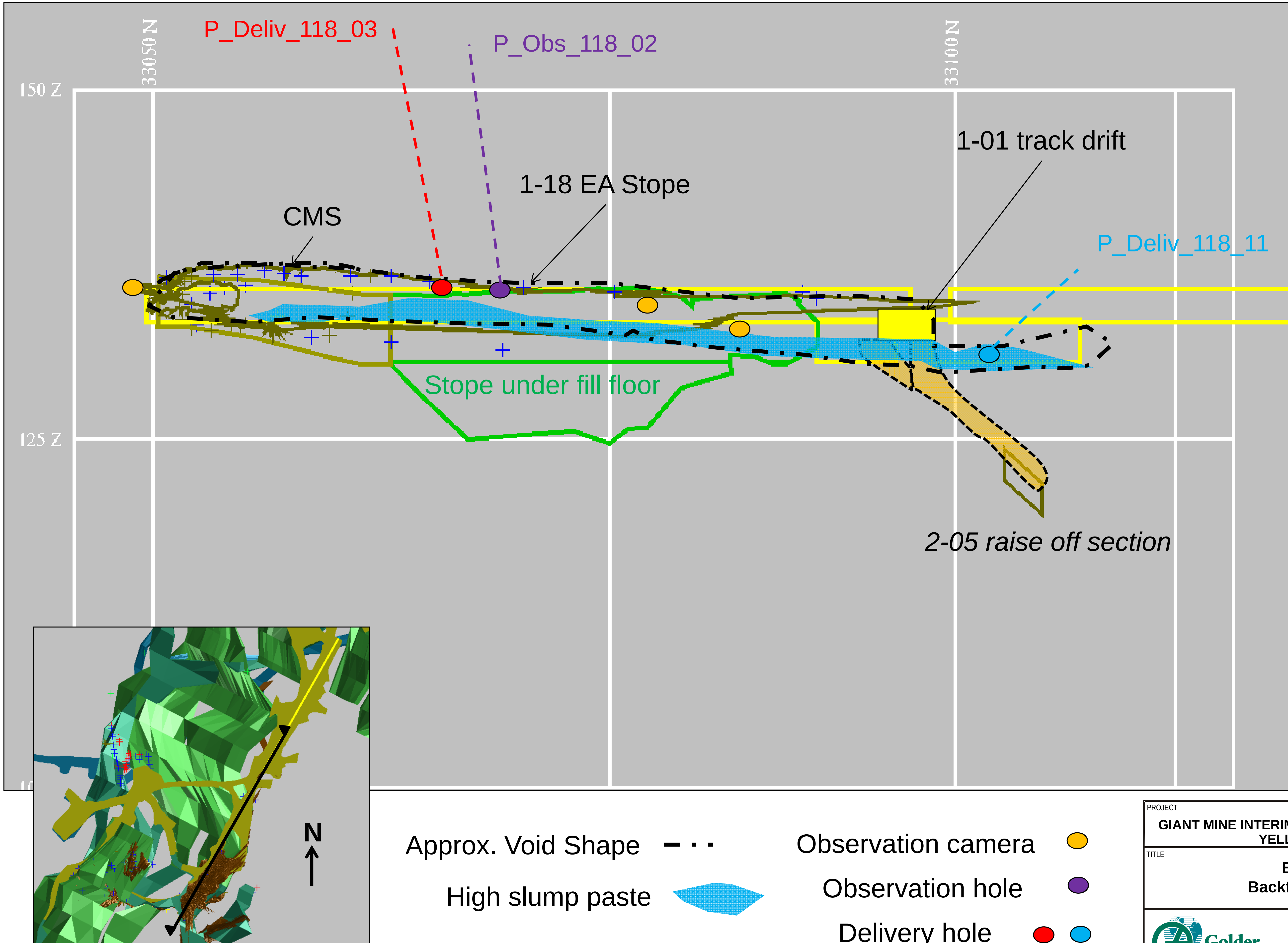
CHECK	DTK/FM	29OCT13		
REVIEW				

Golder Associates



Approx. Void Shape
High slump paste
Observation camera
Observation hole
Delivery hole

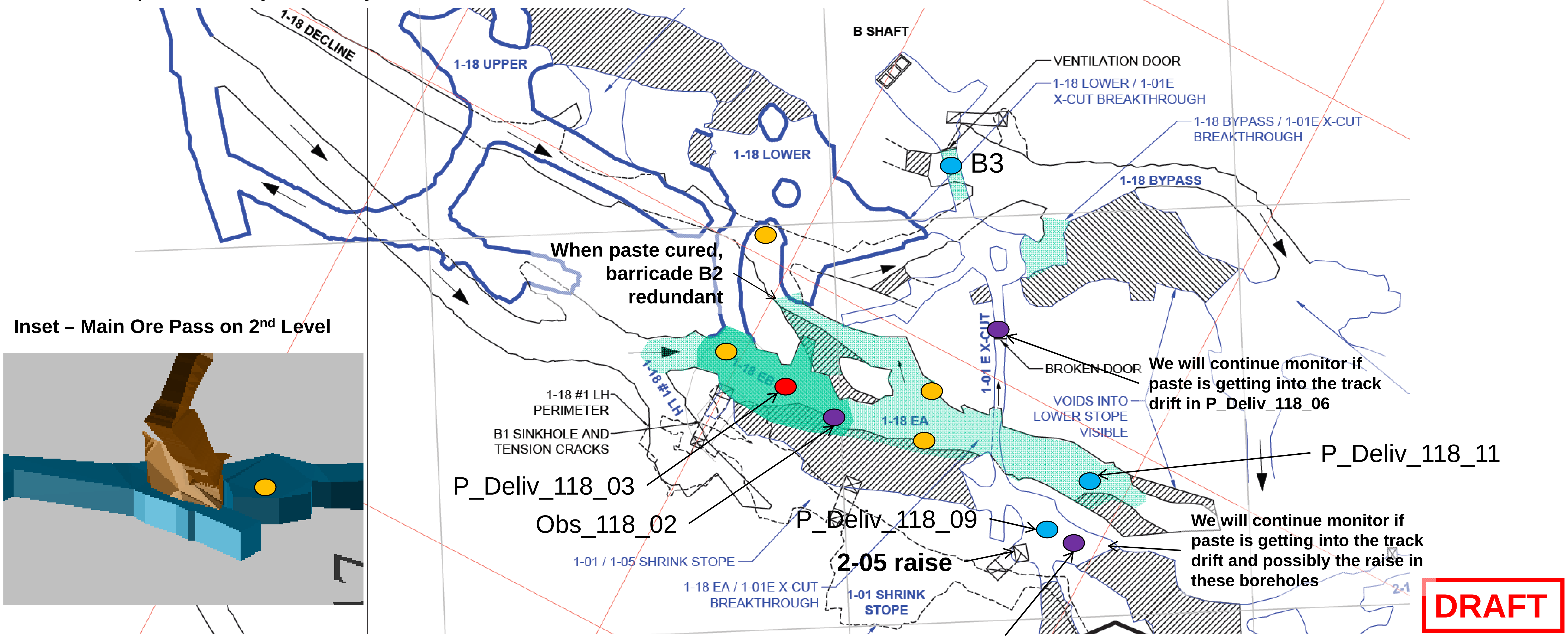
DRAFT

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Step 4

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000	
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13	Page 16	
CHECK	DTK/FM	29OCT13		
REVIEW				

- **Step 5 -** Pump lower slump paste into P_Deliv_118_03 so that it does not flow into the track drift and the raise area into the north.
- This results in a partial filling of the northern portion of 1-18 EA but holes P_Deliv_118_11, Obs_118_02 and P_Deluv_118_06 can be used as complementary delivery holes later.



Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Step 5

Golder Associates

PROJECT No. 10-1426-0010			PHASE No. 1000	
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13	Page 17	
REVIEW				

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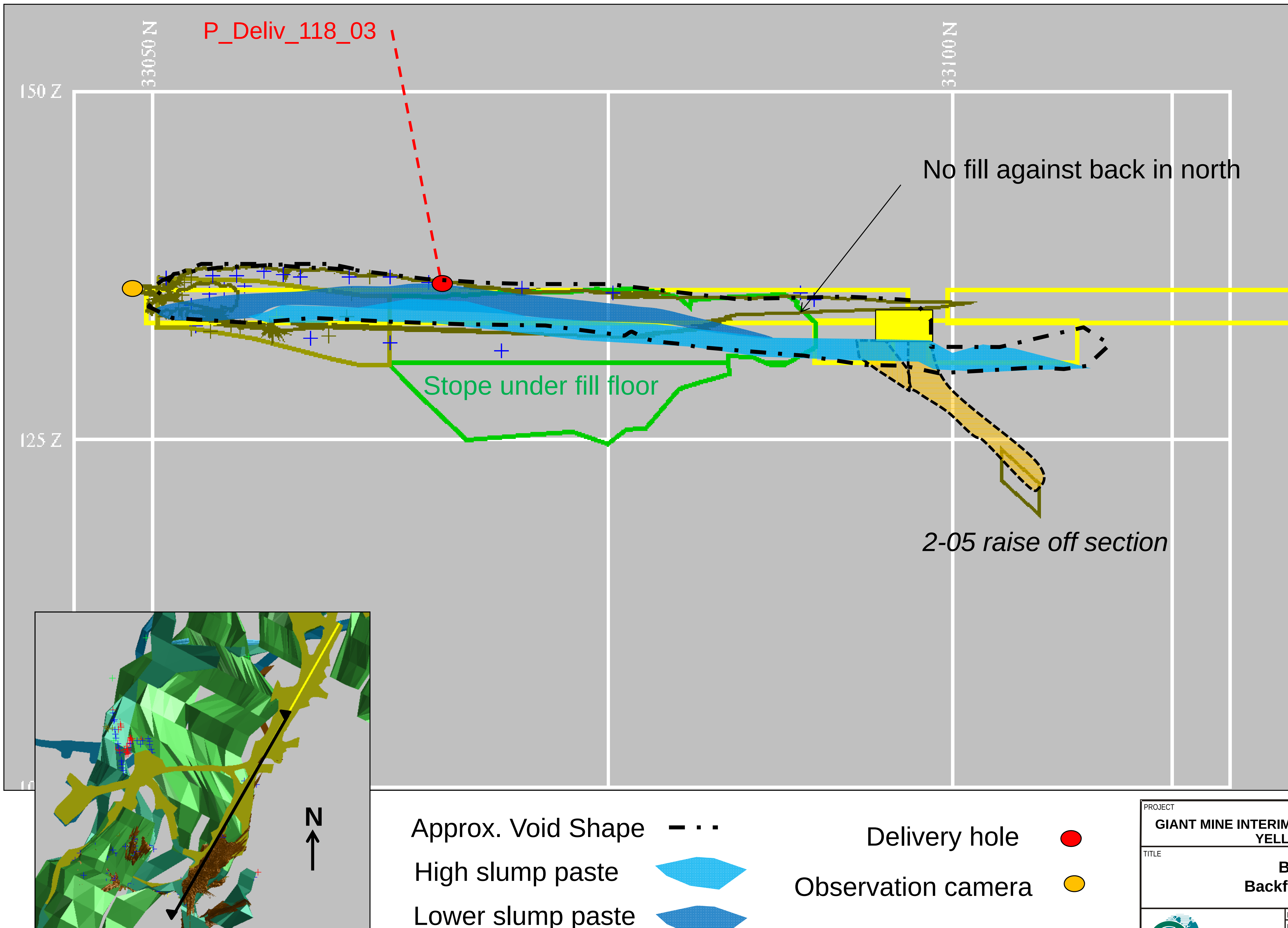

Approx. Void Shape

High slump paste

Lower slump paste

Delivery hole

Observation camera

DRAFT

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT		
TITLE	B1-18 Stope Backfill Plan – Step 5		
Golder Associates	PROJECT No. 10-1426-0010	PHASE No. 1000	
	DESIGN DTK 24SEP13	SCALE N.T.S.	REV. A
	CADD DTK/FM 04OCT13	Page 18	
	CHECK DTK/FM 29OCT13		
	REVIEW		

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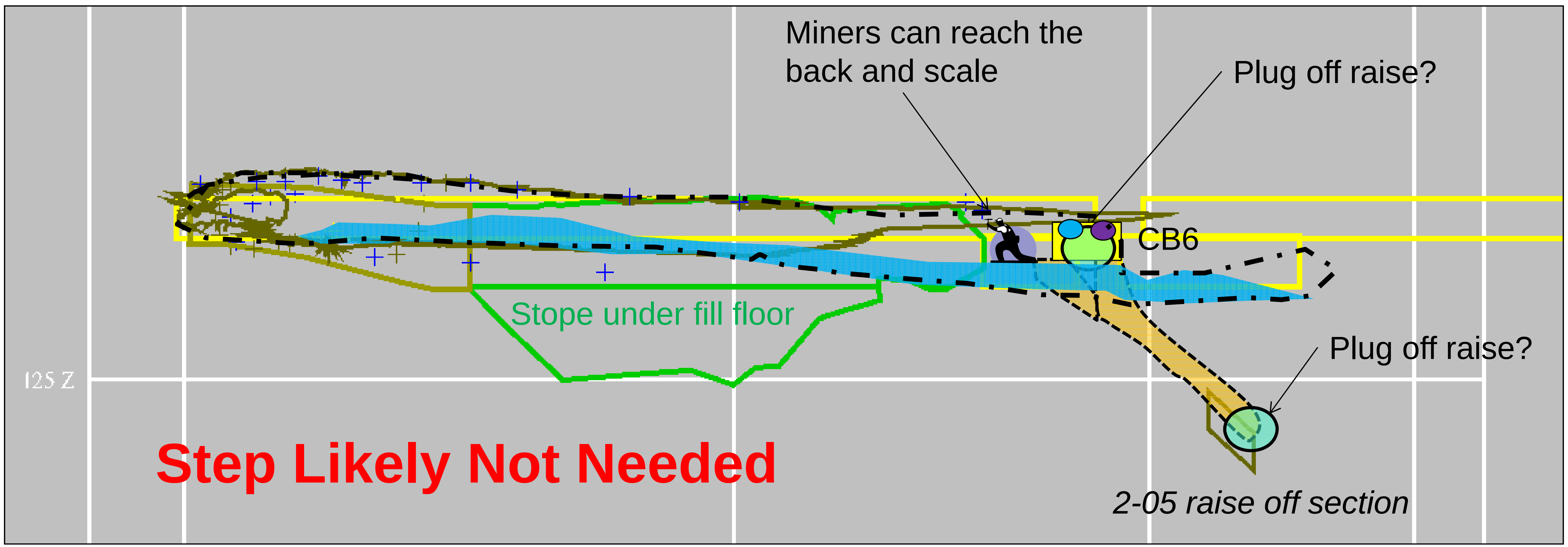
- **<u>Contingency</u> Step 5a – Plug the 2-05 ore pass and backfill remainder of 1-18 EA stope with high slump paste – *can only be done after geotechnical assessment and rehabilitation complete.***
- Once the paste gets to a higher level in the north end of 1-18 EA, allow miners to go into the stope because they might now be able to work off the fill, scale the back, re-gain access to the 2-05 raise area and plug the raise (barricade CB6), allowing us to continue on with filling high slump paste in this area to fill the entire stope fully.
- Alternatively the boreholes drilled from the pit Plug_Deliv_118_09 could be used to build a low slump plug at the raise area but because the mine plans are not complete in this area this is not likely to be a success.



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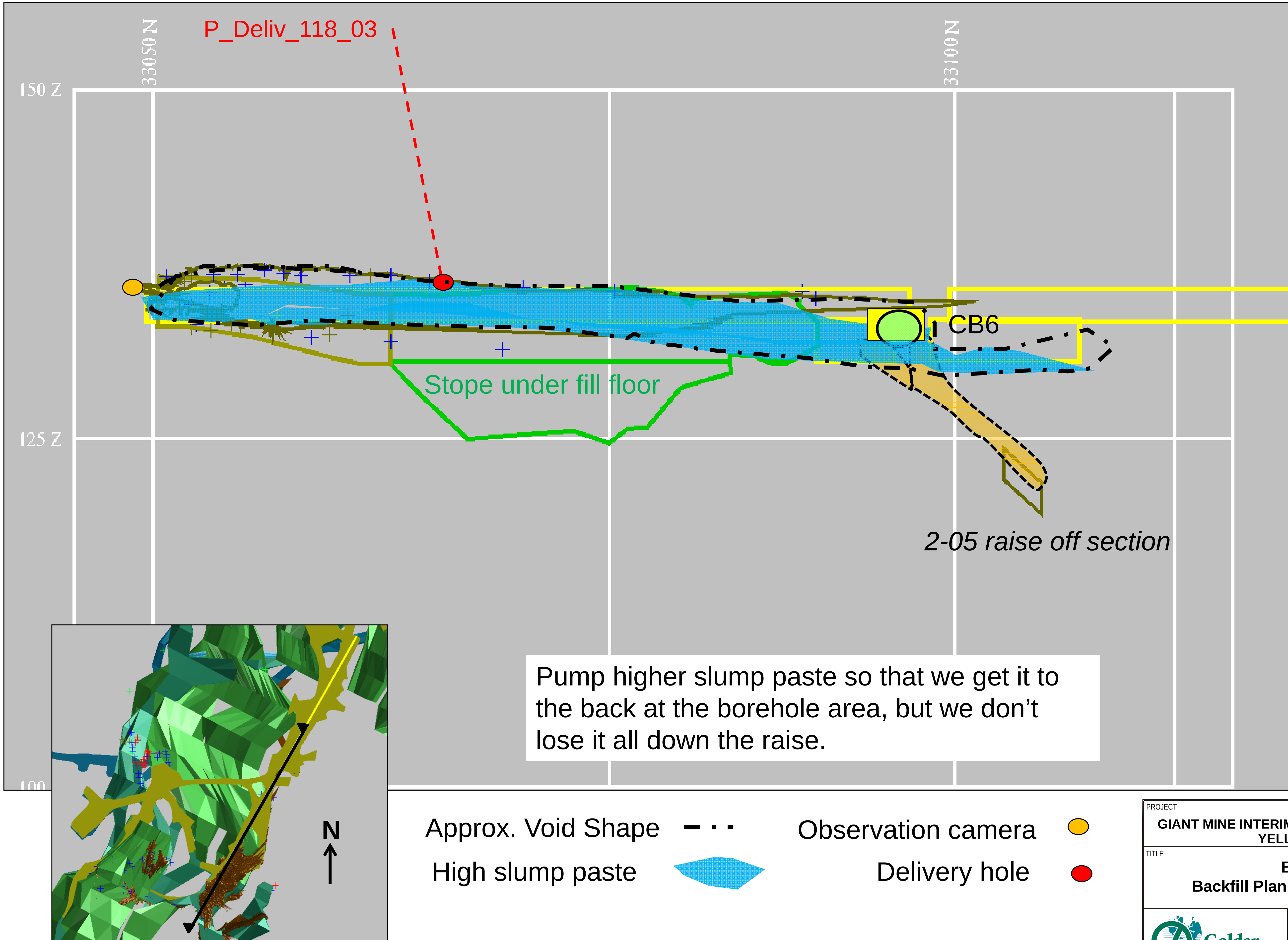
- Last option: look at blocking raise on 2nd level (foam?) then drilling a hole to intersect the ore pass from B1 pit floor and slowly filling

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT		
TITLE	B1-18 Stope Backfill Plan – Contingency Step 5a		
PROJECT No. 10-1426-0010		PHASE No. 1000	
DESIGN	DTK	24SEP13	SCALE N.T.S. REV. A
CADD	DTK/FM	04OCT13	
CHECK	DTK/FM	29OCT13	Page 19
REVIEW			

Golder Associates



Approx. Void Shape

High slump paste

Observation camera

Delivery hole

DRAFT

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Contingency Step 5a

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
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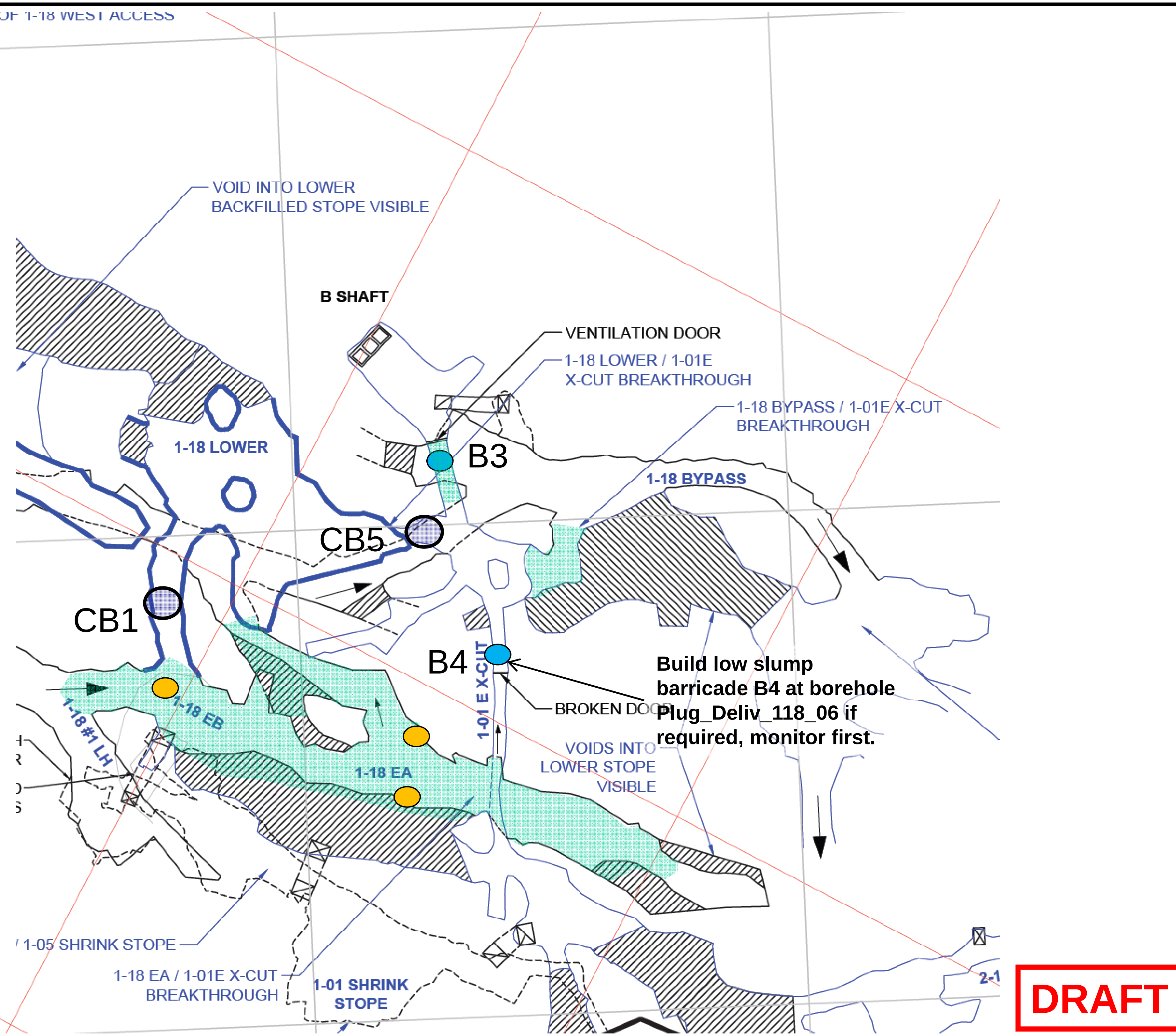
REVIEW				

FILE: \\golder.gds\gal\burnaby\Active_2013\1426\13-1426-0010 Giant Mining Support Services\1000 - MSS-003 Detailed Planning

- ***Contingency*** **Step 5b**
- If we cannot keep paste out of the raises, or we cannot complete step 5, we could build borehole bulkhead B4 and one or even two additional conventional barricade and abandon filling the remainder of 1-18 EA.
- We may not need barricade 4 as the paste might not flow this far and it likely remains a simple observation hole. We would delay building borehole barricade 4 until we see paste during 1-18 Lower, then build it only if necessary.
- Once the contingency barricades are built, go to the next step (1-18 Lower backfill).
- Also, if we can get a stability assessment and get suitable ground support designed and installed for 1-18 lower stope, we could eliminate the need for barricade B3 and B4 with barricade CB5 – but this has not yet been fully assessed.



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Underground paste delivery pipe

Conventional barricade

Contingency barricade

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Contingency step 5b

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13		
REVIEW				

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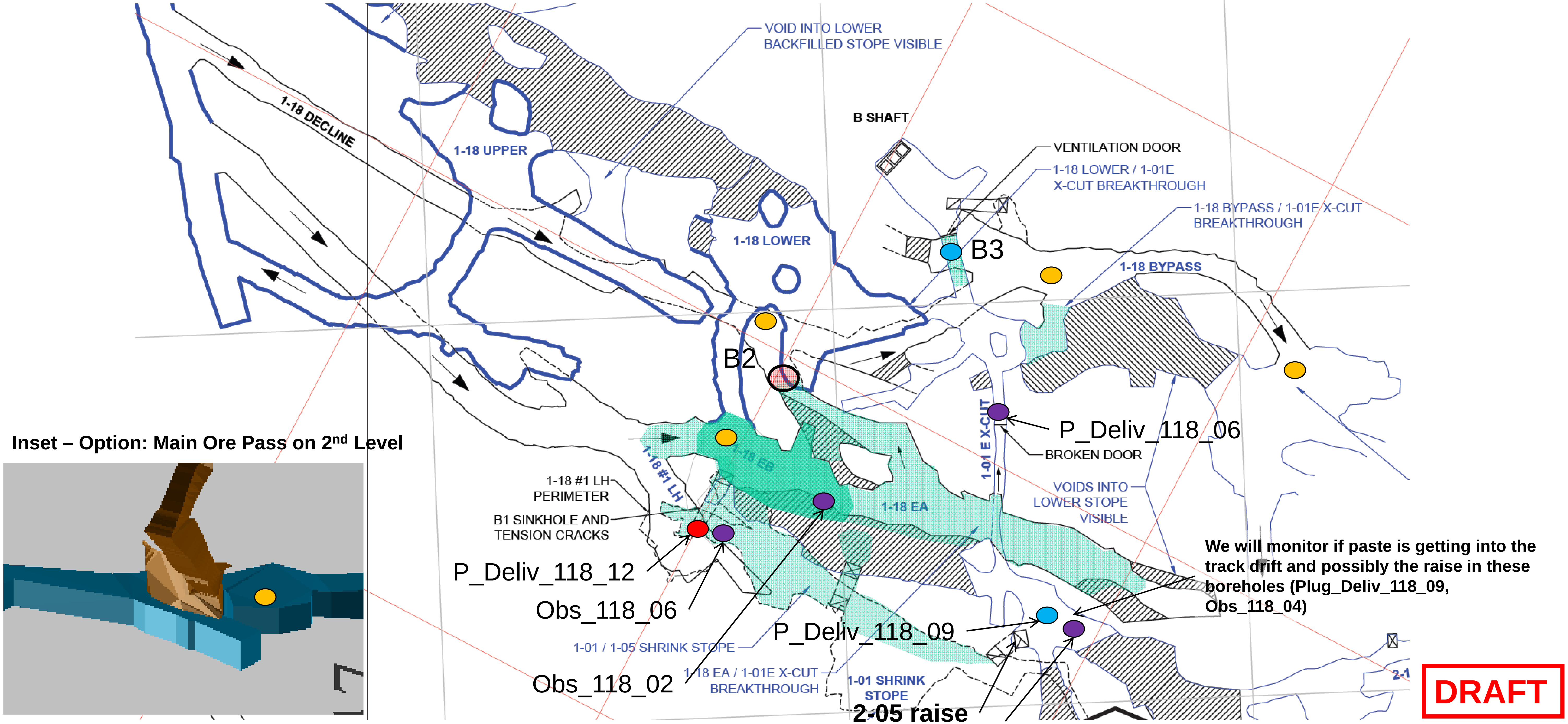
- **Step 6 -** Backfill 1-01 Shrink stope from P_Deliv_118_12 and observe from Obs_118_06 and Obs_118_02 (if accessible). Some paste will leak through the raises and fill some remaining voids in 1-18 EA.



Inset – Option: Main Ore Pass on 2nd Level

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT			
TITLE	B1-18 Stope Backfill Plan – Step 6			
Golder Associates	PROJECT No.	10-1426-0010	PHASE No.	1000
	DESIGN	DTK 24SEP13	SCALE N.T.S.	REV. A
	CADD	DTK/FM 04OCT13	Page 22	
	CHECK	DTK/FM 29OCT13		
	REVIEW			

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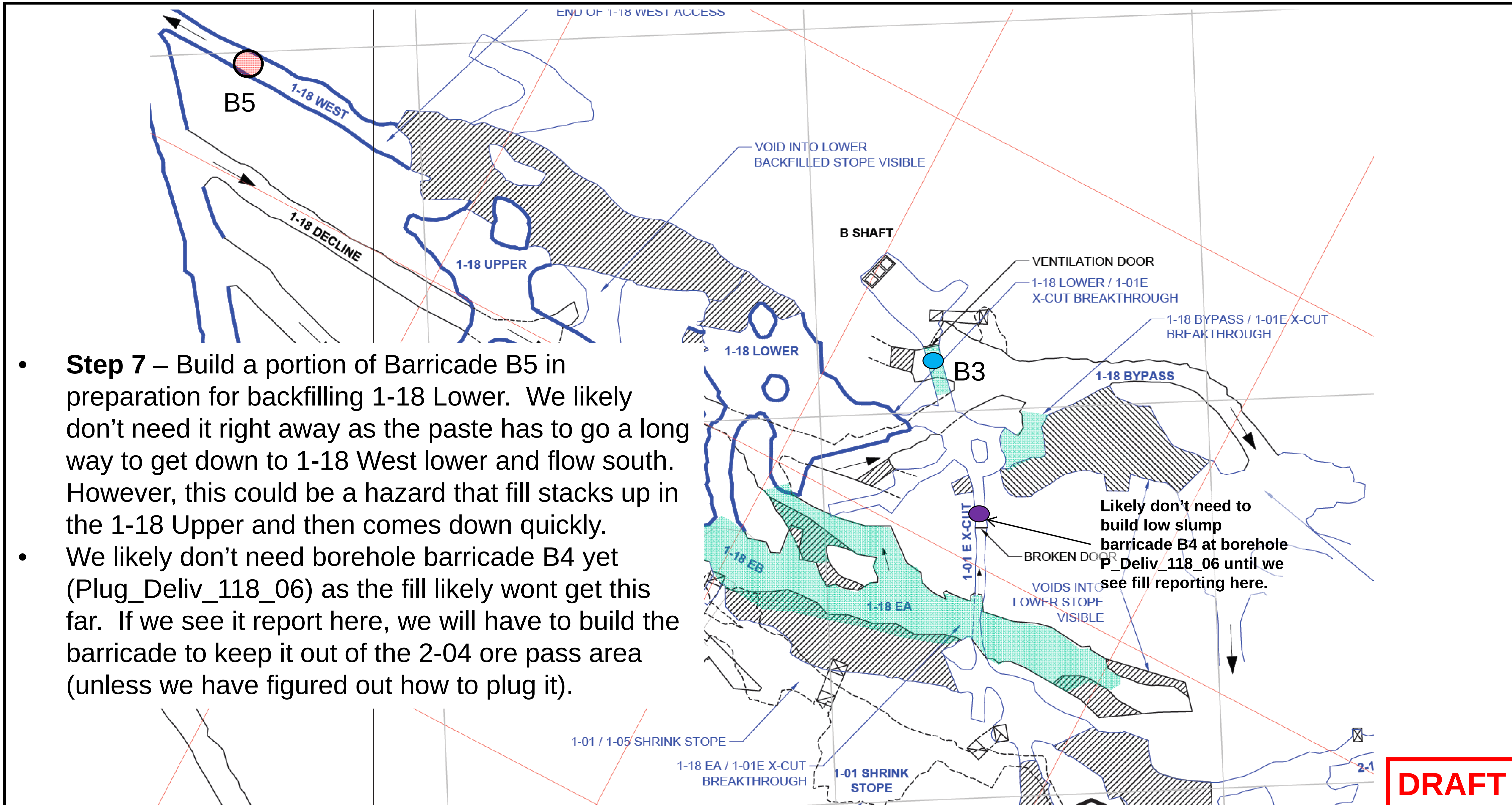

- **Step 7** – Build a portion of Barricade B5 in preparation for backfilling 1-18 Lower. We likely don't need it right away as the paste has to go a long way to get down to 1-18 West lower and flow south. However, this could be a hazard that fill stacks up in the 1-18 Upper and then comes down quickly.
- We likely don't need borehole barricade B4 yet (Plug_Deliv_118_06) as the fill likely wont get this far. If we see it report here, we will have to build the barricade to keep it out of the 2-04 ore pass area (unless we have figured out how to plug it).

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT		
TITLE	B1-18 Stope Backfill Plan – Step 7		
Golder Associates	PROJECT No. 10-1426-0010	PHASE No. 1000	
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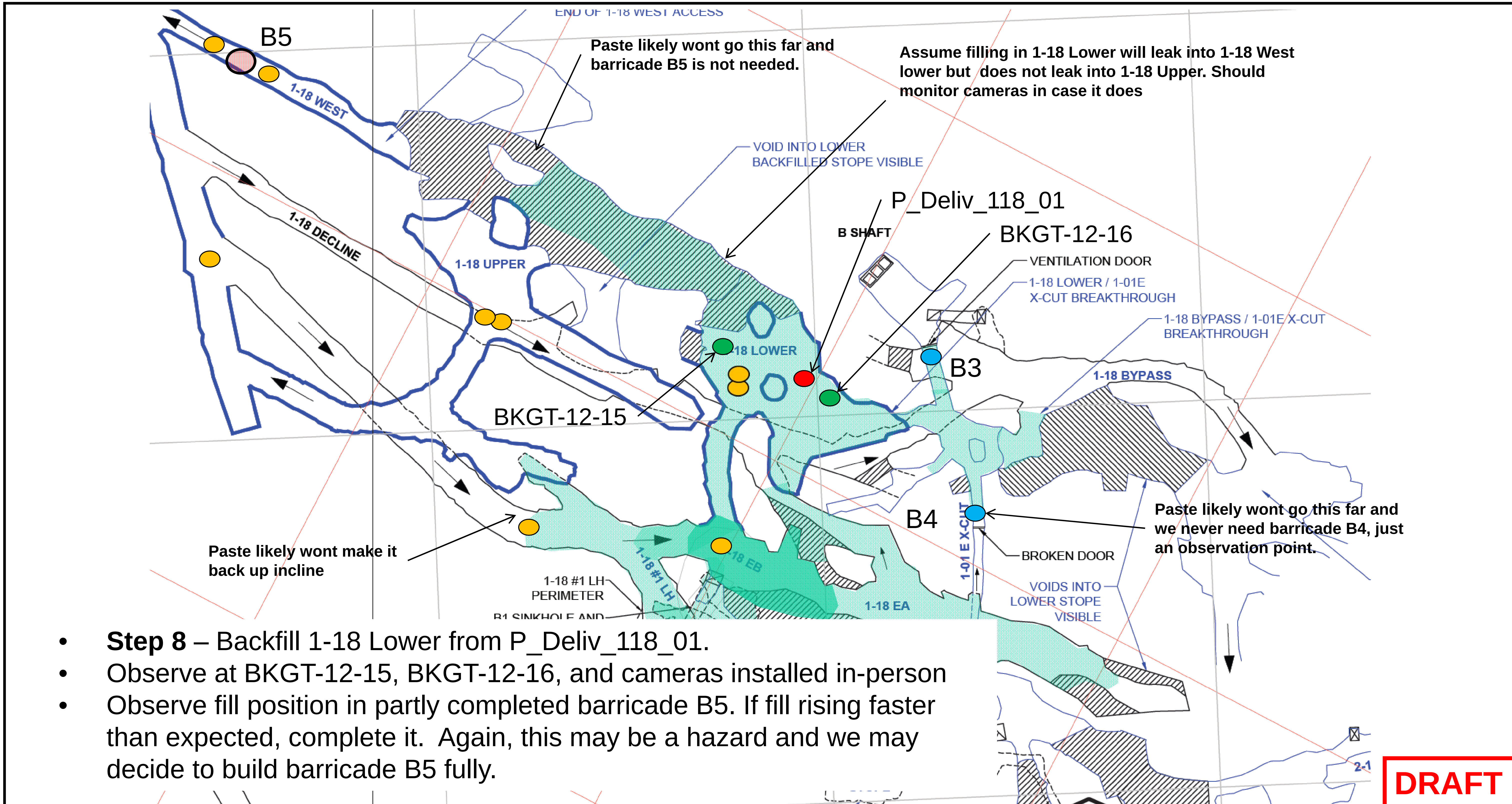

- **Step 8** – Backfill 1-18 Lower from P_Deliv_118_01.
- Observe at BKGT-12-15, BKGT-12-16, and cameras installed in-person
- Observe fill position in partly completed barricade B5. If fill rising faster than expected, complete it. Again, this may be a hazard and we may decide to build barricade B5 fully.

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

2012 Geotechnical boreholes

Borehole low slump or foam barricade

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 8

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
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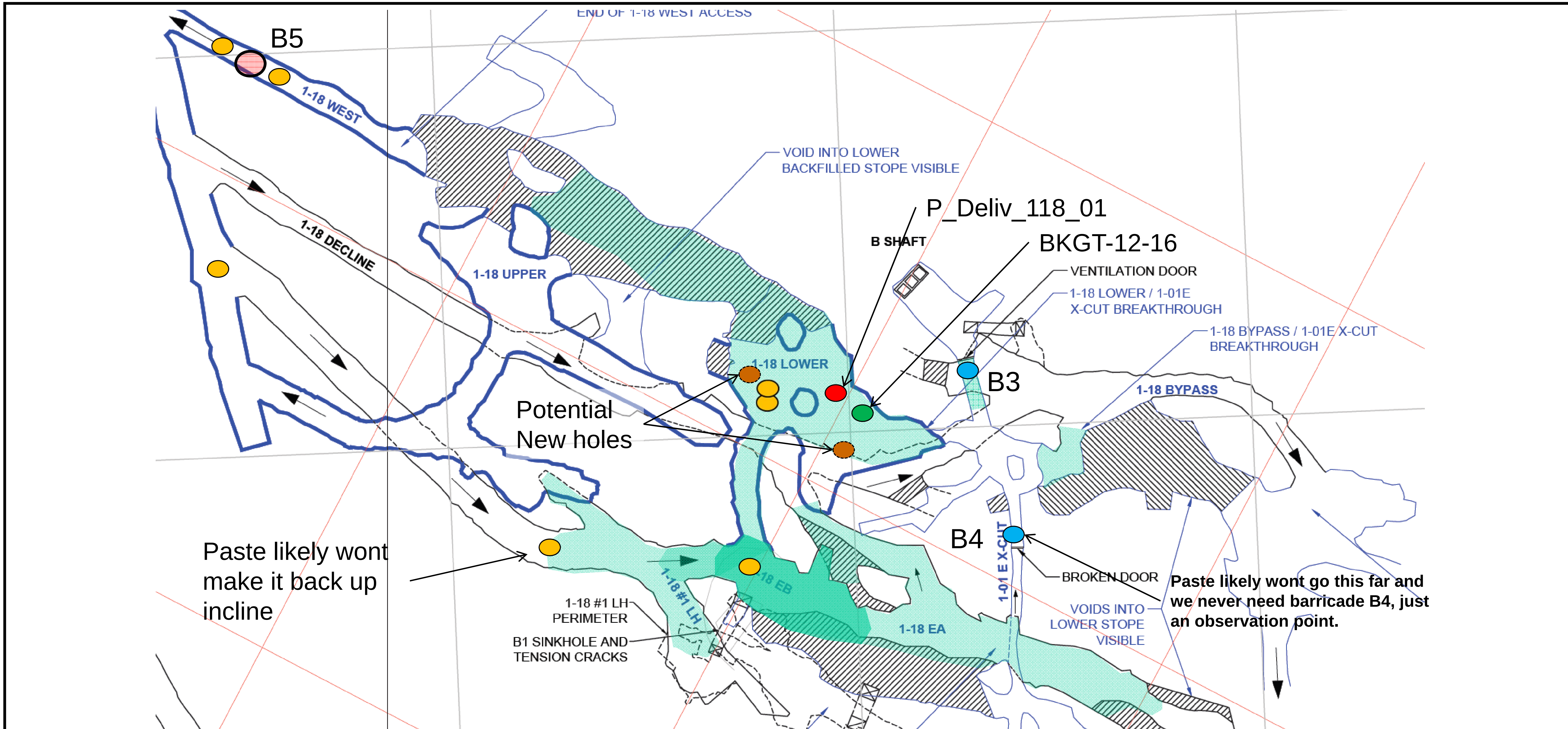

- **<u>Contingency</u> Step 8a** – If the fill does not reach the highest spot of 1-18 Lower or partially fill the stope, drill two new holes (confirmatory/delivery).
- Observe from BKGT-12-16 and from the new delivery holes after each pour.

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

2012 Geotechnical boreholes

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Contingency Step 8a

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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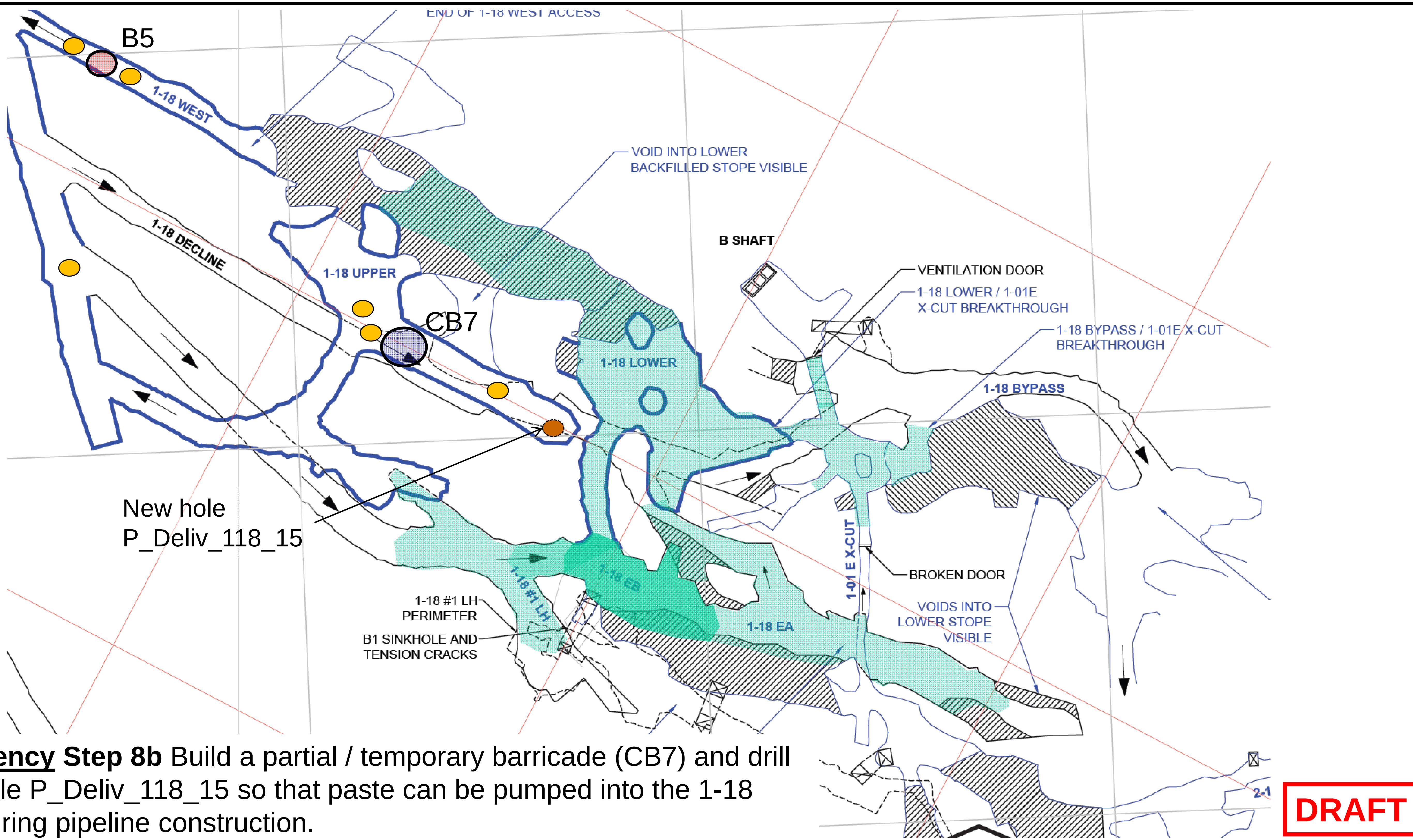

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<u>Contingency</u> Step 8b Build a partial / temporary barricade (CB7) and drill a new hole P_Deliv_118_15 so that paste can be pumped into the 1-18 Upper during pipeline construction.

Underground paste delivery pipe

Contingency-temporary barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

2012 Geotechnical boreholes

Borehole low slump or foam barricade

PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Contingency Step 8b

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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REVIEW			

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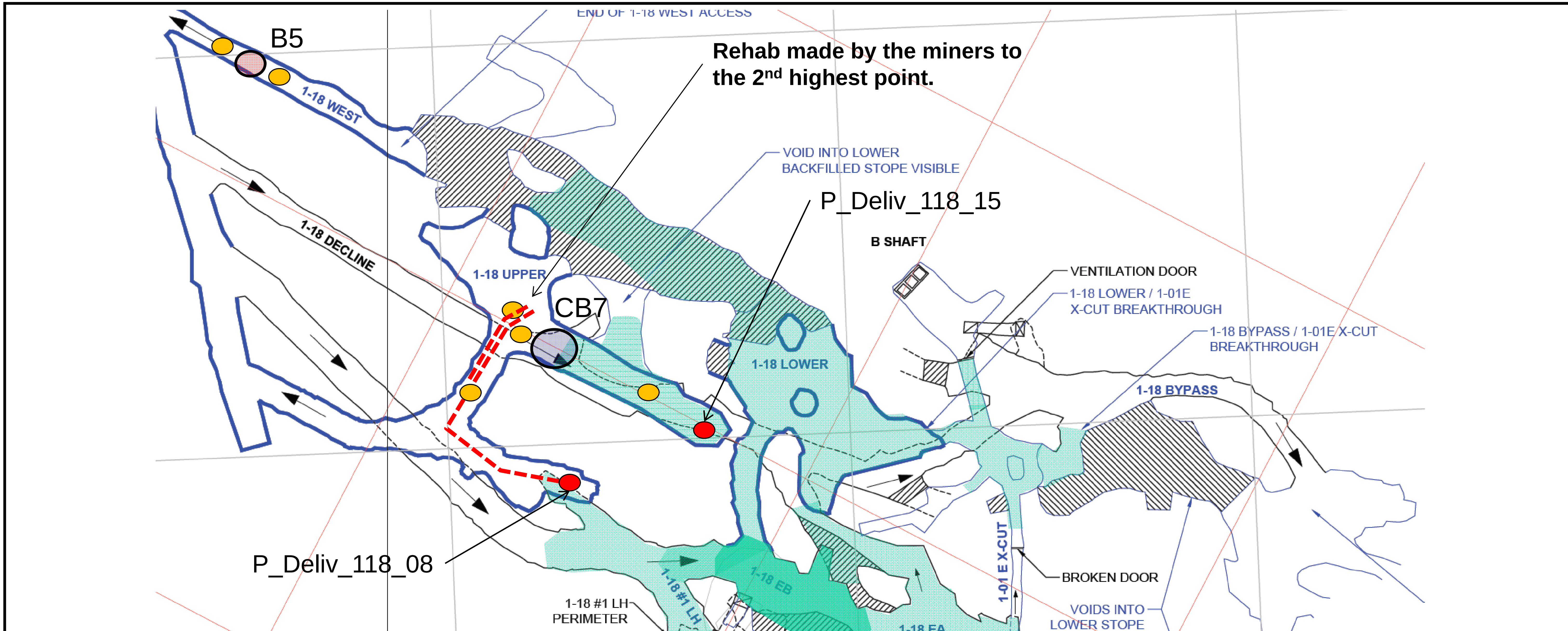

Step 9 – Install paste delivery pipeline into back of 1-18 Upper Stope to the 2nd highest point + a sacrificial pipe (contingency).
Concurrently fill the northern arm of 1-18 Upper (P_Deliv_118_15) if CB7 is built.
Paste fill is monitored by cameras.
Paste is likely to flow down toward voids in the 1-18 Upper stope first. No one works on the pipelines when the paste is building up behind the barricade.

DRAFT

Underground paste delivery pipe
Conventional barricade
Sub-vertical primary fill delivery surface hole
U/G monitoring camera installed in-person
Borehole camera monitoring / secondary paste fill hole(s)
Borehole low slump or foam barricade

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 9

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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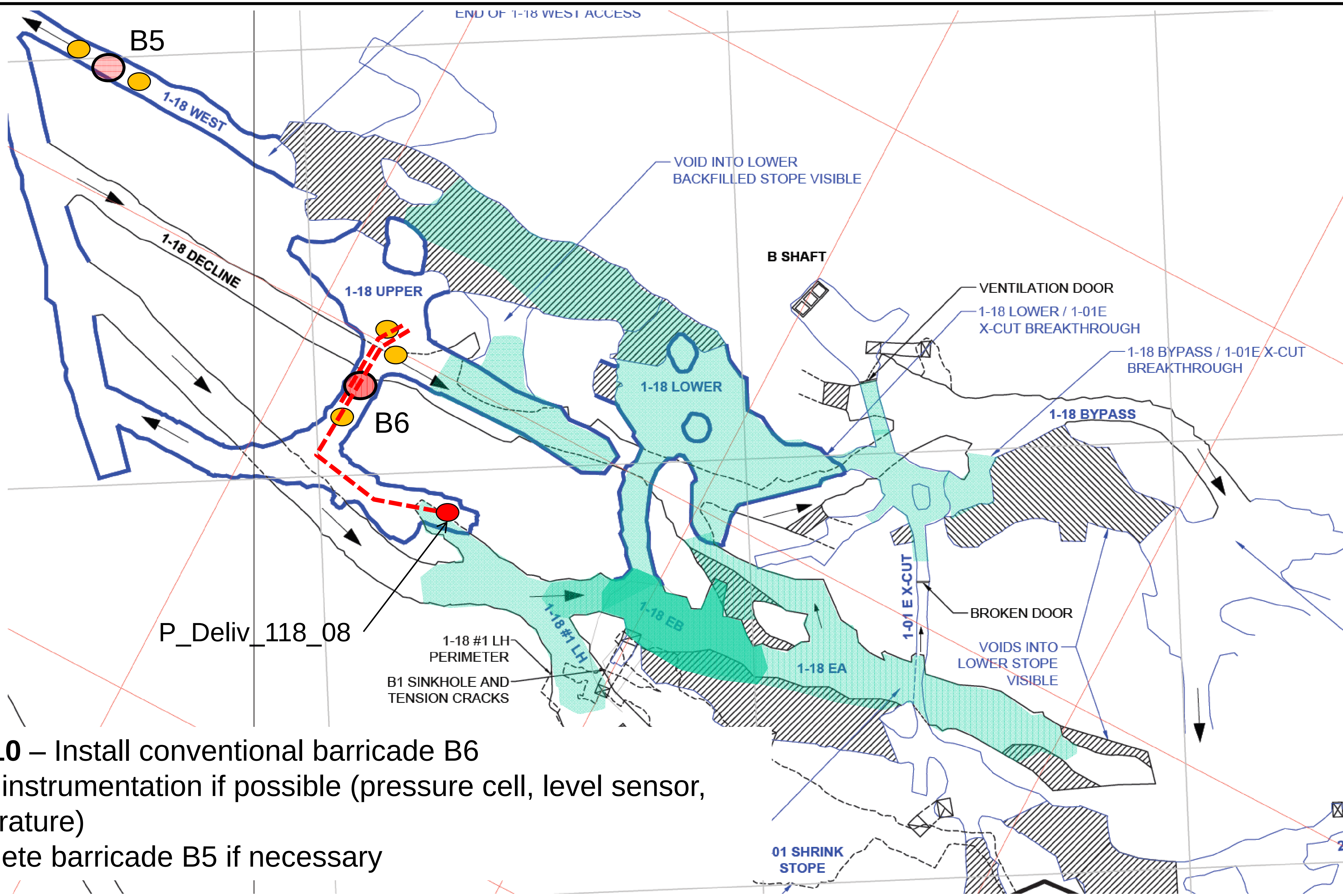

- **Step 10** – Install conventional barricade B6
- Install instrumentation if possible (pressure cell, level sensor, temperature)
- Complete barricade B5 if necessary

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 10

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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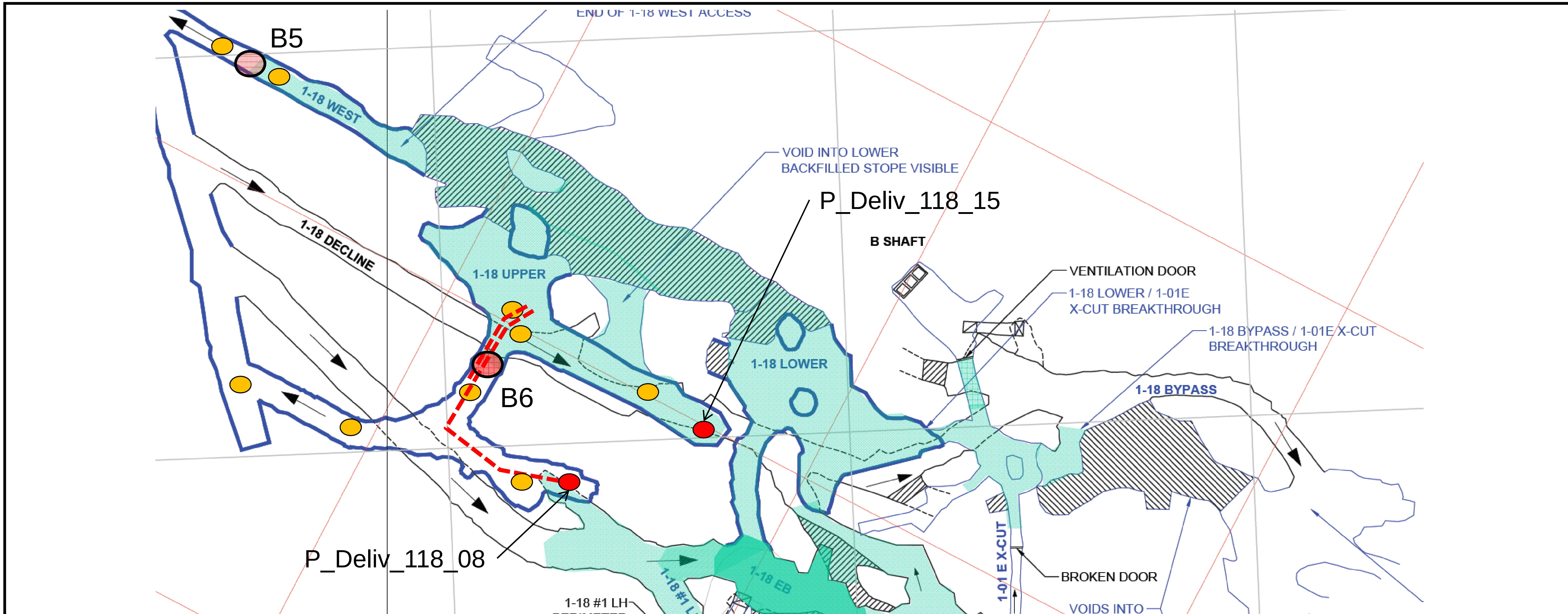

- **Step 11** – Backfill 1-18 Upper from P_Deliv_118_08, P_Deliv_118_15 (if drilled) and fill pipeline using high slump paste.
- Observe at cameras installed in-person.
- This barricade is needed as we want to be able to keep access to the intersection of the fill borehole and the pipe while filling the majority of the 1-18 Upper.

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	**PWGSC** **GIANT MINE INTERIM U/G STABILIZATION PROJECT** **YELLOWKNIFE, NWT**
TITLE	**B1-18 Stope** **Backfill Plan – Step 11**

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
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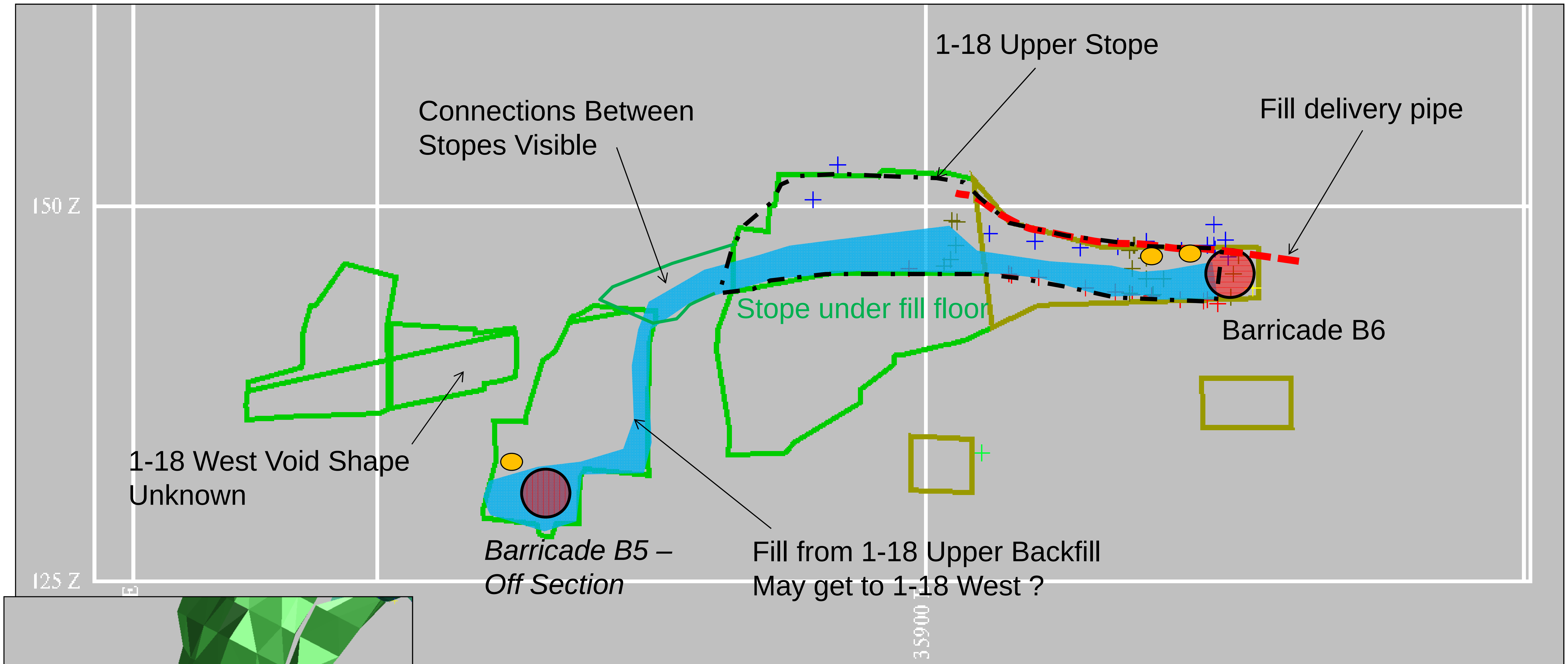
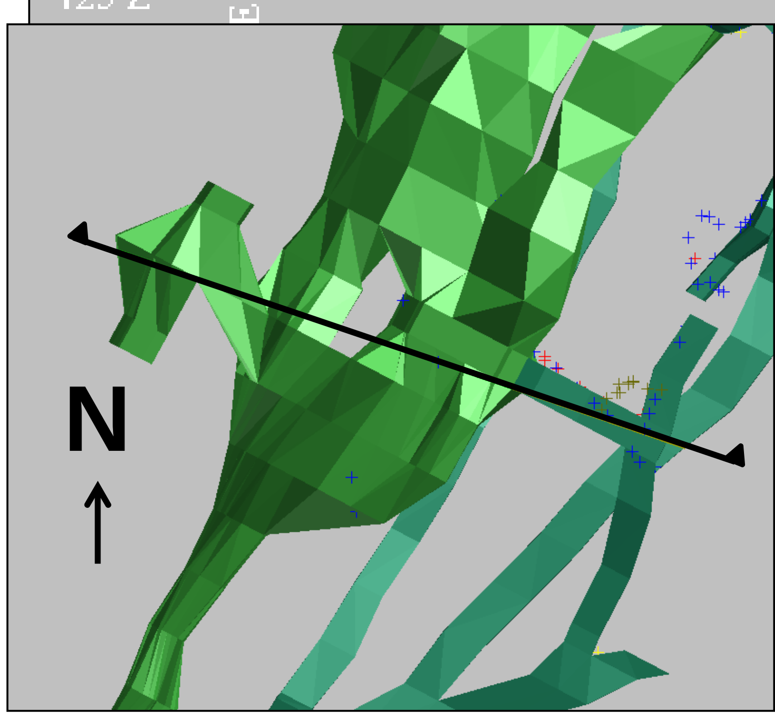
CHECK	DTK/FM	29OCT13	**Page 29**	
REVIEW				





Approx. Void Shape

High slump paste

Observation camera

DRAFT

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 11

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
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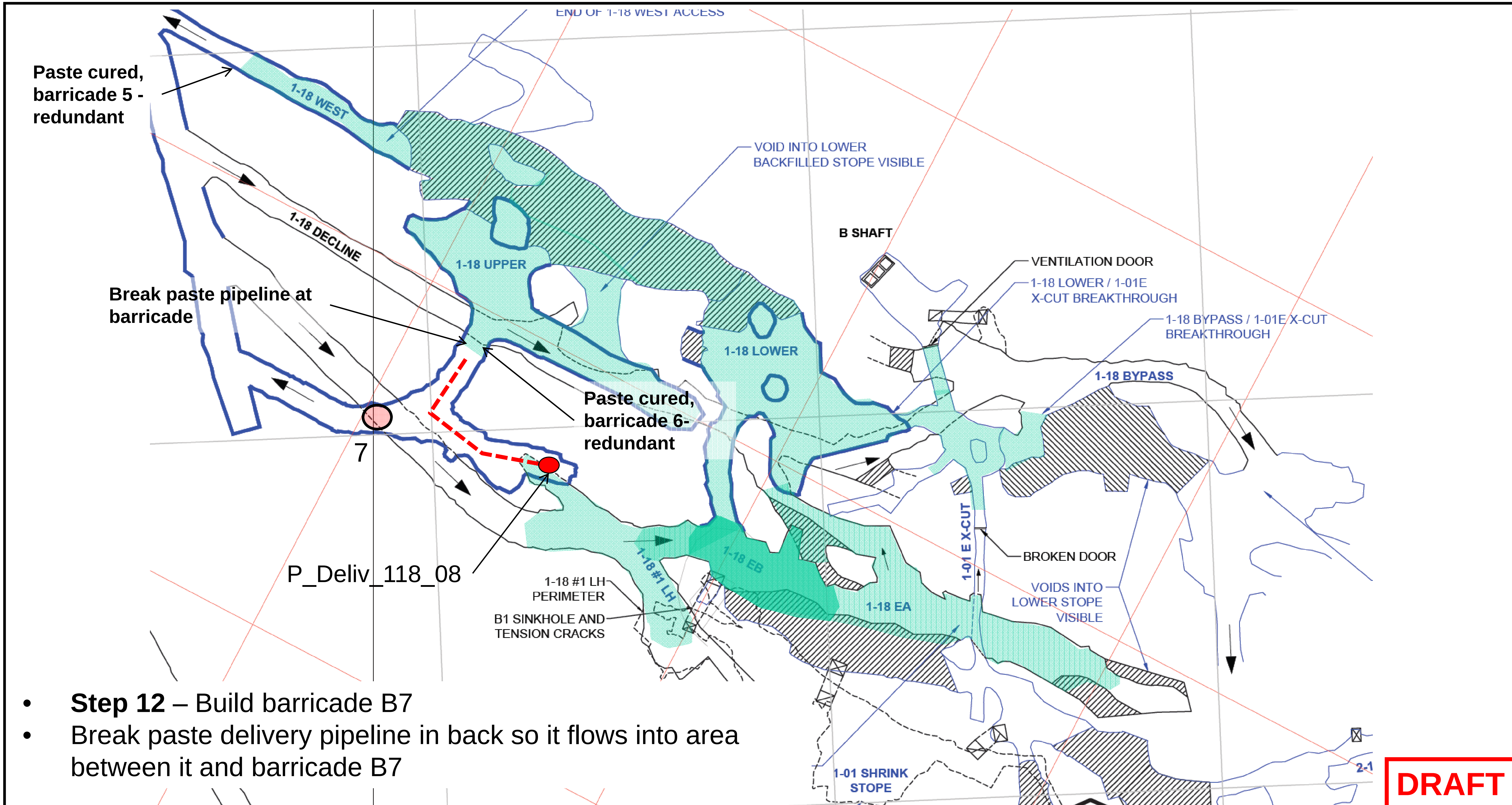
CHECK	DTK/FM	29OCT13		
REVIEW				

Page 30



- **Step 12** – Build barricade B7
- Break paste delivery pipeline in back so it flows into area between it and barricade B7

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT	**PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT**		
TITLE	**B1-18 Stope Backfill Plan – Step 12**		
Golder Associates	PROJECT No. 10-1426-0010	PHASE No. 1000	
	DESIGN DTK 24SEP13	SCALE N.T.S.	REV. A
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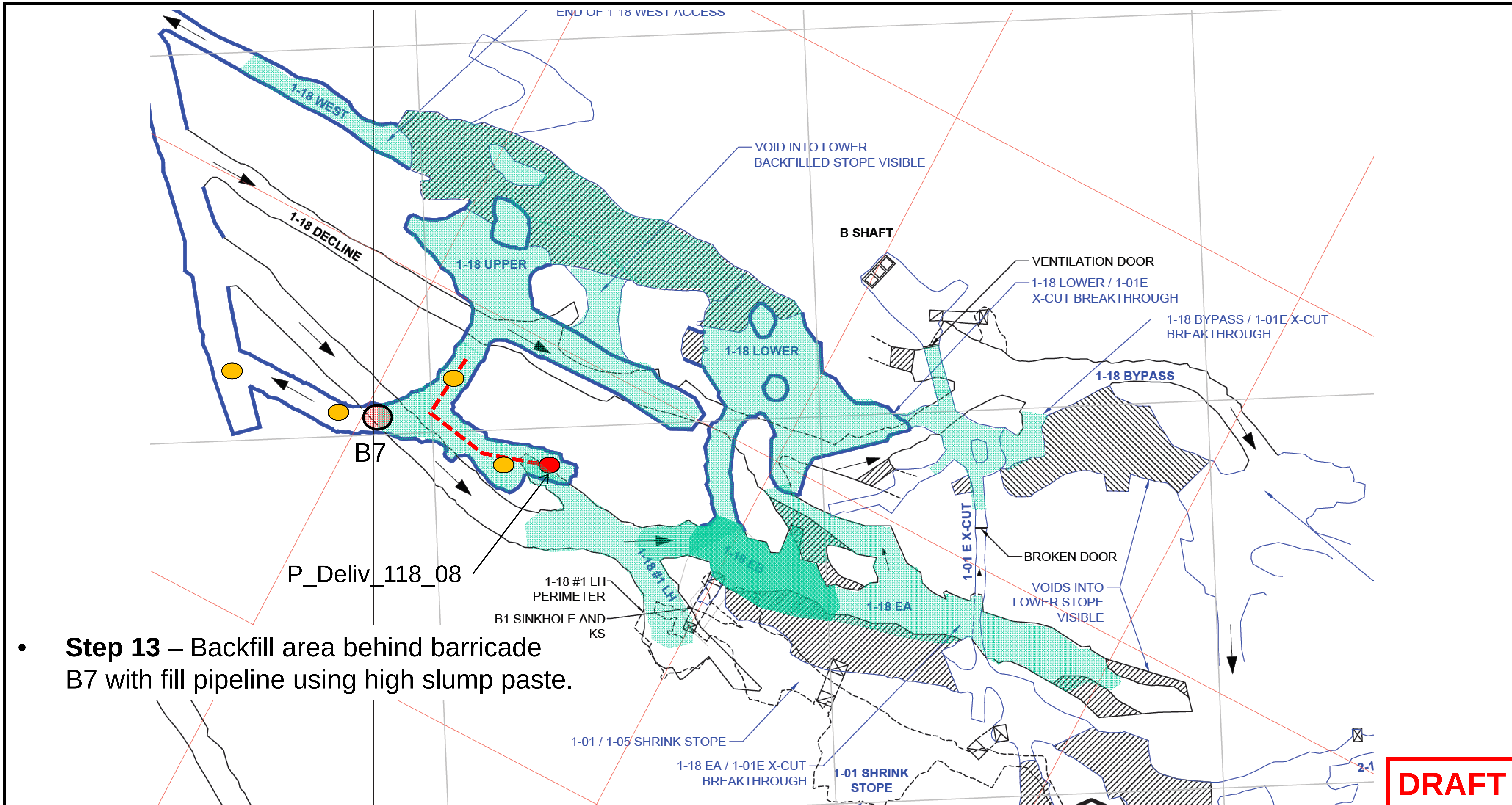

- **Step 13** – Backfill area behind barricade B7 with fill pipeline using high slump paste.

Underground paste delivery pipe

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

PROJECT
PWGSC
GIANT MINE INTERIM U/G STABILIZATION PROJECT
YELLOWKNIFE, NWT

TITLE
B1-18 Stope
Backfill Plan – Step 13

Golder Associates

PROJECT No.	10-1426-0010	PHASE No.	1000
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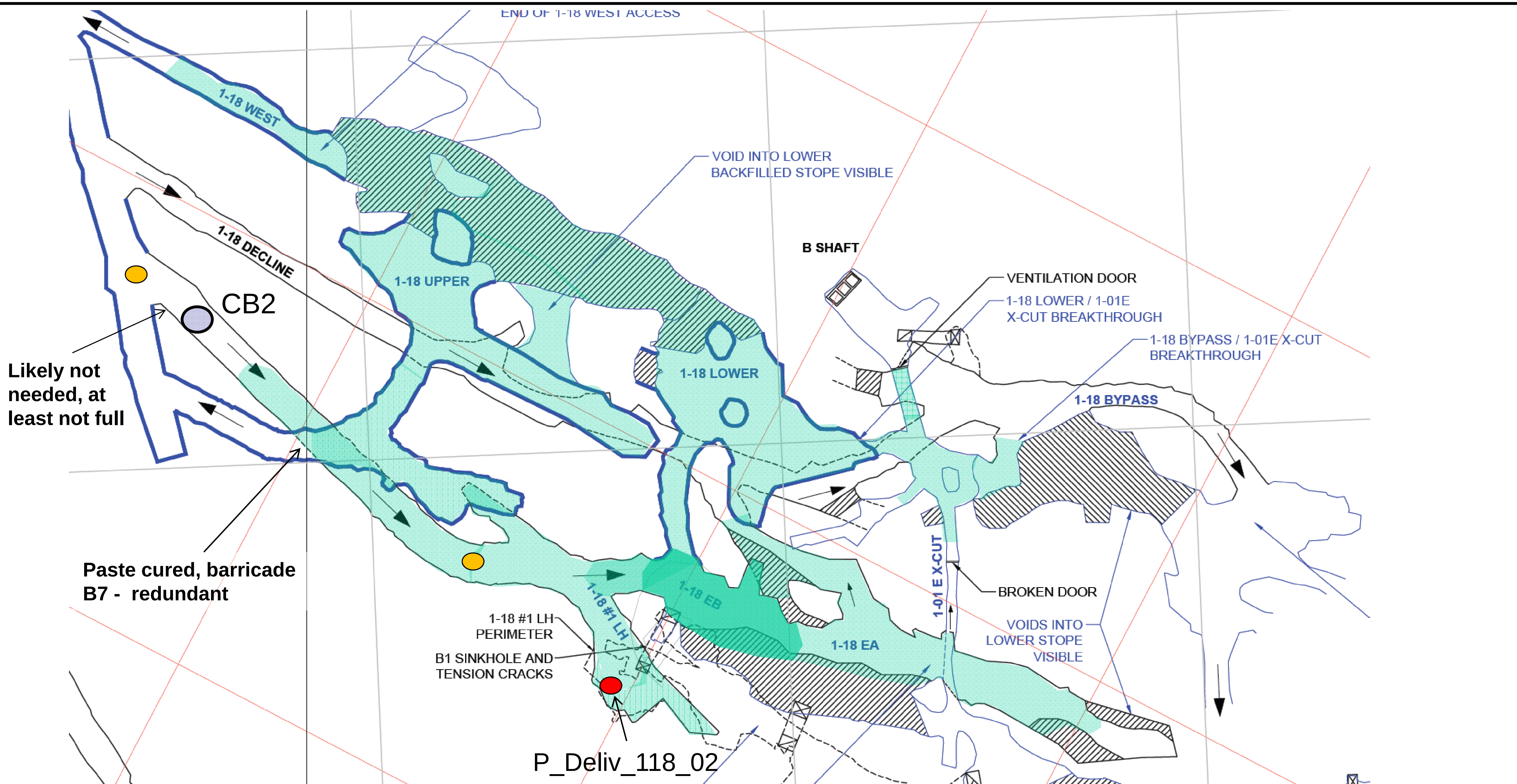
REVIEW			



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- **Step 14** – Top-Up 1-18 #1 Longhole Stope under sinkhole using D_118_02

Contingency barricade

Conventional barricade

Sub-vertical primary fill delivery surface hole

U/G monitoring camera installed in-person

Borehole camera monitoring / secondary paste fill hole(s)

Borehole low slump or foam barricade

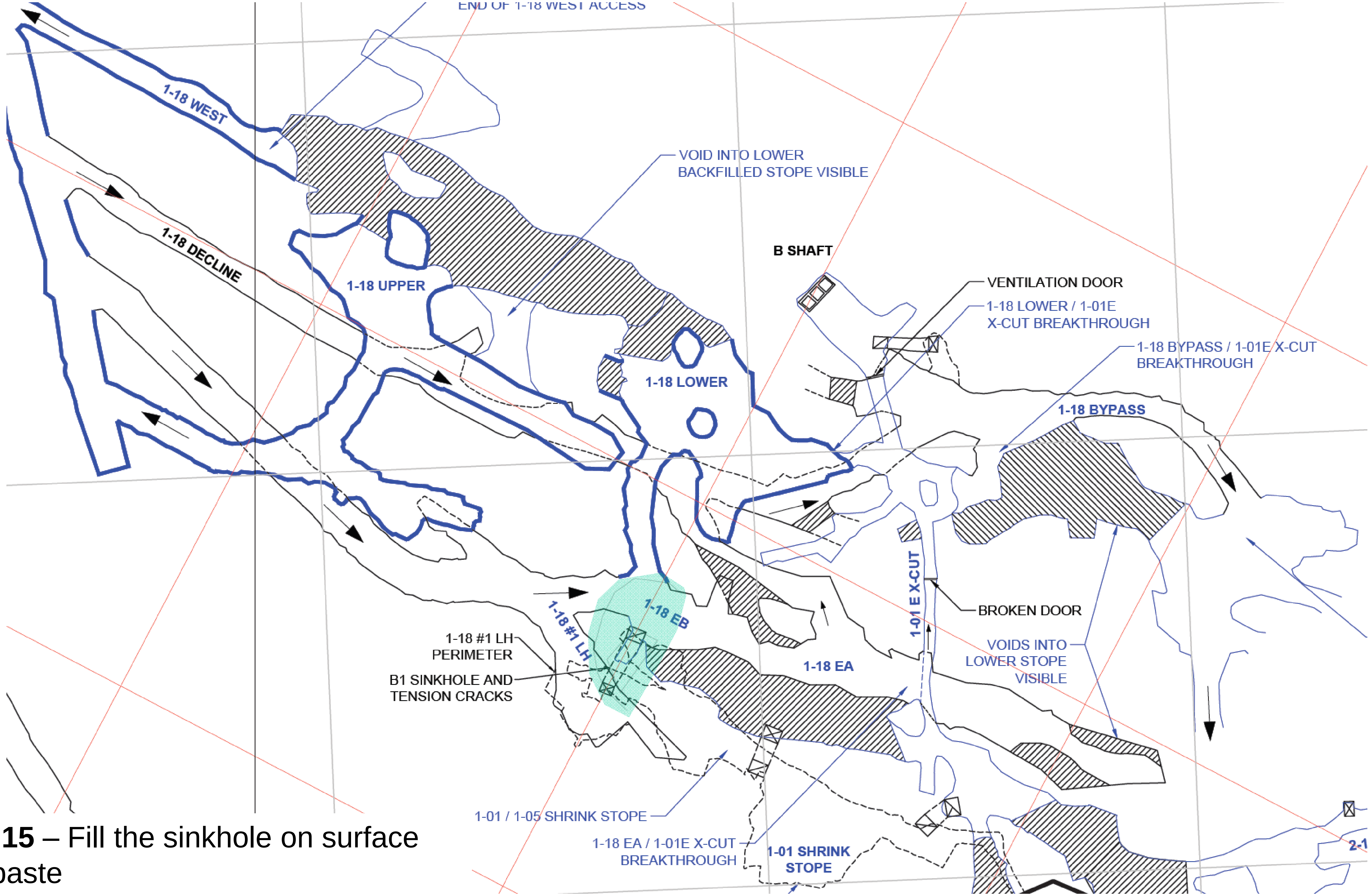
PROJECT	PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT
TITLE	B1-18 Stope Backfill Plan – Step 14

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13		
REVIEW				

Page 33

FILE: \\golder.gds\gal\burnaby\Active_2013\1426\13-1426-0010 Giant Mining Support Services\1000 - MSS-003 Detailed Planning



- **Step 15** – Fill the sinkhole on surface with paste

DRAFT

PROJECT	**PWGSC GIANT MINE INTERIM U/G STABILIZATION PROJECT YELLOWKNIFE, NWT**
TITLE	**B1-18 Stope Backfill Plan – Step 15**

Golder Associates

PROJECT No.	10-1426-0010		PHASE No.	1000
DESIGN	DTK	24SEP13	SCALE N.T.S.	REV. A
CADD	DTK/FM	04OCT13		
CHECK	DTK/FM	29OCT13	**Page 34**	
REVIEW				

APPENDIX 2

Stope Complex Description Spreadsheet

Appendix 2: Giant Mine: Interim Underground Stabilisaiton Activities - Void Volume, Underground Access, Stope Backfill Requirements - February 12, 2014 Version

									Specification and Conceptual Mitigation Plan Informaiton			
Stope Complex	Void Volume Information					Underground Access and Mine Plan Information		Crown or Sill Pillar Thickness Information	Backfill Completeness Criteria Information	Specification backfill volume (including some leakage potential)	Mandatory and Possible Fill Barricades in Conceptual Mitigation Plans	
	Individual Void Description	Are cavity scans (even partials) available (Y to N)	Current neat volume estimate (m^3) *	Description of confidence level in Neat Volume (see legend below)	Do inacessible or un-quantifiable exit voids exist that may allow paste backfill to leak out (Y or N), and what is the relative potential for leakage from the void?	Underground Access Possible?	Has area been visited by Golder (Y or N), have the engineering level plans been assessed (Y or N).	Crown Pillar Thickness Range (m)	Required level of paste required in targetted void to be backfilled	Specified Void Volume (m^3)	Mandatory and Possible Conventional Barricades	Mandatory and Possible Remote Borehole Barricades
B1-18 Stope Complex	**B1-18 Stope, B1-18 Upper Stope and B1-18 Upper Access**	**Y, Lidar**	2,000	C1, C4	Y, but neat volume estimate includes some contingency for leakage.	Access is possible but backfill placed in 2013 has blocked some previously accessible areas.	Y, Y	Crown pillar nominally 5 to 25m thick, see crown pillar thickness contour drawing	**1/20th crown pillar thickness (water license requirement) with a flat paste profile.**	**2000**	**1**	
B3-06 Stope Complex	**B3-06 South / Upper (east and west limbs)**	**Y, cms and c-als**	1,500	C1, C2	Y, exits in the form of timbered manways exist but the leakage is quantified in the next line.	Access to B3-06 South / Upper west limb exists but it is not currently safe, no access to the East limb exists	Y, mine plans partly assessed.	Sill pillar nominally 3m to 15m thick, see sill pillar thickness contour drawing	**Both east and west limbs of the B3-06 South / Upper stope void must be filed to the base of where the arsenic bulkhead raises intersect the void with a flat paste profile - see conceptual mitigation plan.**	**1500**	**1**	
	B3-06 South / Lower Development - raises, mill holes, lower drifts, etc. that will fill up behind planned remote barricades	**N**	2,800	C4	Y, exits exist that are not well quantified but these leakage points are likley through development that can be plugged remotely.	No access.	N, mine plans partly assessed.		n/a	**3220**		**2**
	B3-06 North / B3-02 - potential it will need to be filled	**Y, Lidar**	12,500	C1	Y, exits that would be difficult to plug exist but are visible. Fill would only be required here if containment of fill in B3-06 drawpoints is unsuccessfull.	Northern portion (3-02 stope), partly accessible and visible, 3rd level 3-06 lower stope and drawpoints not currently accessible but visible.	Y, mine plans partly assessed.		n/a	**assume no fill required**	**Will only be required if remote barricades do not work**	
A3-70 Stope	**3-70 Stope void**	**Y, c-als**	12000	C1, Golder - new c-als from Nov. 2013	Y, volume well quantified and stope is partly backfilled, possible exit voids through fill and in timbered manways in-between sub-levels.	No access.	N, mine plans checked	Crown pillar nominally 14 to 30m thick, see crown pillar thickness contour drawing	**Backfill required to within 1m of the high point of the back (top) of the void with a flat paste profile.**	**12600**		
	Backfill in connected drifts to keep fill in stope	**Y - partial c-als**	500	C1, Golder - new c-also from Nov. 2013	Y, but mine plans show few connections.		N, mine plans checked		n/a	**525**		**1**
B3-10 Mid (B2-02, B2-04, B2-18, B3-10) Stope Complex	**B3-10 Mid Complex Below 2nd Level (2-02, 3-10 stopes)**	**Y, partial Lidar**	6,000	C1/C4 - not all areas accessible for cms	Y, exit voids exist that cannot be fully quantified.	Some access possible, old accesses blocked off of main ramp with plywood and muck - may be possible to get in past this for inspection in future.	Y but only partial access, mine plans checked.	Crown pillar nominally 52 to 92m thick, see crown pillar thickness contour drawing. The critical issue is the rib pillar with arsenic stope B2-12/13/14.	n/a	**6900**	**4**	
	B3-10 Mid Complex above 2nd Level (2-04, 2-18 stopes)	**Y, partial Lidar**	11,000	C1/C4 - not all areas accessible for cms	Y, exit voids exist but once lower area is filled there the possibility of inacessible exits is lower.		Y but only partial access, mine plans checked.		**Backfill void to within 2m of the high point of the back (top) of voids (up to 3 seprate areas) with a flat paste profile.**	**11550**	**2**	

Total Neat Volume Estimate (m^3)	
48,300	Includes B3-06 North / Lower (B3-02 Stope)
35,800	Not including B3-06 North / Lower (B3-02 Stope)

	Specified Total Void Volume Estimate (m^3)	Mandatory and Possible Conventional Barricades	Mandatory and Possible Remote Borehole Barricades
Specification Fill Volume (Does not include B3-06 North / Lower Stope)	39000	8	3
Anticipated Leakage (relative to 35,800 m^3)	9%		

Potential additional paste legend (leakage)		
	(green)	No leakage expected
	(yellow)	+5% leakage
	(red)	+10% leakage

Assumptions:
Leakage ammounts are limited based on assumption of management controls

Volume detemination approach used in assessment of confidence levels:
C1 - Based upon recent c-als and/or Lidar scans - may be multiple voids in any one stope complex
C2 - Based upon dated cms, surveys, may be multiple voids in any one stope complex
C3 - Rough estimate based on drilling investigation - void encountered and fill level estimated
C4 - Rough estimate based on historical mining plans and mining practices - presence of fill unknown
C5 - Very rough estimate mine plans not yet assessed

APPENDIX 3

Drillhole Design Criteria

Golder Associates

January 29, 2014

Reference No. 1314260010-077-L-Rev0-5000

Brad Thompson
Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 1S6

CRITERIA FOR DRILLHOLE DESIGN

Dear Mr. Thompson,

This letter summarizes the design guidelines used for the collar and breakthrough locations of the 2013/2014 IUS paste delivery and observation boreholes.

In some instances, following the guidelines for the drilling of specific boreholes was not possible given the geometry of the site, i.e., surface access and underground workings. In these special circumstances the issues encountered were discussed with the paste design group and modification to the design was done for that specific borehole.

Drilling Design Guidelines

1) Design Guidelines for Large Diameter Surface Boreholes:

- Designed at -60 to -90 degrees below horizontal.
- Cased over the full length with 200 mm (± 10mm) inside diameter Schedule 40 nominal thickness casing (A-106, API-5LPT or L-80 steel).
- Borehole breakthrough points spaced to accommodate an assumed 25 m unobstructed flow radius in the stopes and drifts.
- Boreholes which were greater than 40 m in length used for the purpose of delivering paste to a pipe in an underground stope or drift were angled at -65 to -70 degrees to reduce risk and wear on underground connection.
- Outer casing installed from ground surface into bedrock. Bedrock/overburden contact grouted to reduce groundwater flow into the underground voids.

Golder Associates Ltd.
500 - 4260 Still Creek Drive, Burnaby, British Columbia, Canada V5C 6C6
Tel: +1 (604) 296 4200 Fax: +1 (604) 298 5253 www.golder.com

2) Design Guidelines for Small Diameter Surface Boreholes:

- Designed at -50 to -90 degrees below horizontal.
- 96.1 mm borehole diameter, uncased from bedrock contact to end of hole.
- Outer casing installed from ground surface into bedrock. Bedrock/overburden contact grouted to reduce groundwater flow into underground voids.

3) Design Guidelines for Large Diameter Underground Boreholes:

- Designed at any orientation, +90 to -90 degrees above or below horizontal.
- Cased over the full length with 150mm (± 10mm) inside diameter Schedule 40 nominal thickness casing (A-106, API-5LPT or L-80 steel).
- Borehole breakthrough points spaced to accommodate an assumed 25 m unobstructed flow radius in the stopes and drifts.

4) Design Guidelines for Small Diameter Surface Boreholes:

- Designed at any orientation, +90 to -90 degrees above or below horizontal.
- 96.1 mm borehole diameter, uncased from collar to end of hole.

For all drilling conditions, a drilling accuracy of 1% horizontal deviation to vertical depth was assumed for target locations.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Ashley Pakula, P.Eng. (BC)
Geotechnical Engineer

ORIGINAL SIGNED

Darren Kennard, P.Eng. (BC)
Associate, Senior Geotechnical Engineer

ALP/DTK/rs/kp/md

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APPENDIX 4

Paste Test Report

January 31, 2014

PWGSC GIANT MINE

Paste Field Trial and Flow Loop Testing

Submitted to:

Public Works and Government Services Canada
(PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, AB T5J 1S6¶

Attention: Brad Thompson

REPORT

Project Number: 1314260010-105-R-Rev0-5000

Distribution:

1 Electronic Copy: PWGSC, Edmonton, AB

1 Hard Copy: Golder Associates Ltd., Sudbury, ON

Golder Associates

Study Limitations

This report was prepared for the exclusive use of Public Works and Government Services Canada (PWGSC) on the Giant Mine Remediation Project. The report, which specifically includes all tables, figures and appendices, is based on measurements and observations made and data and information collected during the on-site trial and laboratory studies conducted by Golder Associates Ltd. (Golder) for PWGSC. The test results are based solely on the ambient conditions of the site and laboratory at the time the measurements and tests were conducted.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Table of Contents

1.0 INTRODUCTION

PWGSC has retained Golder Associates Ltd. (Golder) to carry out a field trial at Giant Mine prior to full scale paste backfill production as part of the Giant Mine Remediation Project (GMRP). The purpose of the trial was to understand the efficacy of the various void filling materials and to collect engineering data on the behavior of the material in a controlled environment. Such knowledge can only be gained at a field scale and thus this test phase is an essential first step to the remediation works.

The field test was structured to evaluate the following:

- Overall system performance and verification of equipment suitability (calibration of equipment and producing paste with tailings).
- Process for backfilling drifts (defined as an isolated mine development tunnel which is typically rectangular shaped e.g. 3 m wide by 3 m high) using low slump cemented paste tailings delivered through boreholes i.e. amount of material and flow characteristics plus rest periods to achieve a suitable barricade (flow loop testing, piles/sea can tests).
- Suitable multiple mix designs for placement of low slump cemented paste tailings backfill barricades and high slump lightly cemented paste tailings material for bulk filling that will resist liquefaction in the event of a seismic loading (continuous pour, piles/sea cans).
- Pumping performance for various backfill mix designs (flow loop).

Bulk fill is needed to backfill underground stopes. The most readily available and suitable raw material for making bulk void filling material at Giant Mine is the existing tailings on site. Tailings, which is finely crushed rock and is the main by-product of milling gold ore, is abundant on surface in the existing tailings ponds and is also present in large quantities in the underground as it was used during the active mining to stabilize voids.

The material proposed to be used for the majority of the void backfilling material was lightly cemented paste tailings and this same material was therefore used in the paste trial. The paste tailings was made from different recipes of tailings, treated water (which was sourced from the Giant Mine Polishing Pond), binder material (comprised of normal Portland cement [NPC]), and inert rock aggregate sourced from existing stockpiles sourced from nearby locations.

During the field trial, no paste tailings were pumped into any underground workings, chambers or stopes. Used shipping containers, called sea cans, were used to simulate the underground drifts that need to be barricaded (plugged) and backfilled so that the optimal paste recipes could be determined.

A variety of testing was completed including digging test pits, conducting on-site rheological testing, on-site flow loop testing, truck calibration, and piles/sea can testing. These tests are explored in more detail below.

The first step was to determine which tailings would be suitable for the creation of paste – this was done using information generated in July and September 2013, from a test pit program. The test pits were dug and samples gathered from various locations in the south and central tailings ponds at Giant Mine to determine their suitability as feed material. Prior to being sampled, the material in the test pits was visually inspected for content of sand, silt, and clay. The visual inspection assessed whether or not the material was suitable for being used for paste backfill. Tailings containing predominately silty-sand material are the most desirable, and samples were taken from these locations. Locations containing any clay and high quantities of silt material were rejected. Moisture content observations of each test pit were also made during the program.

A field trial equipment general arrangement layout is presented in Appendix A.

2.0 TAILINGS SELECTION AND PREPARATION

2.1 Tailings Selection

The stockpile for the trials, at the northeast area of the South Tailings Pond, was built by contractors using what was thought to be material that could be used to create paste. After Golder arrived on site and inspected the stockpile it was concluded that the material was not suitable due to high amounts of clay and silt material. Therefore, a second stockpile was required to be built from the west area of the south tailings pond which was determined to be good feed material. Figure 1 shows both tailings stockpiles.

Figure 1: Comparison of prepared tailings stockpiles - left: Stockpile #2 used during paste trial; right: Stockpile #1 unusable for paste trial.

Once the proper tailings were identified and gathered, the next step was to calibrate the equipment that would be delivering the paste.

3.0 CALIBRATION OF THE MIXER TRUCK

The following sections outline the methods used to generate the calibration data for the two Reimer mixer trucks used on site to blend tailings, cement, water, and aggregate into paste for the trial and paste production. Both mixer trucks (Mixer #1 and Mixer #2) were calibrated for mass and volumetric throughput during the paste trial prior to paste production.

3.1 Mass Calibrations

During the paste trial both mixer trucks contained a divider that split their material bins in two. This feature allowed the trucks to run alternative materials such as aggregate on one side of the bin and tailings on the other. Aggregate in the mix was used to produce high strength paste for the construction of paste barricades.

Each of the mixer trucks have a hydraulically driven belt feeder under the main center bin. The discharge from the bin falls onto the belt feeder and is controlled by two independent gates. Each gate has a scale with 120 divisions on it. One gate was used for tailings while the other was used to regulate the flow of aggregate. If there was no aggregate, both sides of the bin were filled with tailings so both gates were used to regulate the flow of tailings.

The head pulley of the belt feeder has a toothed wheel attached to the drive shaft. A proximity sensor mounted beside the toothed wheel produces a pulse signal each time a tooth passes by. A totaliser display counts the pulses as they are generated. The pulse signal can be correlated to the amount of material flowing on the belt feeder. This is done by running the belt feeder at a gate setting for a fixed time period and collecting the material discharged. The weight of the material is divided by the pulses or "counts" generated during the time period to produce a kg/count value.

The mixer trucks were calibrated at various gate settings with tailings to produce a kg/count for each gate setting. The mixer trucks were also calibrated with aggregate on a single side of the divided center bin, at various gate settings in order to produce a kg/count value specific to aggregate. This is necessary due to the fact that tailings and aggregate have different bulk specific gravities.

Cement intake also required calibration. Each of the mixer trucks are equipped with a cement screw feeder powered by a hydraulic motor. Both the belt feeder and screw feeder's hydraulic motors are driven by the same hydraulic pump. A proportioning valve precisely splits the flow between the belt feeder and screw feeder motors in a constant ratio. The proportioning valve can be adjusted in order to change the ratio of cement to tailings. The cement feeder is calibrated (in the same way as the belt feeder) by dividing the weight of cement discharged by the counts generated by the belt feeder to produce the kg/count of cement discharged. This is possible because the proportioning valve always keeps the ratio of tailings to cement equal. The discharge of cement is controlled by a 2 positioned valve – lean mix and rich mix (maximum binder output). Paste production was done on the lean mix setting.

The resulting calibration graphs for Mixer #1 and #2 are shown in Figures 2 to 5. Calibrations for 100% tailings were done with both sides of the bins full of tailings, both gates at varying settings. The sum of both gates settings are shown in the figures below (Figures 2 and 4). Calibration for the aggregate was done with one side with tailings (gate at 120 units) and one side with aggregate (gate at varying settings).

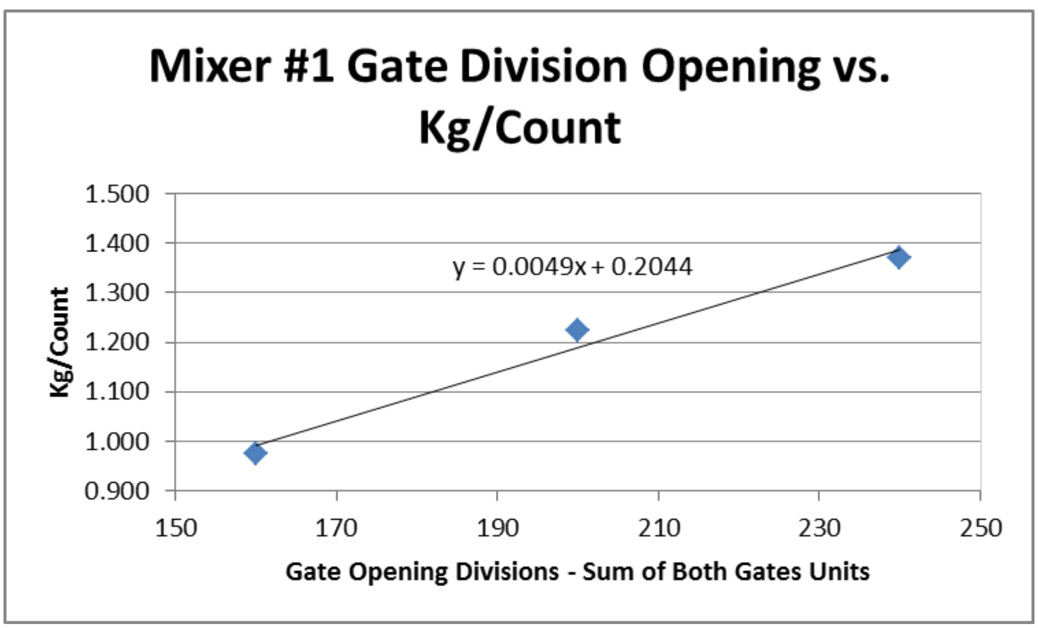

Figure 2: 100% tailings calibration for Mixer #1

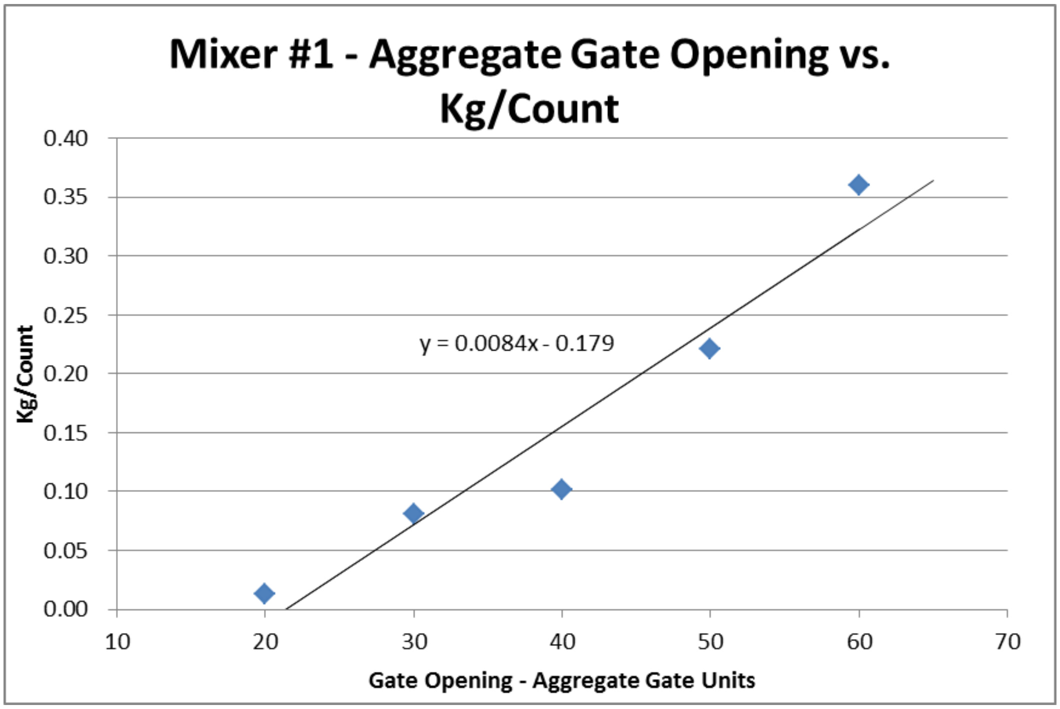

Figure 3: Aggregate calibration for Mixer #1

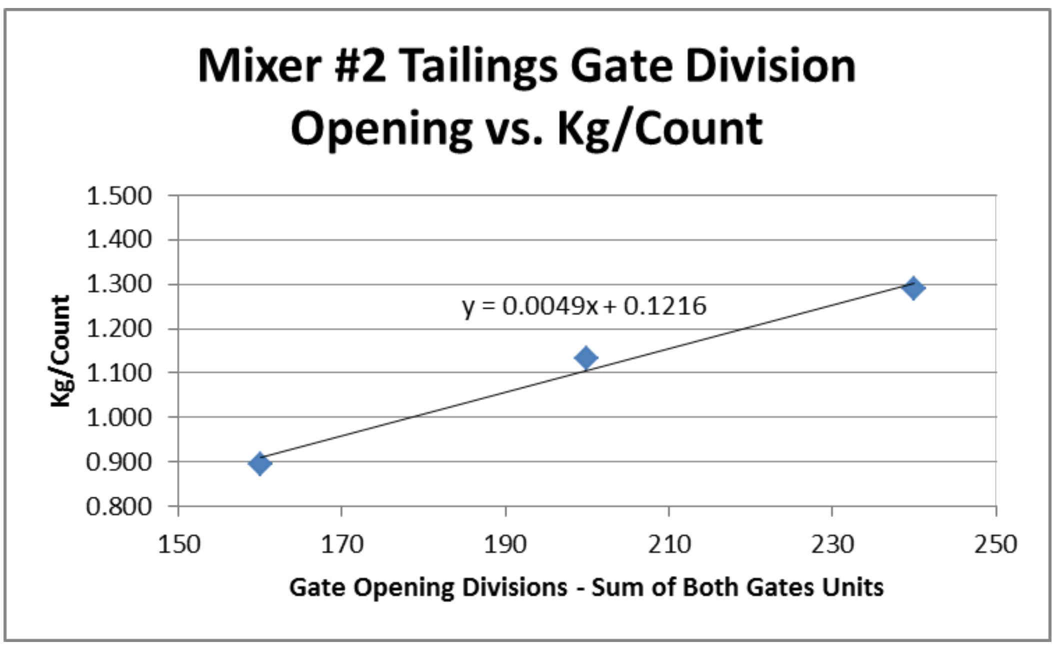

Figure 4: 100% tailings calibration for Mixer #2

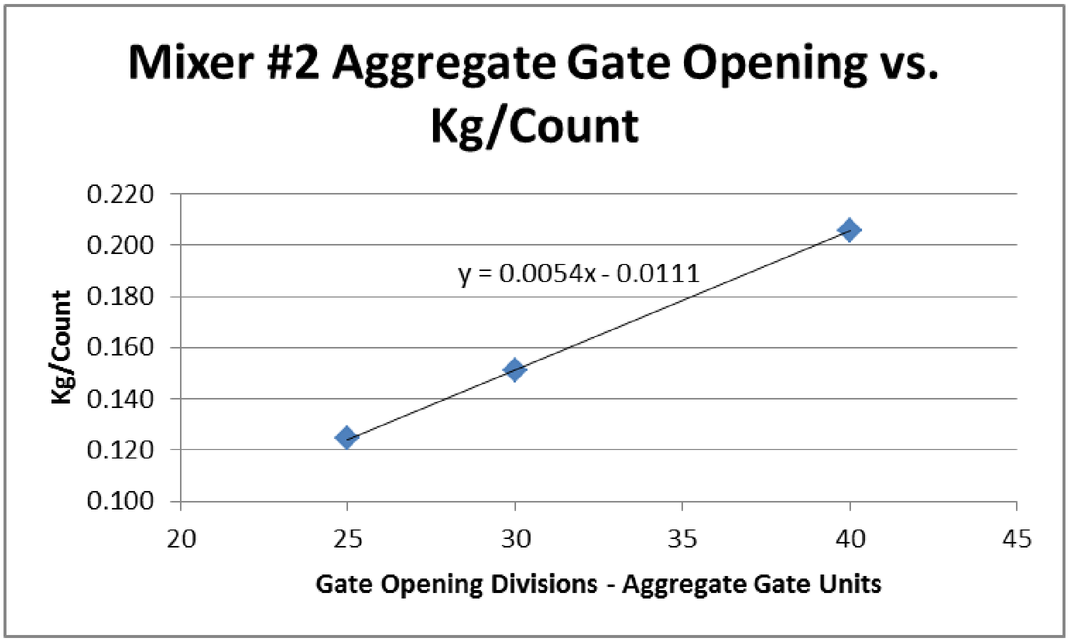

Figure 5: Aggregate calibration for Mixer #2

The calibration data was used to determine the precise amounts of tailings, cement and aggregate used for a specific paste pour by multiplying the counts for the run by the respective kg/count at a specific gate setting for that material. Separate calibrations were required to determine the volume throughputs of the mixer trucks.

3.2 Volume Calibrations

Volumetric calibrations were determined using a 1 m x 1 m x 1 m wooden yield box. Paste of a known slump was blended in the mixer truck and poured into the yield box. The quantity of counts to fill the 1 m^3 box was measured at each slump.

Using this data, the cubic meters of paste produced for a specific batch could be determined by dividing the counts generated for that batch by the counts/m^3. The results are shown in Table 1 for Mixer #1 and #2.

Table 1: Yield Box Results

Truck	Slump	Counts/m^3
Mixer #1	7"	1103
Mixer #2	5"	1040

After Mixer #1 was calibrated, it was used for the on-site flow loop test performed on the south pond in the paste trial area.

4.0 ON-SITE FLOW LOOP TESTING

Flow loop testing provides essential data for the design and operation of pump and pipeline distribution systems. An assessment of the data provides fluid characterization and corresponding rheological properties such as viscosity and yield stress values.

Truck #1 was used to create paste by mixing water, tailings, and aggregate (no cement was used in these flow loop tests). The paste was then pumped through a positive displacement pump to the field scale flow loop system consisting of 100 mm (4-inch) and 125 mm (5-inch) Schedule 40 steel piping. The flow loop pipelines are instrumented with a magnetic flow meter and various pressure transmitters. Instrumentation data was collected by a high-speed data acquisition system and laptop computer for data storage.

The paste recipes for the individual test runs were 100% tailings mix and a 90/10 tailings/aggregate mix at a range of moisture contents (targeting 5”, 7”, 8.5”, and 10” slumps). The tests were to measure pipeline friction loss at the different moisture contents at several flow rates. A ‘ramp up’ and ‘ramp down’ technique was used to determine any possible changes in measured pipeline friction loss over time, which would indicate either shear thinning or thickening properties.

The ranges of losses for the aggregate mix were slightly larger with higher top range losses, except in the case of a 5” slump, than the losses experienced by the 100% tailings mixture. For the 100% tailings flowloop, the pressure losses in the 5” pipe varied from 4-37kPa/m while the pressure losses in the 4” pipe varied from 6-51kPa/m. The highest and lowest losses for this sample were seen at the 5” and 10.25” respectively. For the 90/10 Tailings/aggregate ratio flowloop, the pressure losses in the 5” pipe varied from 4-34kPa/m while the pressure losses in the 4” pipe varied from 9-55kPa/m. The highest and lowest losses were at the 5” slump.

The samples collected during the flow loop test were tested for pH, specific gravity and particle size distribution (PSD). The pH of the tailings and the tailings with aggregate were 8.3 and 8.2 respectively. The specific gravity of these two samples was 2.78 and 2.81 respectively. The particle size D50 for the tailings was 96 µm, for the aggregate was 9326 µm and for the tailings and aggregate for both 5” and 9.75” slump was 2172 and 114 µm respectively. The change in the tailings and aggregate PSD is due to the sizes and amount of aggregate in each sample.

For the 100% tailings samples, the weight percent solids varied between 80-77.5% from a 5-10.25” slump respectively with corresponding yield stress values of 487 Pa and 206 Pa for the 5” and 10.25” slump respectively. For the 90/10 Tailings/aggregate samples, the weight percent solids varied between 86.3-82.6% from a 5-10” slump respectively. Yield stress could not be performed on this sample due to the coarseness of the aggregate.

The assessment of data for each mixture, material characterization and a general arrangement of the flow loop are presented in Appendix B.

5.0 PILES AND SEA CAN TESTING

Piles and sea can testing was performed using varying slump paste (with and without aggregate) in order to simulate the pouring of remote paste barricades as well as to refine the recipe for the underground paste program. The paste would be mixed in the mixer truck until the desired slump was achieved, which was confirmed with slump tests, and then the pump truck would deposit a certain amount of paste, at a height approximately 3 m above the ground, in a pile adjacent to the sea cans. The 3 m height was to simulate the drop from the back of the drift to the floor in the underground scenarios. The truck counts were recorded, as well as the heights and width of the pours. These piles were used to experiment with the paste recipes and refine the mixes before depositing the paste into sea cans.

During the sea can trial, paste was pumped into the top of an empty sea can in order to simulate an underground drift. Several lifts were deposited until the paste reached the walls and ceiling of the sea can. Data was gathered and used to calculate the volumes, weights, and dimensions of these mock barricades. The resulting data can be seen in Appendix C. Location of these piles and sea cans can be seen in the Field Trial General Arrangement (Appendix A).

In between the piles and sea can tests, two continuous pours were performed to fine tune calibration and obtain field verification of throughput. The two pours lasted for 38 min 47 sec, and 25 min 0.3 sec respectively. The slumps which varied during the pour were tested and recorded and when the pours were completed, the counts on the mixer truck were used to calculate the weight of the tailings poured. Calculations involving the counter on the mixer truck, buckets of excavator and pump strokes were examined during these pours.

6.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

ORIGINAL SIGNED

Andrés Quintero
Mechanical Specialist

Sue Longo, P.Eng.
Associate, Mechanical Engineer

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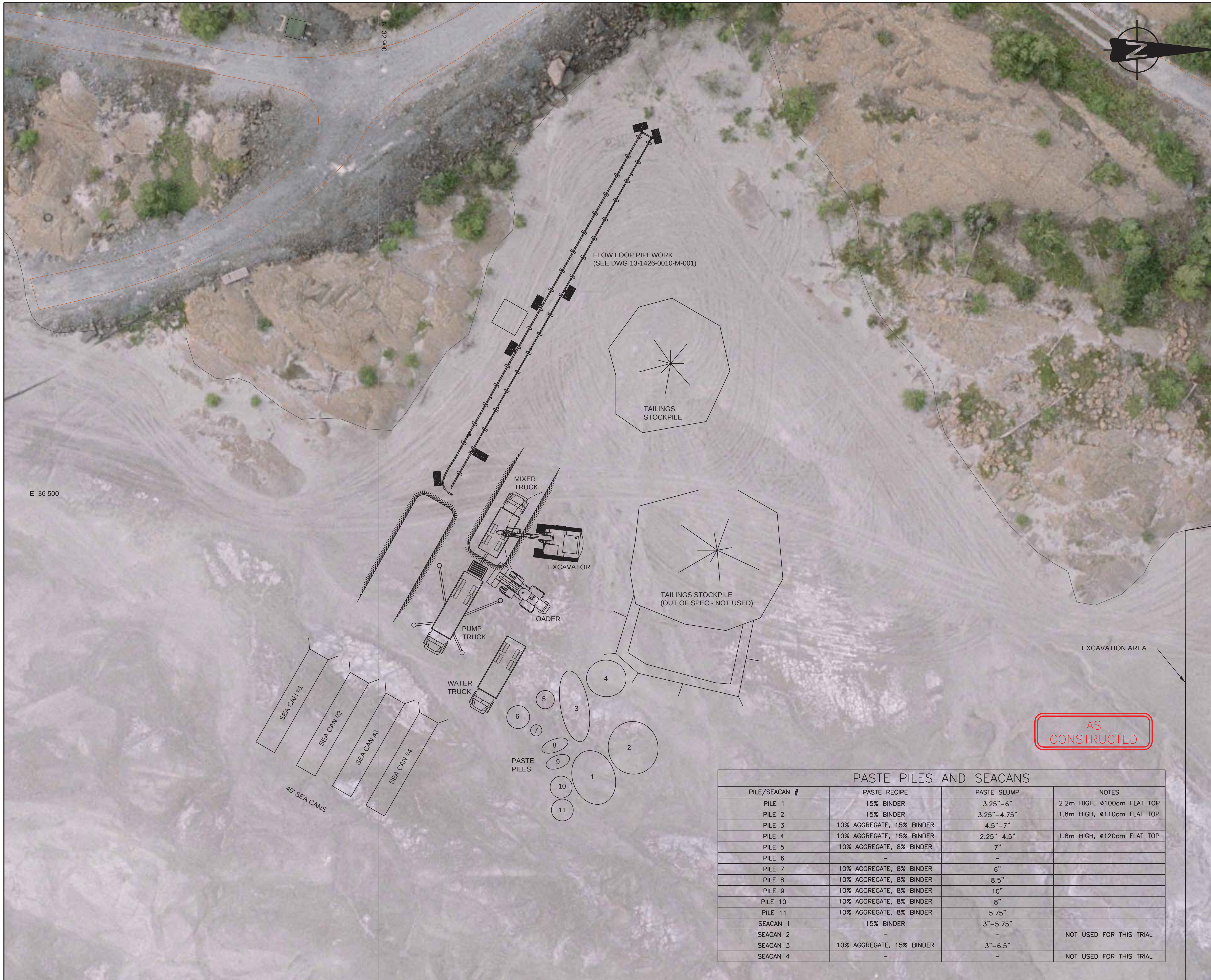
APPENDIX A

Field Trial General Arrangement



PASTE PILES AND SEACANS

PILE/SEACAN #	PASTE RECIPE	PASTE SLUMP	NOTES
PILE 1	15% BINDER	3.25"–6"	2.2m HIGH, ø100cm FLAT TOP
PILE 2	15% BINDER	3.25"–4.75"	1.8m HIGH, ø110cm FLAT TOP
PILE 3	10% AGGREGATE, 15% BINDER	4.5"–7"	
PILE 4	10% AGGREGATE, 15% BINDER	2.25"–4.5"	1.8m HIGH, ø120cm FLAT TOP
PILE 5	10% AGGREGATE, 8% BINDER	7"	
PILE 6	–	–	
PILE 7	10% AGGREGATE, 8% BINDER	6"	
PILE 8	10% AGGREGATE, 8% BINDER	8.5"	
PILE 9	10% AGGREGATE, 8% BINDER	10"	
PILE 10	10% AGGREGATE, 8% BINDER	8"	
PILE 11	10% AGGREGATE, 8% BINDER	5.75"	
SEACAN 1	15% BINDER	3"–5.75"	
SEACAN 2	–	–	NOT USED FOR THIS TRIAL
SEACAN 3	10% AGGREGATE, 15% BINDER	3"–6.5"	
SEACAN 4	–	–	NOT USED FOR THIS TRIAL

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

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

Golder Associates

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Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuve par: S.L.

Designed by/Concept par: J.S.

Drawn by/Dessine par: J.S.

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
**PASTE TRIAL AREA
SOUTH TAILINGS POND
GENERAL ARRANGEMENT
AS CONSTRUCTED**

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	0

PWGSC – A1 – 841X594

0 10 20 30 40 50 60 70 80 90 100mm

13-1426-0010-L-001

APPENDIX B

Flow Loop Data, Material Characterization, and Flow Loop General Arrangement

January 29, 2014

PILOT SCALE FLOW LOOP TEST

Giant Mine Backfill Testing

Submitted to:
Public Works and Government Services Canada
(PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6

Attention: Brad Thompson

REPORT

Report Number: 13-1426-0010

Distribution:

1 e-copy: Public Works and Government Services Canada

1 copy: Golder Associates Ltd., Sudbury, Ontario

Study Limitations

This report was prepared for the exclusive use of Public Works and Government Services Canada (PWGSC) on the Giant Mine Project. The report, which specifically includes all tables, figures and appendices, is based on measurements and observations made and data and information collected during the laboratory studies conducted by Golder Associates Ltd. (Golder) for PWGSC. The test results are based solely on the ambient conditions of the laboratory at the time the measurements and tests were conducted.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Table of Contents

TABLES

FIGURES

Table of Contents (cont.)

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Golder Associates Ltd. (Golder) to perform an on-site flow loop test at the Giant Mine in Yellowknife, NT. The flow loop testing results provide a basis for the design of the tailings pumping and distribution system.

Transport properties are a function of a number of parameters including tailings characteristics (mineralogy, PSD, chemical composition, slurry pH), slurry densities, volumetric flow rates, temperature, pipeline diameter, degree of shear, pipeline layout. The tests conducted at Giant Mine covered a range of consistencies typical for paste backfill, using un-cemented material.

2.0 SCOPE OF SERVICES

Golder's scope of services included the following.

- On-site flow loop testing:
  - providing instrumentation;
  - monitoring and recording of data; and
  - analysing and reporting of data.
- Bench scale lab testing:
  - material testing; and
  - analysing and reporting of data.

3.0 FLOW LOOP TESTING

3.1 Flow Loop Setup

An instrumented flow loop was constructed by LPR Concrete, RTL Construction, and Golder personnel to determine the transport characteristics of high solids content paste backfill. The loop was a closed circuit pipeline powered by a diesel engine piston pump, specifically a Concord CCP-40X-170 boom truck pump. The pump was capable of delivering up to 170 m^3/hour.

Industrial, high accuracy flush mount pressure transmitters (Endress+Hauser PMC71) designed for up to 41 bar (600 PSI) were installed in predetermined sections of straight pipe. Pressure data was recorded and the pressure differential between the units was calculated to determine unit pressure gradients. The unit pressure gradients are related to material density, flow velocities and pipeline diameters.

A magnetic flow meter (Endress Hauser Model Promag 55S) was provided by Golder for the flow loop test. During the commissioning of the flow loop, using water, the flow meter was used to determine the delivery volume per stroke of the positive displacement pump. As a supplemental check, the volume of material delivered by the pump was also estimated using the number of strokes required to fill the flow loop, a known volume.

The pipeline and instrumentation layout is presented in Appendix A and Photographs are presented in Appendix B.

3.2 Test Mixes

Testing was conducted on October 8, 2013 (Day 1) for the un-cemented tailings paste sample and October 9, 2013 for the un-cemented tailings and aggregate paste sample.

The tailings from the South Pond were transferred into a Reimer mixer truck and the moisture content adjusted to get a measureable slump of approximately 5" (125 mm). The material initially used to fill the flow loop had a measured slump of 5" (125 mm). A sample of the tailings was collected to determine the moisture content of the starting material. Samples were also collected to determine the moisture content for each of the pulp densities for which flow loop data was collected.

Several paste backfill mixes were prepared from tailings stockpiled and stored onsite next to the flow loop in the South tailings pond area. Table 1 presents the details for each mix tested.

Table 1: Flow Loop Mix Details

Day	Slump (mm)	Material	Aggregate	Solids Content (%)
1	125 (5")	100% South Pond Tailings	N/A	80.0
	170 (6.75")			79.0
	216 (8.5")			78.6
	260 (10.25")			77.5
2	125 (5")	90% South Pond Tailings	10% Aggregate	86.3
	190 (7.5")			84.6
	216 (8.75")			83.2
	248 (9.75")			82.6

Moisture determinations during the flow loop were completed by Golder's on-site laboratory personnel and in our Sudbury Ontario Laboratory. Each mix was pumped at variable rates from approximately 20% of maximum flow up to the maximum flow rates possible with the supplied pump. Targeted minimum flow velocity through the Diameter Nominal (DN) 125 mm (National Pipe Size (NPS) (5")) pipe was around 0.5 m/sec to minimize the potential for sliding bed to occur.

3.3 Material Properties

Samples collected during the flow loop test were tested for pH, specific gravity and particle size distribution. Results are presented in Tables 2 to 4 and on Figures 1 to 3.

3.3.1 pH of Samples

Table 2: pH of Samples Received

Sample	pH
13-1426-0010 South Pond Tailings	8.3
13-1426-0010 South Pond Tailings + Aggregate	8.2

3.3.2 Specific Gravity

The specific gravity (SG) of the sample was determined using vacuum de-aired water. Each slurry sample was also vacuum de-aired prior to SG measurement.

Table 3: Specific Gravity Results

Sample	Average
13-1426-0010 South Pond Tailings	2.78
13-1426-0010 South Pond Tailings + Aggregate	2.81

3.3.3 Particle Size Distribution

The particle size distribution (PSD), Specific D-values (% passing a sieve opening). The PSD of the samples were similar to the sample(s) as tested in our Sudbury laboratory in previous phases.

Table 4: Particle Size Distribution

Sample	D10	D30	D50	D60	D80
	(µm)				
13-1426-0010 South Pond Stockpile	6	30	84	115	139
13-1426-0010 Aggregate	4516	7003	9326	10401	12521
13-1426-0010 South Pond Tailings – 5” (127 mm) slump	5	34	95	118	141
13-1426-0010 South Pond Tailings – 10.5” (267 mm) slump	5	35	98	118	140
13-1426-0010 South Pond Tailings + Aggregate – 5” (127 mm) slump	14	119	2172	6727	11887
13-1426-0010 South Pond Tailings + Aggregate – 9.75” (248 mm) slump	5	26	114	3044	10848

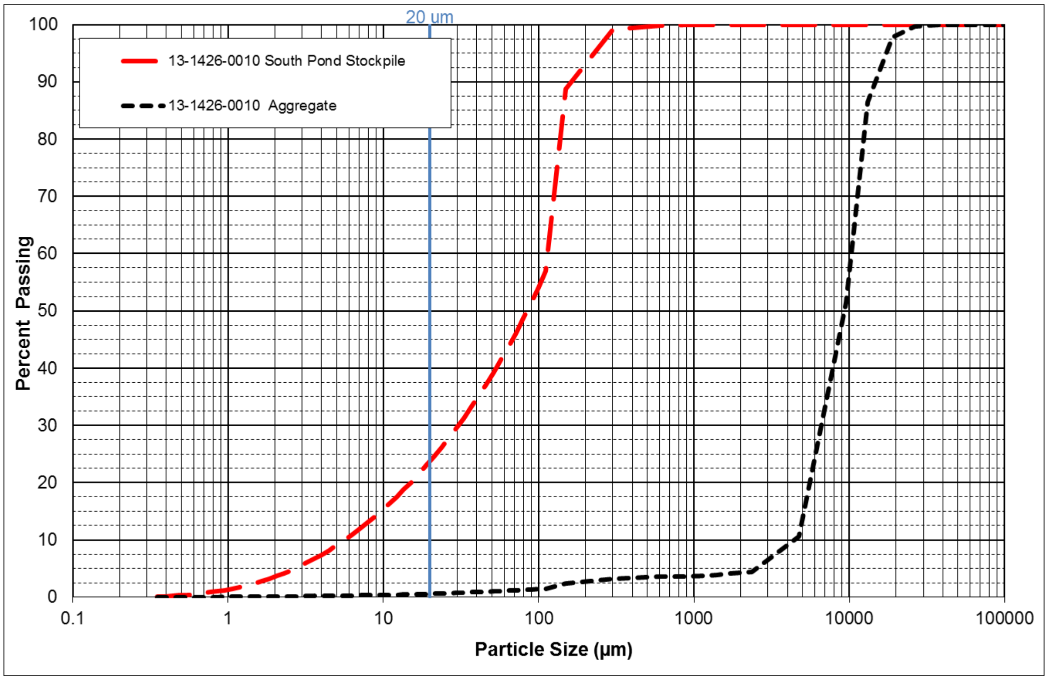


Figure 1: Particle Size Distribution

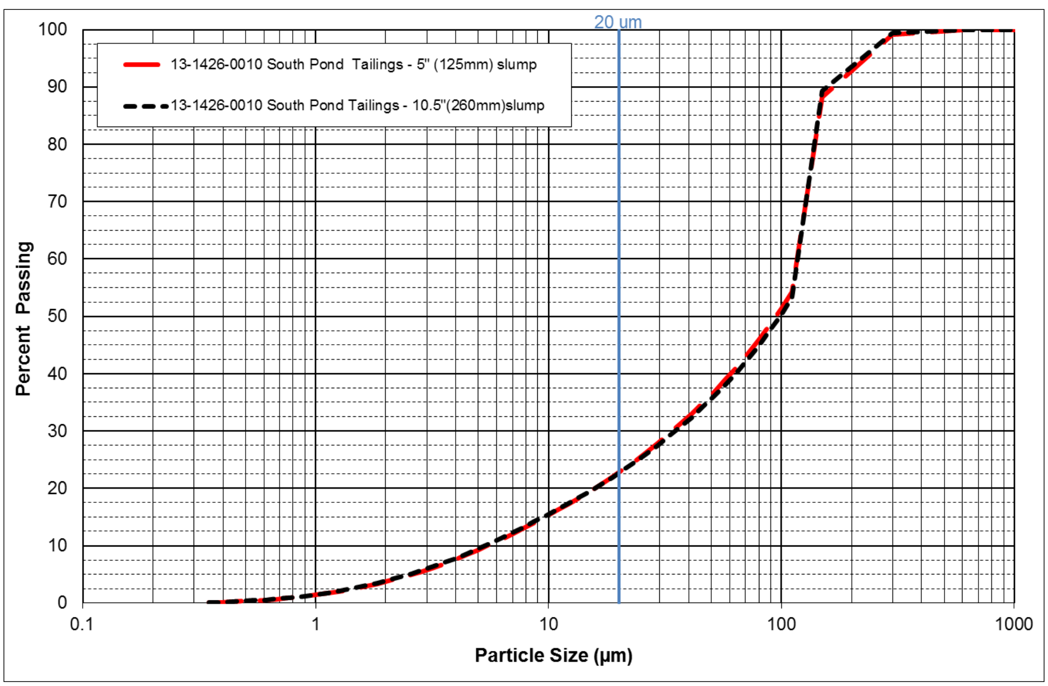


Figure 2: Particle Size Distribution – South Pond Tailings Flow Loop

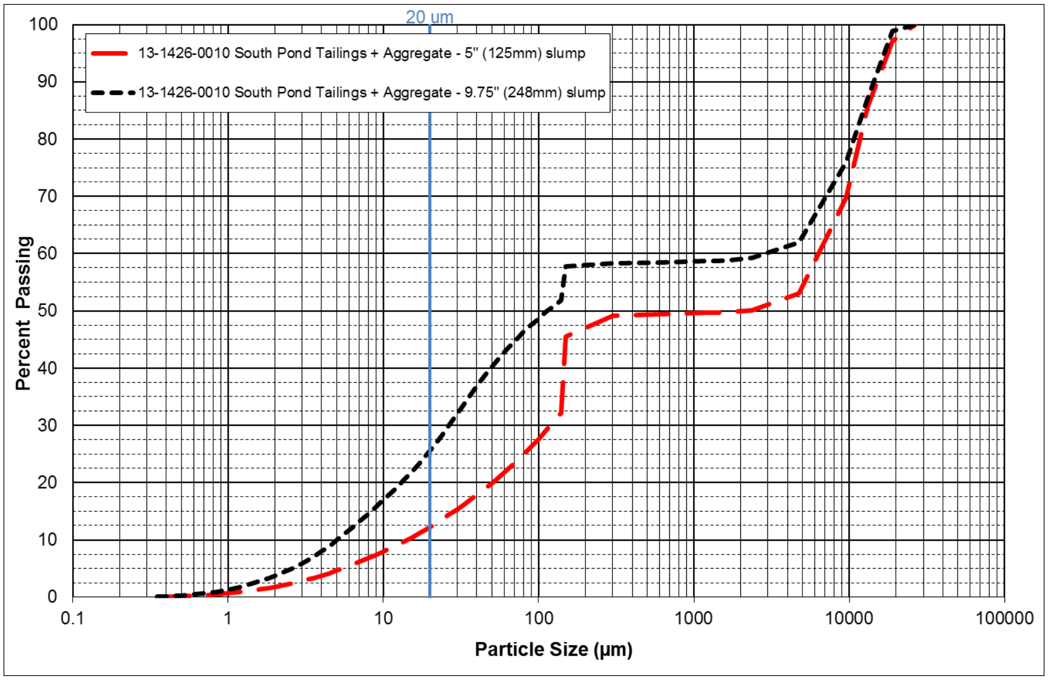


Figure 3: Particle Size Distribution – South Pond Tailings + Aggregate Flow Loop

4.0 RHEOLOGICAL CHARACTERIZATION

Rheological testing was carried out to evaluate flow and handling properties. These tests provide an indication regarding the material's behaviour in the course of mixing, slump adjustment, pumping, flowing and also while sitting idle. Rheological characterization provides data for the selection of process equipment such as mixers, pumps and pipelines.

4.1 Slump vs. Solids Content

To gauge sensitivity to water additions, small increments of water were added to the bulk sample. After each addition, slump and solids content was determined. This generates a relationship between slump and solids content which is typically used to determine the degree of process control required to maintain slump control of the final product. The results are presented on Figures 4 and 5.

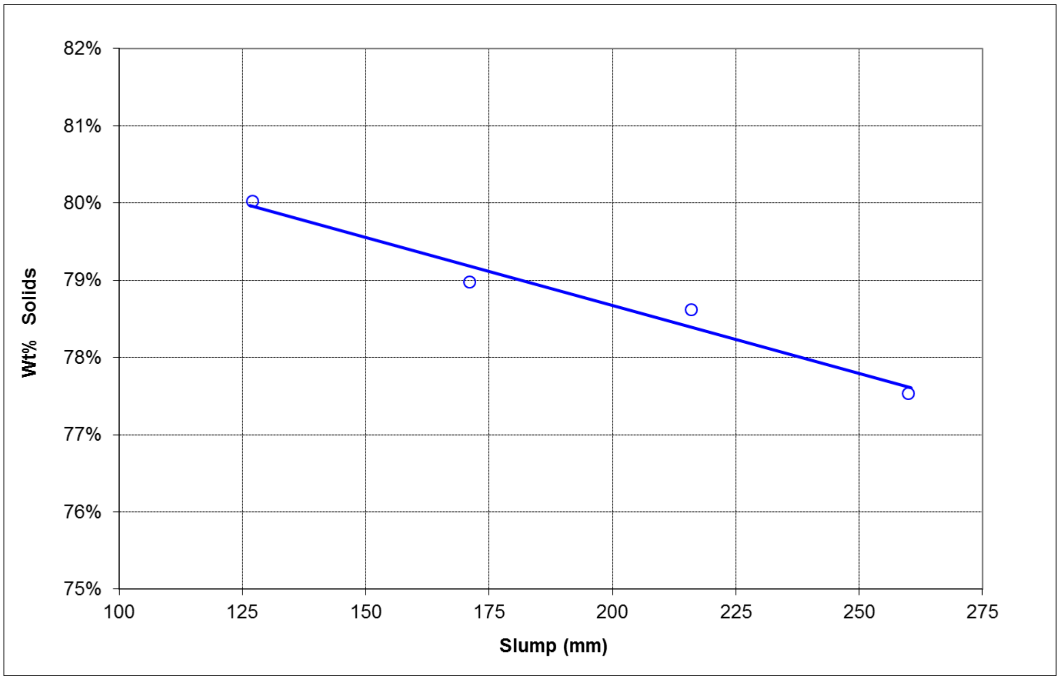


Figure 4: Solids Content vs. Slump - 13-1426-0010 South Pond Tailings

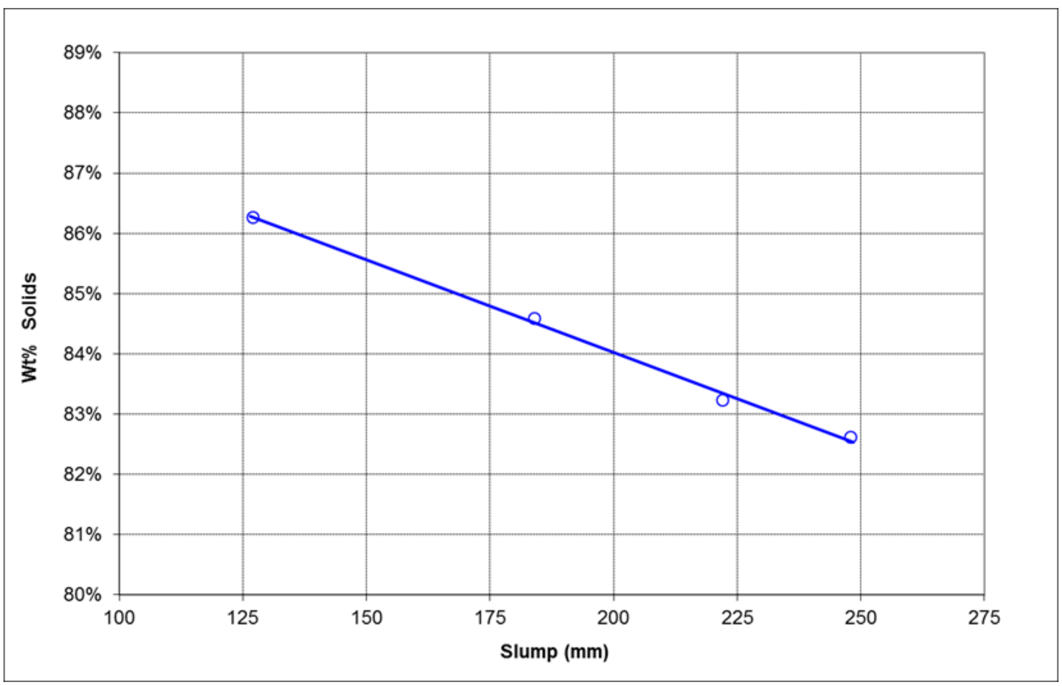


Figure 5: Solids Content vs. Slump - 13-1426-0010 South Pond Tailings + Aggregate

4.2 Static Yield Stress Testing

Yield stress is defined as the minimum force required to initiate flow. Static yield stress was determined by using a very slow moving (0.2 RPM) vane spindle attached to a torque spring. The spindle was immersed in the sample and measurements were taken at various solids contents. There are different test methods to determine yield stress, one termed 'static' and the other 'dynamic'. Figure 6 presents the static yield stress testing results.

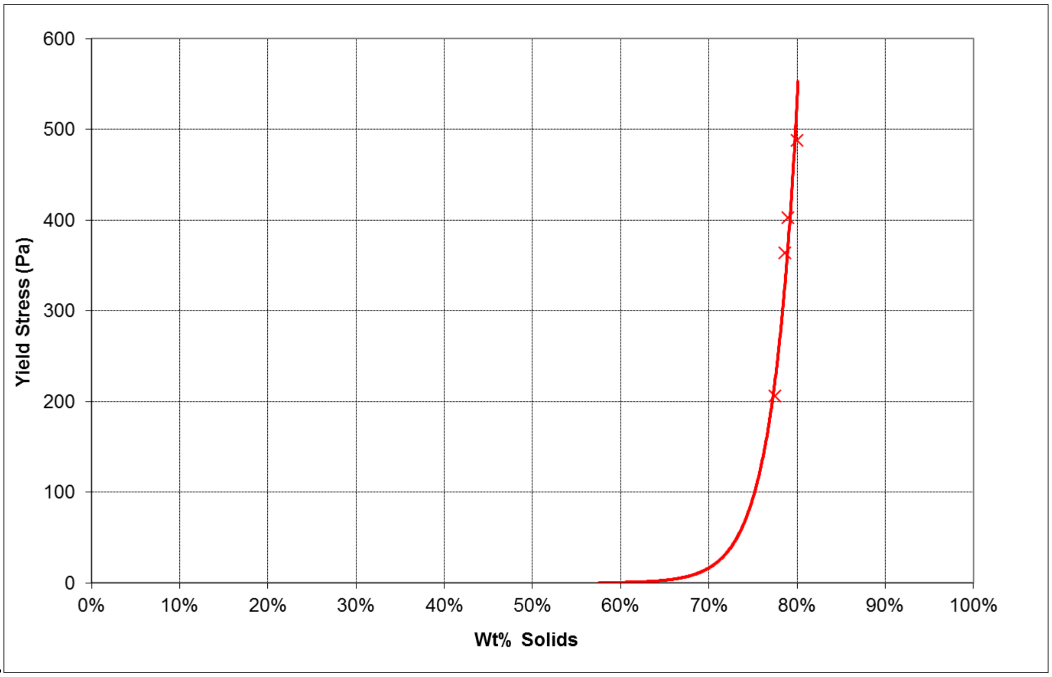


Figure 6: Static Yield Stress vs. wt% Solids - 13-1426-0010 South Pond Tailings

4.3 Flow Loop Test Results

4.3.1 Un-cemented Paste – 100% Tailings

Flow loop testing of the un-cemented paste samples occurred on Day 1 of the flow loop test. The Reimer mixer truck was loaded using an excavator. Once the material was prepared to the target slump, it was discharged via a chute to the concrete pump.

The system was first charged with the thickest material, 125 mm (5”), slump and progressively diluted until 267 mm (10.5”) slump was achieved. At the above slumps and each additional interval outlined in Table 1, full data sets were recorded consisting of pressure loss recordings at varying flow rates. To understand possible changes in flow properties (shear sensitivity) from the beginning to end of each run, pressure losses for the ramp up and ramp down were measured.

The results are presented in Table 5 and on Figures 7 to 10.

Table 5: Un-cemented 100% Tailings Paste Pressure Losses

Slump	DN 125 mm (NPS 5”) Pipe		DN 100 mm (NPS 4”) Pipe	
	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)
125 mm (5”)	0.4 – 2.0 m/s	10 - 37	0.6 – 2.9 m/s	17 – 51
	17 – 87 m^3/hr		17 – 87 m^3/hr	
170 mm (6.75”)	0.5 – 2.0 m/s	8 -16	0.7 – 2.6 m/s	14 – 25
	20 – 86 m^3/hr		20 - 86 m^3/hr	
216 mm (8.5”)	0.4 – 2.1 m/s	7 - 13	0.5 – 3.0 m/s	10 – 20
	15 -90 m^3/hr		15 – 90 m^3/hr	
260 mm (10.25”)	0.4 – 2.1 m/s	4 - 7	0.5 – 3.0 m/s	6 - 10
	15 - 91 m^3/hr		15 – 91 m^3/hr	

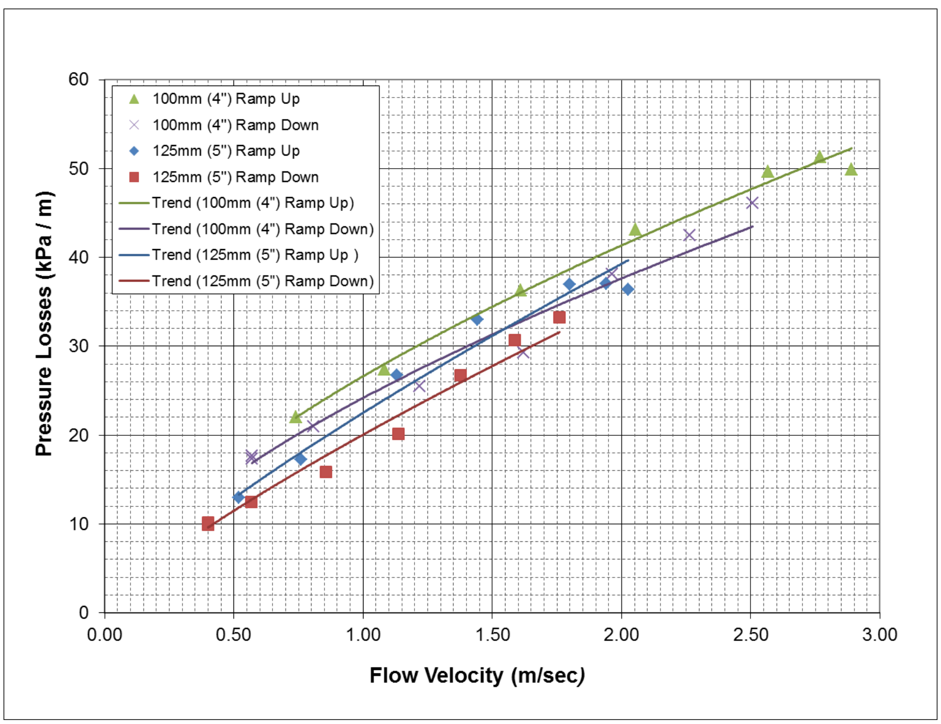


Figure 7: 125 mm (5") Slump - 80.0wt% Solids, Pressure Losses vs. Flow Velocities

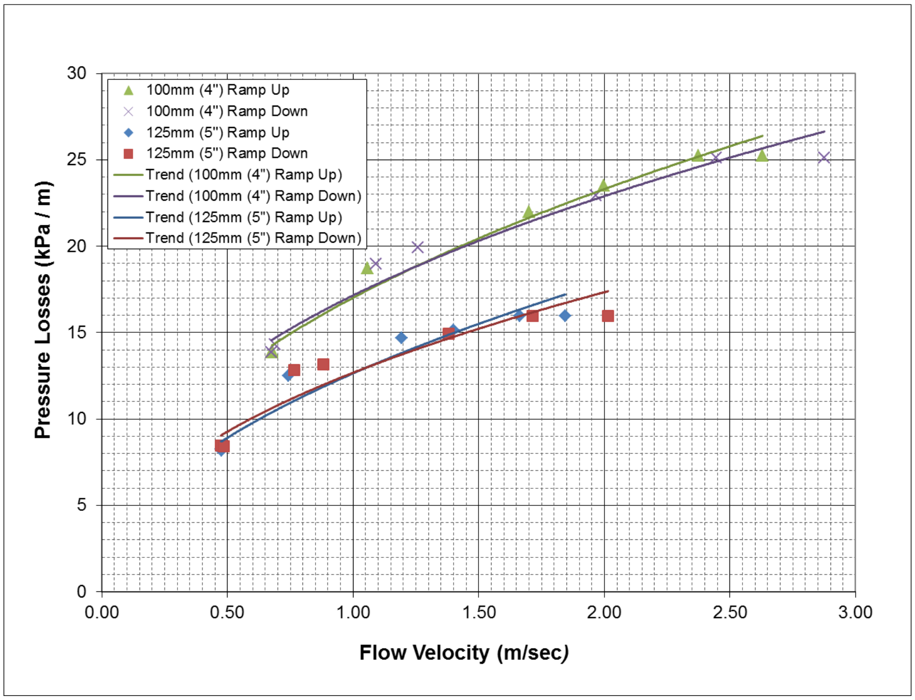


Figure 8: 170 mm (6.75") Slump - 79.0 wt% Solids, Pressure Losses vs. Flow Velocities

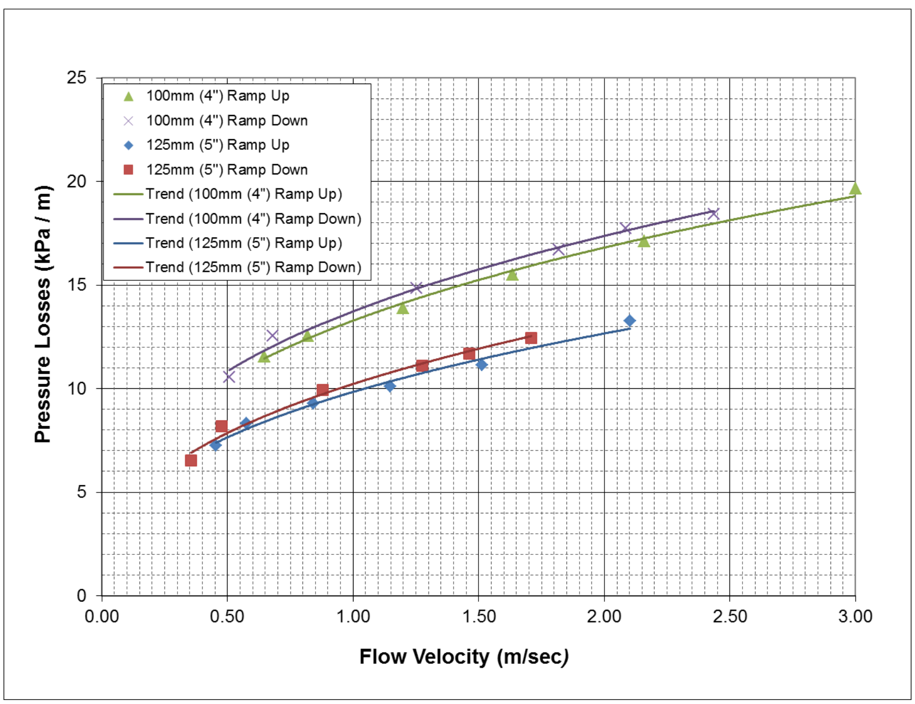


Figure 9: 216 mm (8.5") Slump - 78.6 wt% Solids, Pressure Losses vs. Flow Velocities

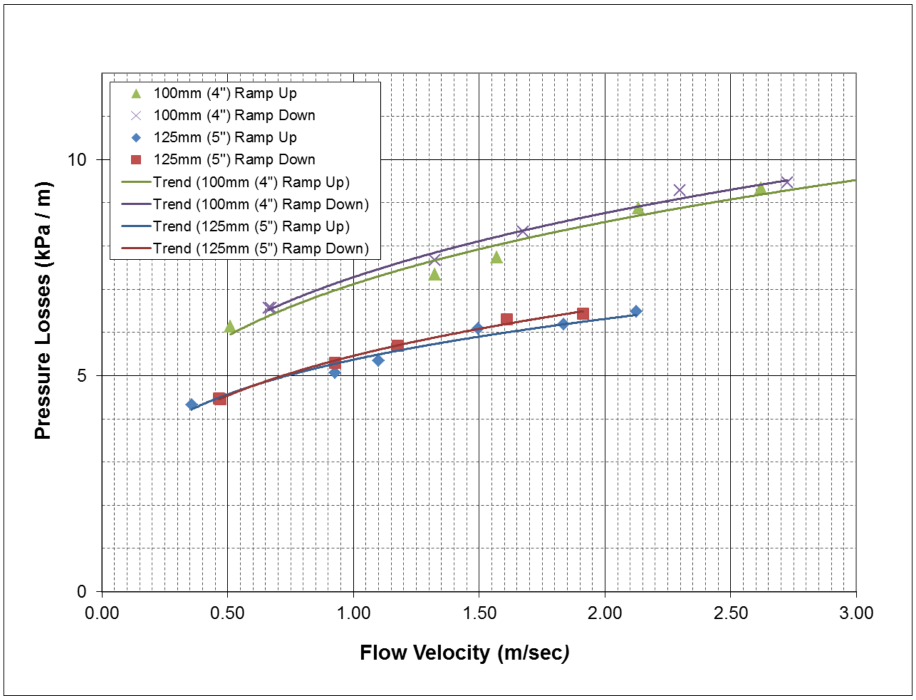


Figure 10: 260 mm (10.25") Slump - 77.5 wt% Solids, Pressure Losses vs. Flow Velocities

4.3.2 Un-cemented Paste + Aggregate

Flow loop testing of the un-cemented 90/10 Tailings/aggregate paste samples occurred on Day 2 of the flow loop test. A blend of 90 wt% South Pond Tailings and 10 wt% aggregate was prepared using the Reimer mixer truck and added slowly to the pump hopper as the paste circulated through the system.

As with the previous un-cemented tailings testing, pressure losses for flow rate ramp up and ramp down were measured. The results are presented in Table 6 and on Figures 11 to 14.

Table 6: Un-cemented 90/10 Tailings/Aggregate Paste Pressure Losses

Slump	ND 125 mm (NPS 5") Pipe		ND 100 mm (NPS 4") Pipe	
	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)
125 mm (5")	0.2 – 1.5 m/s	4 - 34	0.3 – 2.1 m/s	9 – 55
	9 - 62 m^3/hr		9 - 62 m^3/hr	
190 mm (7.5")	0.3 – 2.2 m/s	10 - 28	0.5 – 3.1 m/s	18 – 46
	14 – 92 m^3/hr		14 - 92 m^3/hr	
216 mm (8.75")	0.3 – 2.0 m/s	10 – 28	0.4 – 2.9 m/s	16 – 46
	13 - 87 m^3/hr		13 - 87 m^3/hr	
248 mm (9.75")	0.3 – 1.9 m/s	9 – 16	0.4 – 2.7 m/s	12 - 24
	11 – 80 m^3/hr		11 – 80 m^3/hr	

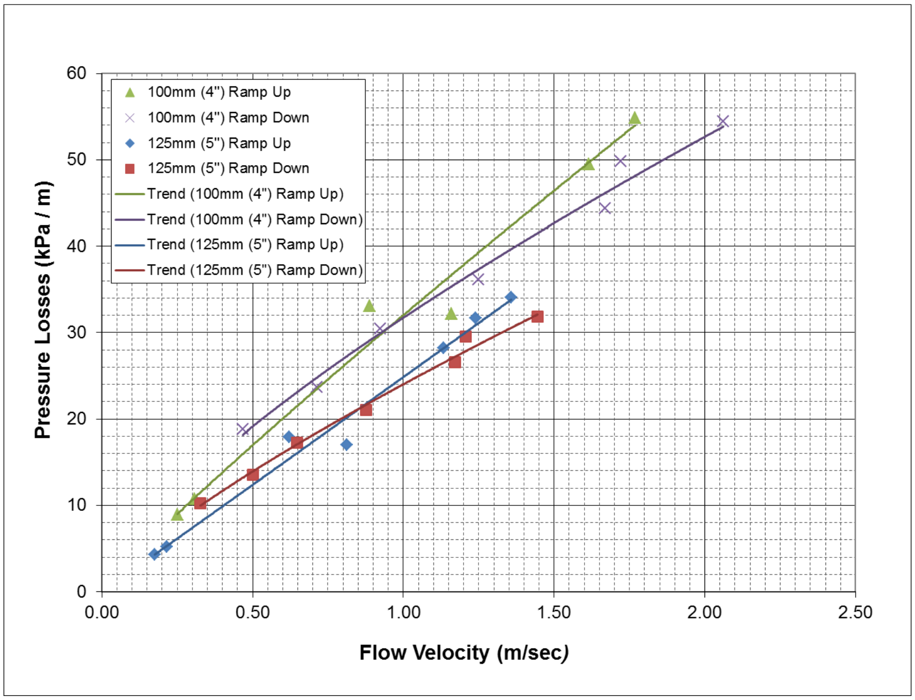


Figure 11: 125 mm (5") Slump with Aggregate - 86.3 wt% Solids, Pressure Losses vs. Flow Velocities

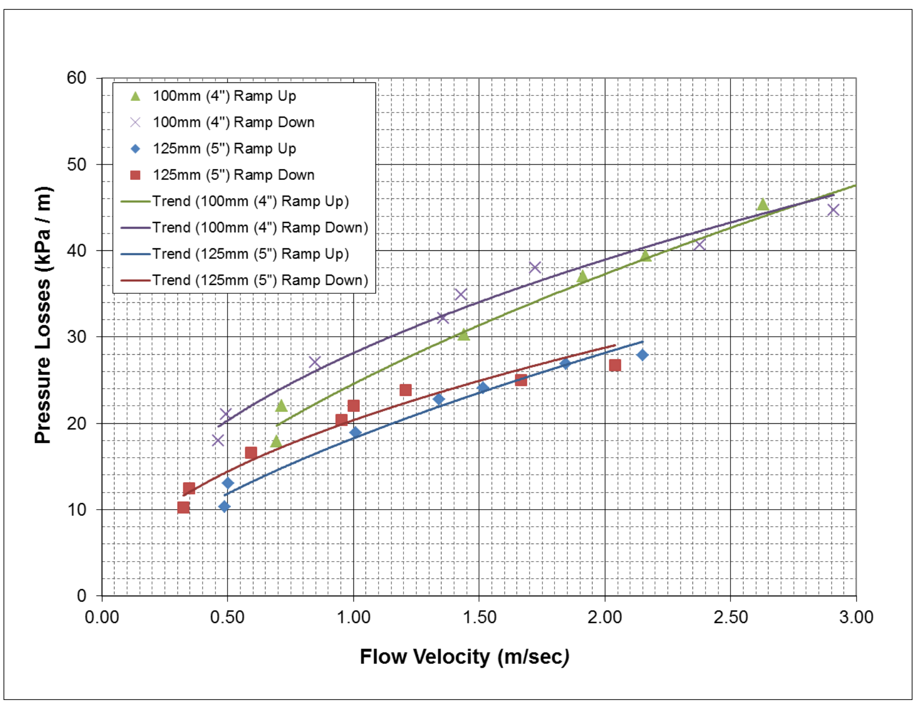


Figure 12: 190 mm (7.5") Slump with Aggregate - 84.6 wt% Solids, Pressure Losses vs. Flow Velocities

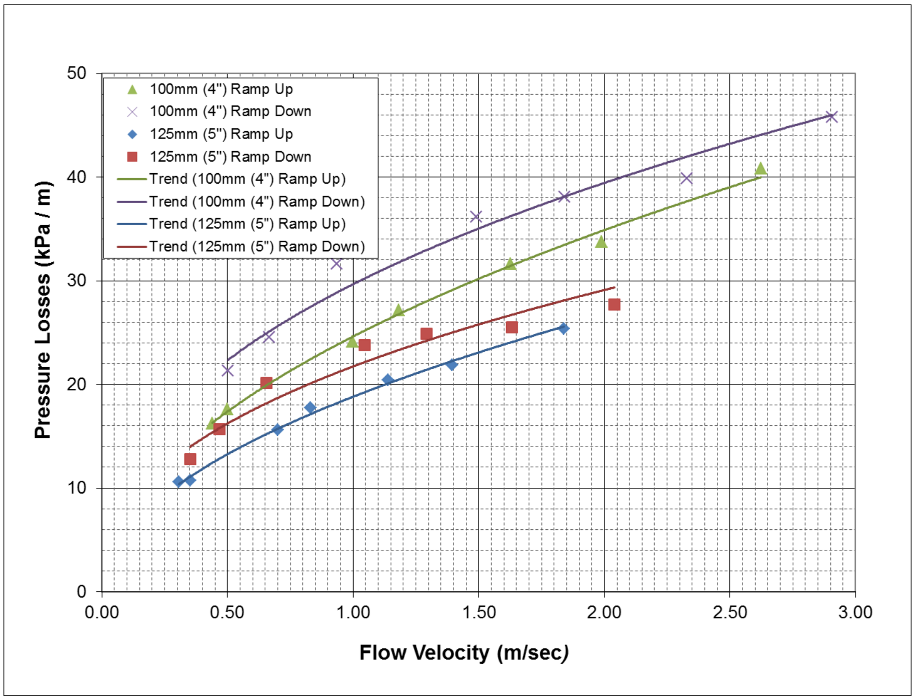


Figure 13: 216 mm (8.5") Slump with Aggregate - 83.2 wt% Solids, Pressure Losses vs. Flow Velocities

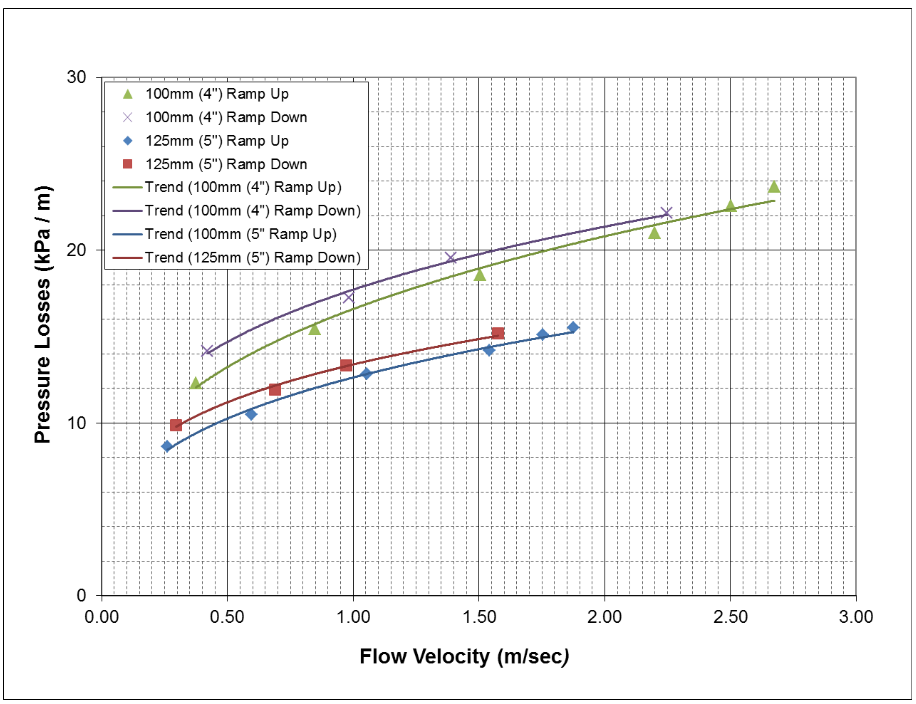


Figure 14: 248 mm (9.75") Slump with Aggregate - 82.6wt% Solids, Pressure Losses vs. Flow Velocities

5.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED	ORIGINAL SIGNED
Mark Labelle	Sue Longo, P.Eng.
Process Laboratory Manager	Associate / Mechanical Engineer

ML/SL/ds

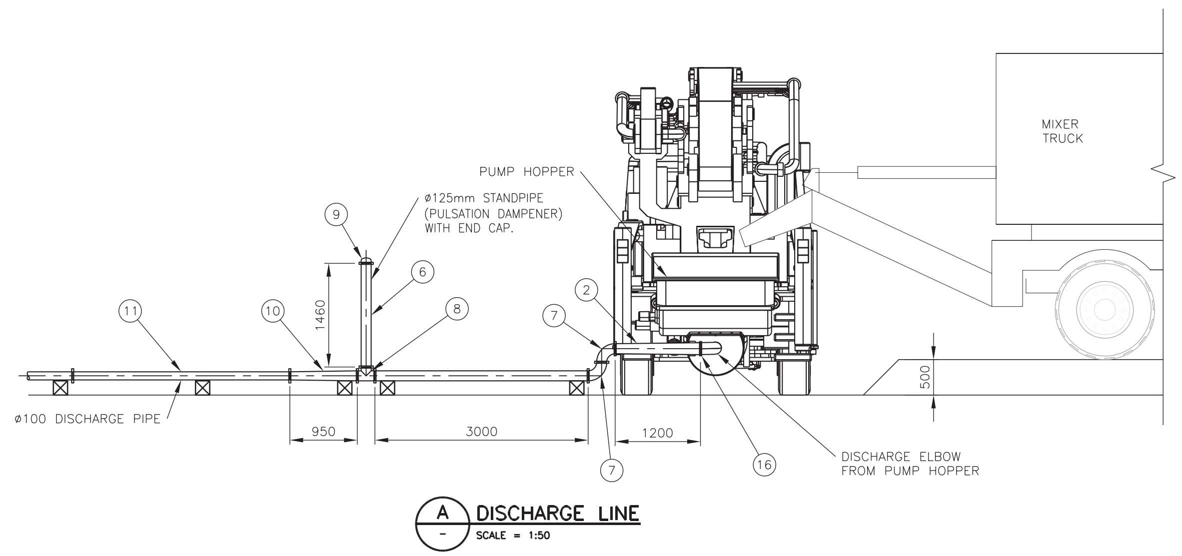
APPENDIX A

Pipeline and Instrumentation Layout

BILL OF MATERIALS

ITEM	QTY.	DESCRIPTION
1	1	POSITIVE DISPLACEMENT PUMP
2	1	ø150mm x ø125mm 'LONG' REDUCER
3	12	ø125mm SCH40 PIPE, 3m LONG
4	2	ø125mm SCH40 TRANSDUCER SPOOL, 3m LONG
5	24	ø125mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
6	2	ø125mm 1.46m LONG SPOOL PIECE
7	3	ø125mm SCH40 90° ELBOW
8	1	ø125mm SCH40 EQUAL TEE
9	1	ø125mm SCH40 END CAP
10	2	ø125mm x ø100mm 'LONG' REDUCER
11	11	ø100mm SCH40 PIPE 3m LONG
12	2	ø100mm SCH40 TRANSDUCER SPOOL, 3m LONG
13	15	ø100mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
14	1	ø100mm SCH40 90° ELBOW
15	1	ø125mm X 20' LONG FLEXIBLE HOSE WITH GROOVED END FITTINGS
16	1	ø150mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
17	Ass't	SOURCE OF WATER FOR FLUSHING / DILUTION

ITEMS MARKED WITH * ARE GOLDER SUPPLY (PRESSURE TRANSDUCERS, FLOWMETER, DATA LOGGING EQUIPMENT AND WIRING TO PRESSURE TRANSDUCERS.)



A DISCHARGE LINE
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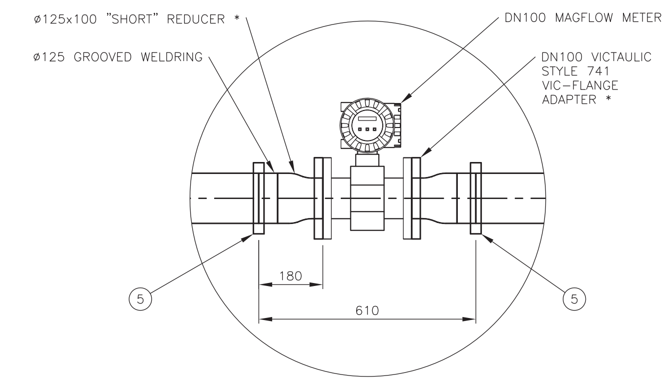

1 DETAIL – FLOWMETER SPOOL
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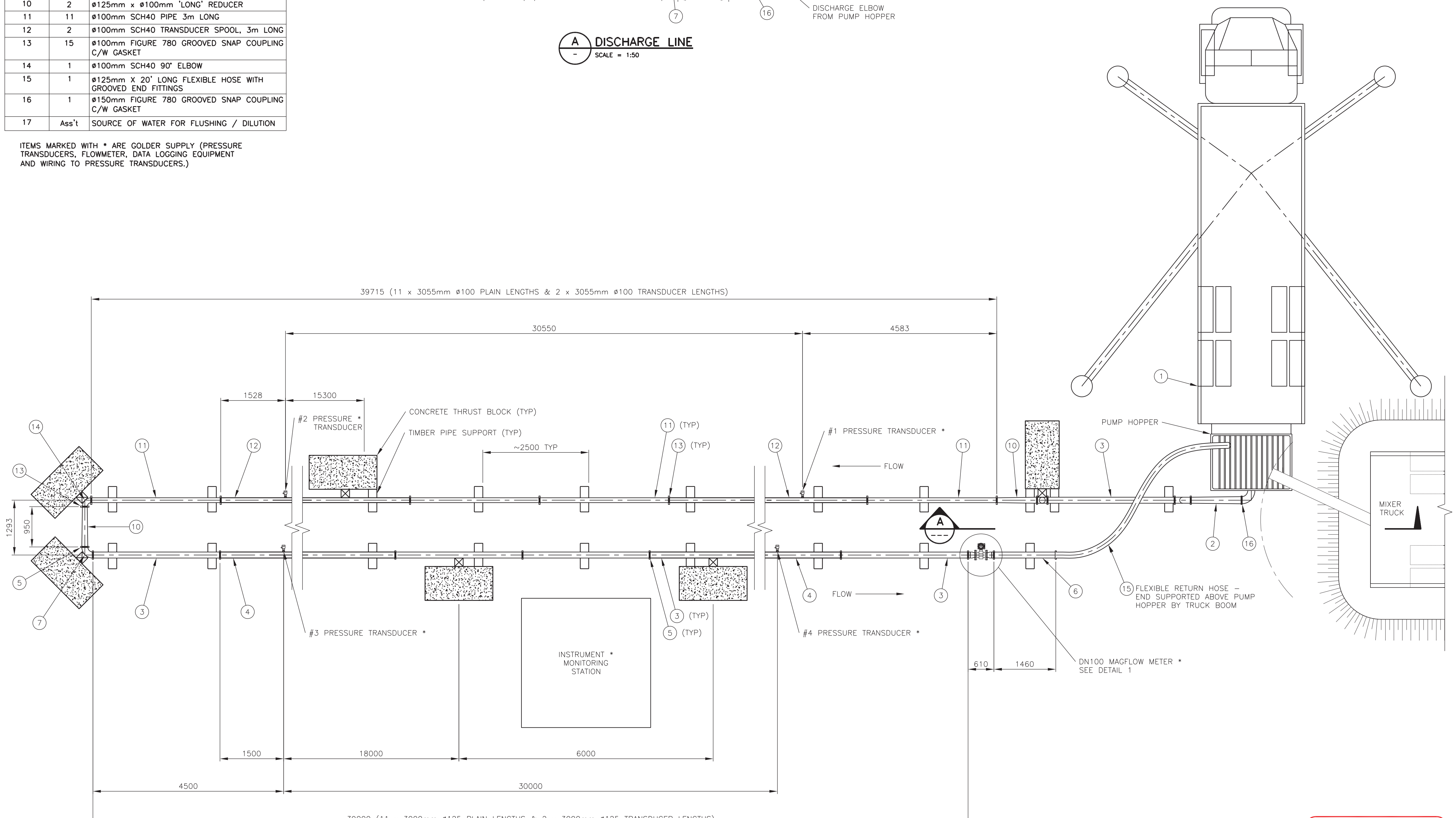

AS CONSTRUCTED

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada
REAL PROPERTY SERVICES
Western Region
SERVICES IMMOBILIERS
Région de l'ouest

Golder Associates

Revision/Révision	Description/Description	Date/Date
0	AS-BUILT	13-12-03

Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

Approved by/Approuvé par: S.L.
Designed by/Conçu par: J.S.
Drawn by/Dessiné par: J.S.
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
PASTE TRIAL AREA
FLOWLOOP
GENERAL ARRANGEMENT
AS CONSTRUCTED

Project No./No. du projet: 13-1426-0010
Sheet/Feuille: 1 OF 1
Revision no./La Révision no.: 0

APPENDIX B

Photos

APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 1

South Pond Tailings Stockpile for Flow loop testing

Photograph 2

Large clay pieces located within the stockpile

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APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 3 South Pond Tailings trial using the Reimer truck	
Photograph 4 Paste Trial with the Reimer truck	

APPENDIX B

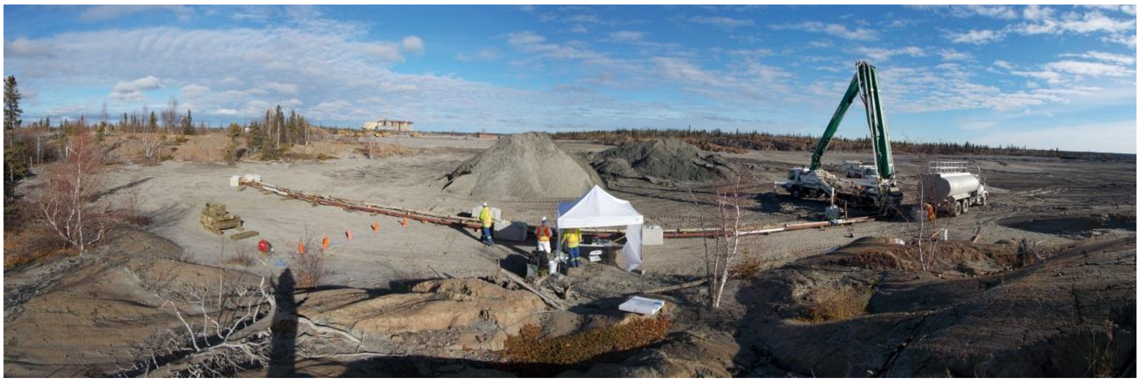
Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 5 Flow loop pipe setup	
Photograph 6 Pressure transmitter installed in the pipeline	

Golder Associates

APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 7 Complete Flow loop set up including pump and water truck for pressure test	
Photograph 8 Data collection area	

APPENDIX B

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Pond	

Photograph 9

Start of South Pond tailings flow loop – Reimer truck feeding pump hopper with paste

Photograph 10

Slump test – 170mm

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APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 11 Collection of samples for laboroatory testing	
Photograph 12 Slump test – 260mm	

APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	
Photograph 13 Flow loop return line into the pump hopper	
Photograph 14 Flushing of the pipeline with water into an escavator bucket	

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APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	
Photograph 15 90% South Pond Tailings – 10% Aggregate flow loop set up - small trailer was used as a data collection area due to high winds	
Photograph 16 90% South Pond Tailings – 10% Aggregate slump test – 125mm	

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APPENDIX B

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Pond	

Photograph 17 90% South Pond Tailings – 10% Aggregate slump test – 190mm	

END OF DOCUMENT

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For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

Golder Associates

APPENDIX C

Pile and Sea Can Testing

Lift Number	Pour Date	Mixture Ratio (%) [Tailings/Aggregate /Cement]	Slump (in)	Moisture Content (wt%)	Paste Specific Gravity	Weight of Tailings (kg)	Height of Paste Stack (m)	Volume of Paste Pumped (m^3)	Notes
Pile #1 (Tailings)									
Lift 1	10-Oct	100/0/15	5"	79.95%	2.14	N/A	1	N/A	
Lift 2	10-Oct	100/0/15	3.5"/6"	80.63%	2.16	15474	1	7.16	
Lift 3	11-Oct	100/0/15	4.5"- 6"	80.18%	2.15	N/A	0.7	N/A	boom is 3m above ground, paste is sticky on shovel
Lift 4	11-Oct	100/0/15	4"	80.40%	2.16	N/A	N/A	N/A	average slump is 4"
Lift 5	12-Oct	100/0/15	3.75"	80.51%	2.16	9170	0.9	4.25	medium sticky
Lift 6	12-Oct	100/0/15	4.5"	80.18%	2.15	5098	N/A	2.37	boom at a height of 3m
Lift 7	12-Oct	100/0/15	N/A	N/A	N/A	N/A	1.4	N/A	
Lift 8	14-Oct	100/0/15	4.75"	80.06%	N/A	N/A	N/A	N/A	
Lift 9	14-Oct	100/0/15	4"	80.40%	2.16	949	N/A	0.44	
Lift 10	15-Oct	100/0/15	2.75"	80.96%	2.17	3086	1.9	1.42	not sticky
Lift 11a	15-Oct	100/0/15	3.25"	80.74%	2.17	2690	1.92	1.24	
Lift 11b	15-Oct	100/0/15	3.25"	80.74%	2.17	2188	1.92	1.01	
Lift 12a	16-Oct	100/0/15	2.75"	80.96%	2.17	2797	N/A	1.29	pretty juicy
Lift 12b	16-Oct	100/0/15	N/A	N/A	N/A	1502	N/A	N/A	pretty juicy
Pile #2 (Tailings)									
Lift 1	10-Oct	100/0/15	N/A	N/A	N/A	N/A	N/A	N/A	
Lift 2a	11-Oct	100/0/15	3.75"	80.51%	2.16	6450	N/A	2.99	
Lift 2b	11-Oct	100/0/15	4.75"	80.06%	2.14	9369	0.53	4.37	
Lift 3	11-Oct	100/0/15	N/A	N/A	N/A	N/A	0.8	N/A	
Lift 4	12-Oct	100/0/15	N/A	N/A	N/A	3905	N/A	N/A	boom at a height of 3m
Lift 5	12-Oct	100/0/15	N/A	N/A	N/A	N/A	1.05	N/A	
Lift 6	14-Oct	100/0/15	4.75"	80.06%	2.14	4274	1.45	1.99	very sticky
Lift 7	15-Oct	100/0/15	3"	80.85%	2.17	2169	1.45	1.00	
Lift 8	15-Oct	100/0/15	3.25"	80.74%	2.17	2394	1.64	1.11	
Lift 9	16-Oct	100/0/15	5"	79.95%	2.14	1783	N/A	0.83	
Pile #3 (Tailings)									
Lift 1	10-Oct	100/0/15	3.5"/6"	80.63%	2.16	15474	N/A	7.16	boom at a height of 3m
Lift 2	11-Oct	100/0/15	N/A	N/A	N/A	N/A	N/A	N/A	
Lift 3	11-Oct	100/0/15	4.75"	80.06%	2.14	N/A	0.5	N/A	average slump for 3 lifts is 4.75"
Lift 4	12-Oct	100/0/15	4.75"	80.06%	2.14	N/A	0.62	N/A	average slump for 3 lifts: 4.75"
Pile #4 (Aggregate)									
Lift 1	11-Oct	90/10/15	4.5"	80.18%	2.15	N/A	0.3	N/A	boom at a height of 4.5m
Lift 2		90/10/15	N/A	N/A	N/A	N/A	N/A	N/A	
Lift 3	12-Oct	90/10/15	N/A	N/A	N/A	N/A	0.7	N/A	
Lift 4	14-Oct	90/10/15	2.25"	81.19%	2.18	2056	1.1	0.94	paste is squishy, very thick, but not sticky
Lift 5	14-Oct	90/10/15	2.25" - 4"	81.19%	2.18	N/A	N/A	N/A	
Lift 6	15-Oct	90/10/15	3.5"	80.63%	2.16	1658	1.5	0.77	
Lift 7		90/10/15	2.75"	80.96%	2.17	N/A	N/A	N/A	
Seacan #1 (Tailings)									
Lift 1	11-Oct	100/0/15	3.75"	80.51%	2.16	5015	N/A	2.32	approx 1/3 binder bin 'solid' cake - slides well
Lift 2	11-Oct	100/0/15	5.75"	79.61%	2.13	5801	0.3	2.72	good consistent cake
Lift 3	12-Oct	100/0/15	5.25"/4"	79.84%	2.14	4850	0.62	2.27	mildly sticky
Lift 4	12-Oct	100/0/15	4"	80.40%	2.16	5829	N/A	2.70	mildly sticky
Lift 5	14-Oct	100/0/15	3.75"/4.5"	80.51%	2.16	5629	1.06	2.61	3.75" paste is not sticky; 4.5" paste is mildly sticky
Lift 6	14-Oct	100/0/15	4.25"	80.29%	2.15	2654	N/A	1.23	mildly sticky
Lift 7	15-Oct	100/0/15	3"/3.25"	80.85%	2.17	3764	1.53	1.74	3" paste is not sticky; 3.25" paste is mildly sticky
Lift 8a	15-Oct	100/0/15	3.25"/3"	80.74%	2.17	3161	N/A	1.46	
Lift 8b	15-Oct	100/0/15	4.5"	80.18%	2.15	2636	N/A	1.23	
Lift 9	15-Oct	100/0/15	4.75"	80.06%	2.14	3329	N/A	1.55	
Lift 10a	16-Oct	100/0/15	4"	80.40%	2.16	1589	2.08	0.74	
Lift 10b	16-Oct	100/0/15	4.5"	80.18%	2.15	619	N/A	0.29	very sticky
Lift 10c	16-Oct	100/0/15	4"	80.40%	2.16	2099	N/A	0.97	mildly sticky
Seacan #2(Aggregate)									
Lift 1	11-Oct	90/10/15	4"/6.5"/4.75"	80.40%	2.16	N/A	N/A	N/A	
Lift 2	12-Oct	90/10/15	6.5"/4"	79.50%	2.13	6811	0.48	3.20	6.5" paste is very sticky; 4" paste is mildy sticky; sample taken
Lift 3	12-Oct	90/10/15	3.3"/5"	80.74%	2.17	4285	N/A	1.98	3" paste is not sticky; 5" paste is mildly sticky
Lift 4	14-Oct	90/10/15	3.75"/3"	80.51%	2.16	5367	1.13	2.49	3.75" paste is mildly sticky; 3" paste is not sticky
Lift 5	14-Oct	90/10/15	3.25"/3.5"	80.74%	2.17	2776	N/A	1.28	3.25" paste is not sticky; 3.5" paste is not sticky
Lift 6	14-Oct	90/10/15	3"	80.85%	2.17	2699	N/A	1.24	paste is not sticky
Lift 7	15-Oct	90/10/15	3"	80.85%	2.17	2653	1.89	1.22	paste is mildly sticky
Lift 8	15-Oct	90/10/15	5.5"/5.25"	79.73%	2.13	2708	N/A	1.27	paste forms a narrow shoulder in the sea can (almost at the top)
Lift 9	16-Oct	90/10/15	3.5"/3.75"	80.63%	2.16	2651	2.2	1.23	

Figure 1: Summary of pile and sea can testing

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

Golder Associates

January 31, 2014

PWGSC GIANT MINE

Paste Field Trial Alternate Binders

Submitted to:
Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6

Attention: Brad Thompson

REPORT

Reference Number: 1314260010-103-R-Rev0

Distribution:

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Study Limitations

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The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

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The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Table of Contents

1.0 INTRODUCTION

PWGSC has retained Golder Associates Ltd. (Golder) to carry out field trial testing at the Giant Mine site as part of the Giant Mine Remediation Project (GMRP). The field test described in this report follows an initial field trial performed in October 2013 to understand the behaviour and characteristics of the Giant Mine tailings and Normal Portland Cement (NPC) as the major constituents for the B1-18 stope backfill recipe.

The purposes of this second field trial is to assess the properties of the backfill recipe when adding alternate binder material to the mix with the purpose of reducing the amount and/or costs of normal Portland cement (NPC). The addition of alternative binders, such as cement kiln dust (KD), fly ash (FA) or blast furnace slag (BFS) could potentially have economical advantages if the backfill recipe gains the target strengths within the target timeframes with a reduced use of NPC.

Once an alternative binder has been selected, the behaviour and characteristics of the new backfill recipe has to be assessed to evaluate the following:

- Overall system performance and verification of equipment suitability;
- Process for backfilling drifts (defined as an isolated mine development tunnel which is typically rectangular shaped e.g. 3 m wide by 3 m high) using low slump cemented paste tailings delivered through boreholes i.e. amount of material and flow characteristics plus rest periods to achieve a suitable barricade;
- Suitable multiple mix designs for placement of low slump cemented paste tailings backfill barricades and high slump lightly cemented paste tailings material for bulk filling that will resist liquefaction in the event of a seismic loading; and
- Pumping performance for various backfill mix designs.

During this second field trial, no paste tailings were pumped into any underground workings. A used shipping container, called a sea can, was used to simulate the underground drifts that need to be backfilled and a closed pipeline loop was used to determine the hydraulic properties of the mix. The field trial equipment set up layout is presented in Appendix A.

The entire field trial was conducted inside the superdome structure to minimize the impact of weather conditions on the trial.

2.0 SAMPLE RECEIPT AND PREPARATION

2.1 Sample Receipt

Tailings samples used in the field trial were acquired from the tailings heated storage dome (superdome) located at the tailings pad area at Giant Mine. This material was originally excavated from the South Tailings Pond and stockpiled by contractors for its use during the backfill program for the B1-18 stope in the fall of 2013. The tailings were excavated from previously selected areas within the pond to avoid collecting material with high clay and/or silt contents. The tailings were then screened to remove any large chunks or foreign objects and were placed in the superdome for paste production.

Samples from the flow loop test (described below) were collected and shipped to the Golder Laboratory in Sudbury, ON for material characterization and further unconfined compressive strength (UCS) tests.

3.0 ON-SITE UCS TESTING

The initial step during this field trial was to perform UCS testing on a variety of paste recipes using an assortment of different binder additives including BFS, KD, and FA. The purpose of this testing was to get a base line of the strength achieved with the NPC mix recipe used in production and to assess the three proposed binder types while keeping the binder concentration and slump consistency constant. Based on the results obtained during the UCS campaign, one binder mix was selected to continue with the field trial. The UCS testing matrix is outlined in Table 1.

Table 1: UCS Trial Testing Matrix

Mix	Binder Content (%)	Binder Type	Sample	Slump	Days Curing (Number of Cylinders Required)				Total No. of Cylinders
					1	3	7	28	
1	3%	100% NPC	100% Giant Mine Tailings	7"	3	3	3	3	12
2	3%	70% NPC / 30% FA		7"	3	3	3	3	12
3	3%	70% NPC / 30% KD		7"	3	3	3	3	12
4	3%	90% BFS / 10% NPC		7"	3	3	3	3	12
5	15%	100% NPC	90% Giant Mine Tailings / 10 wt% Aggregate	7"	3	3	3	3	12
6	15%	70% NPC / 30% FA		7"	3	3	3	3	12
7	15%	70% NPC / 30% KD		7"	3	3	3	3	12
8	15%	90% BFS / 10% NPC		7"	3	3	3	3	12

Cylinders were cured at the on-site lab (Mobile Equipment Garage building) in a humid environment until they were ready to be broken. Cylinders were broken using a Sigma-1 GeoTac load frame. The load was measured using a 10,000 lb (45 kN) s-type load cell as per all other UCS test programs.

The UCS Matrix showed above was designed to provide strength values during the first few days of curing as well as strength values for long term curing. The decision on which alternate binder to choose is based on its early strength gain potential. In the quick turnaround times needed on-site during paste production it is most important to note the one and three days break results. These early strength gain goals are primarily focused on the bulk fill paste recipes i.e. 10" slump with low binder content.

The resulting strengths of the cylinders can be seen in Figures 1 and 2 and are summarized in Tables 2 and 3.

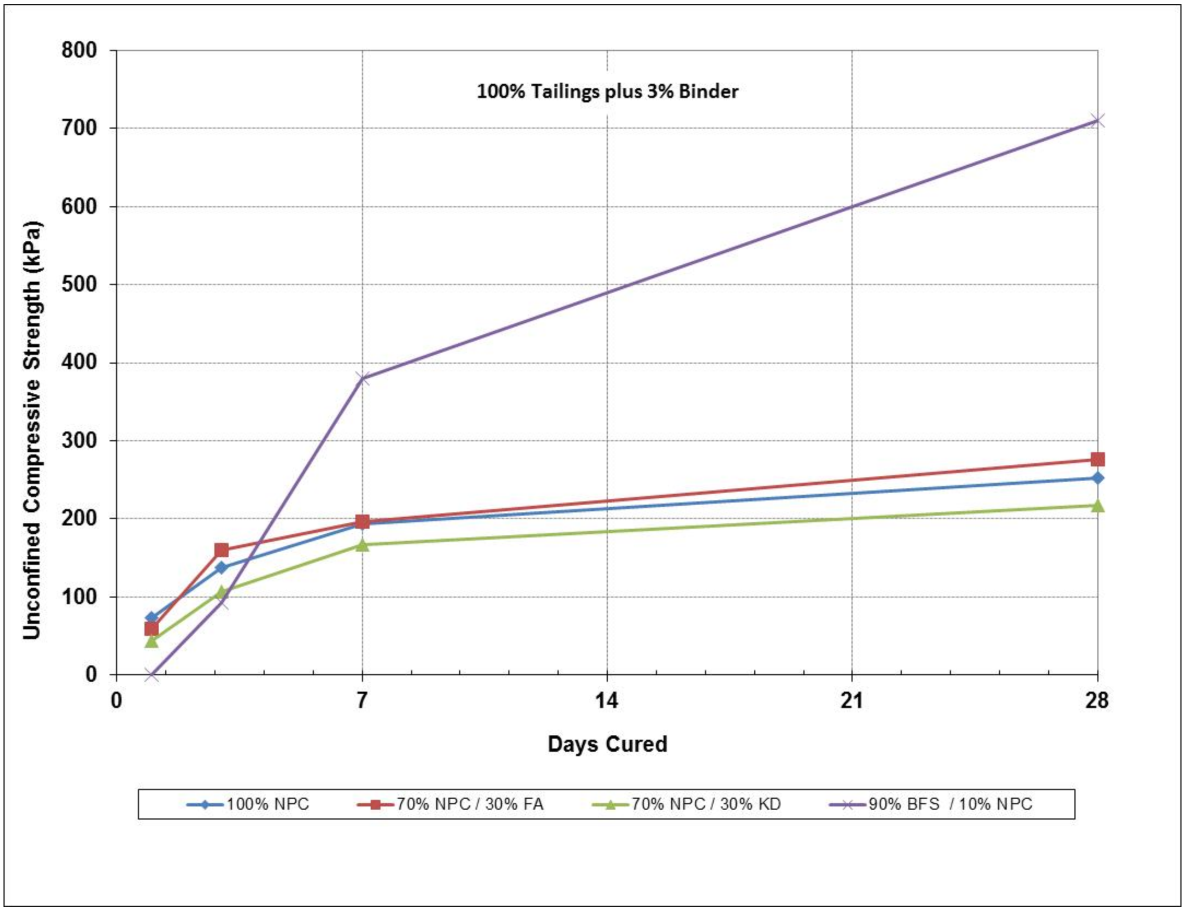


Figure 1: UCS Results- 100% Tailings plus 3% Binder, 7" Slump

Table 2: UCS Trial Testing Results – Paste Mixes with 100% Tailings

Paste Mixes with 100% tailings plus 3% binder					
Mix	**Binder**	**Average Cylinder Strength (kPa)**			
		1-Day	**3-Day**	**7-Day**	**28-Day**
1	100% NPC	73	137	194	252
2	70% NPC / 30% FA	59	161	196	276
3	70% NPC / 30% KD	44	107	167	218
4	90% BFS / 10% NPC	--	92	380	710

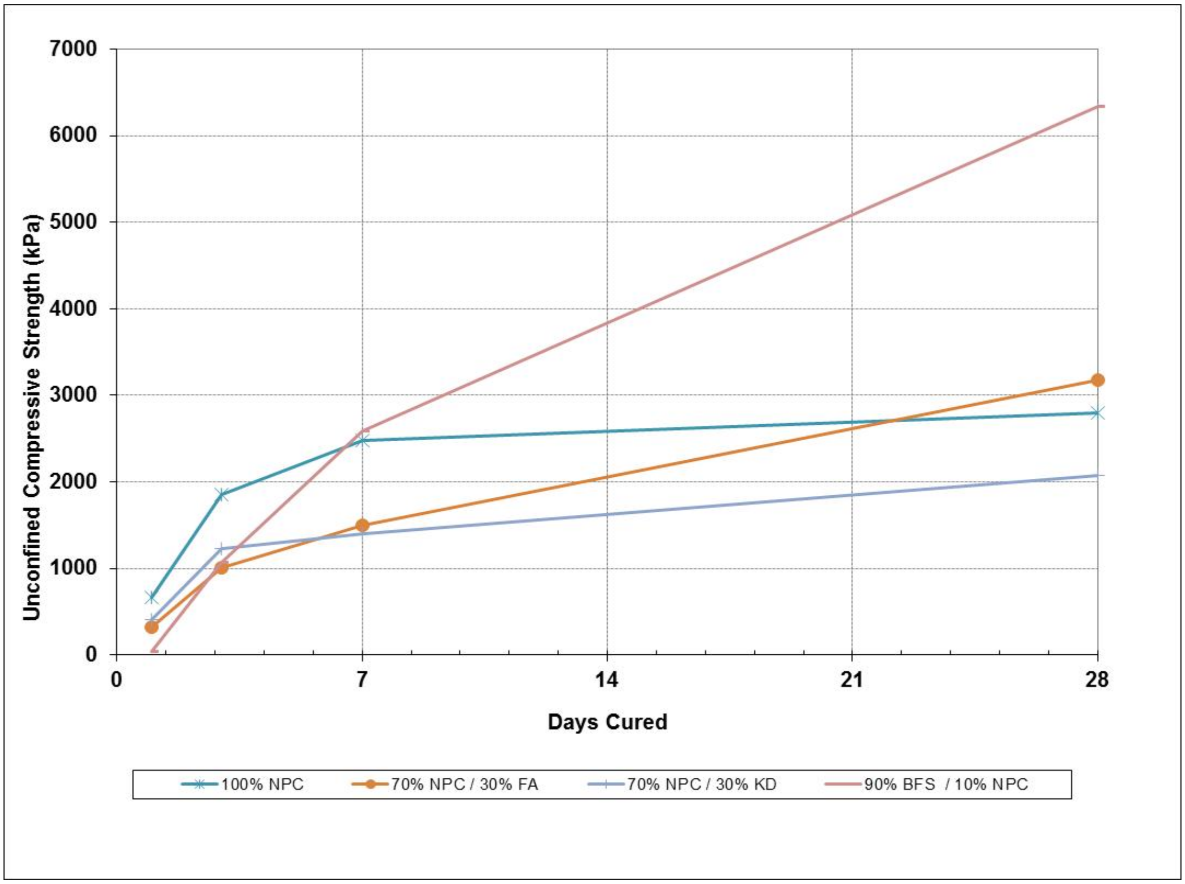


Figure 2: UCS results- 90% tailings, 10% aggregate plus 15% binder, 7" slump

Table 3: UCS Trial Testing Results – Paste Mixes with Aggregate

Paste Mixes with 90% tailings, 10% aggregate plus 15% binder					
Mix	**Binder**	**Average Cylinder Strength (kPa)**			
		1-Day	**3-Day**	**7-Day**	**28-Day**
5	100% NPC	669	1847	2472	2801
6	70% NPC / 30% FA	319	1013	1498	3171
7	70% NPC / 30% KD	407	1231	1400	2073
8	90% BFS / 10% NPC	44	1071	2586	6334

As can be seen in Figure 1 and Table 2 the highest strength during the 1- and 3-day breaks with the 100% tailings mix was obtained with the 70% NPC/30% FA binder. At the same time, the 70% NPC/30% FA with aggregate mix (Figure 2 and Table 3) at the 1-day break reached the second highest strength after KD, but much higher than BFS. As expected, the cylinders prepared with BFS provided the highest strength in the long term, but its relatively slow strength gain makes BFS not an ideal candidate for paste production. Since the vast majority of the paste pours are currently planned with 100% tailings, the selected binder mix to continue the field trial is 70% NPC/30% FA.

4.0 ON-SITE FLOW LOOP TESTING

Flow loop testing provides essential data for the design and operation of pump and pipeline distribution systems. An assessment of the data provides fluid characterization and corresponding rheological properties such as viscosity and yield stress values.

One of the two Reimer mixer trucks used during paste production (Mixer #2) was used to create paste by mixing water, tailings, aggregate, and cement in two different recipes. The paste was then pumped through a positive displacement pump to the field scale flow loop system consisting of 100 mm (4-inch) and 125 mm (5-inch) diameter steel piping. The flow loop was instrumented with a magnetic flow meter and various pressure transmitters. Instrumentation data was collected by a high-speed data acquisition system and laptop computer for data storage. For details on the field trial equipment set up and on the flow loop layout refer to Appendix A.

Flow loop testing was conducted on two paste recipes: one with 100% tailings, and the other with an additional 22% of aggregate. In order to see the effect that binder has on the behaviour of the paste material, 2% binder was added to the first paste mix (bulk fill recipe) while 15% binder was added to the second mix (barricade recipe). The binder added to these mixes was the blend selected from the UCS campaign described above, 70% NPC and 30% FA. A water reducing and cement dispersing admixture (Eucon 727) was also added to the aggregate mix to increase the curing time and ensure that the mixture did not harden in the loop. Both paste mixes targeted 5”, 7”, 8.5”, and 10” slump material.

Individual test runs were performed on each mixture to measure pipeline friction loss at several flow rates. A ‘ramp up’ and ‘ramp down’ technique was used to determine any possible changes in measured pipeline friction loss over time, which would indicate either shear thinning or thickening properties.

In general, the paste mix that showed the highest friction losses was the one containing aggregate. Both paste mixes had the tendency to increase their friction losses as its slumps were lowered.

Samples of each mixture were collected during the flow loop test and were shipped to the Golder Laboratory in Sudbury, ON. Once in the laboratory these samples were tested for pH, specific gravity, particle size distribution (PSD), and further UCS testing.

The pH of the mixture without aggregate and the mixture with aggregate, both without binder, was 8.08 and 8.17 respectively. The specific gravity of these two samples without binder was 2.83 and 2.87 respectively. The particle size D50 for the mixture without aggregate was 116 µm, the D50 of the one with aggregate was 113 µm and the D50 of the aggregate by itself was 8,299 µm.

For the mixture without aggregate, the weight percent solids varied between 79.8 - 77.0% from a 6 - 10.5” slump respectively; and for the mixture with aggregate, the weight percent solids varied between 87.1 - 81.4% from a 5 - 10” slump respectively.

The assessment of the flow loop data, material characterization, and further UCS testing on the flow loop mixes are presented in Appendix B.

4.1 Admixture Calibrations

As explained above, the addition of an admixture (Eucon 727) was required in the paste mix that included aggregate due to its high binder content. The admixture dosage required was calculated to be 100 mL of admixture/100 kg of wet paste. This dosage was calculated using vendor data as well as laboratory testing conducted in the Golder Sudbury Laboratory. The dosage was converted to a total volumetric amount by determining the amount of paste required to fill the loop using the calibrations obtained previously. The resulting volume (~2850 mL) of admixture was slowly added to the paste hopper by hand using a 500 mL volumetric beaker. However, due to high temperatures in the flow loop and a stiffening of the paste mixture an additional 5200 mL of admixture was added to the flow loop (a dosage of approximately 280 mL/100kg of wet paste) over the course of the flow loop testing.

5.0 PILE AND SEA CAN TESTING

Piles and sea can testing were performed using 5" slump paste mixture of 78% tailings, 22% aggregate plus15% of the selected binder (70% NPC/30% FA) to examine whether or not the binder has an effect on the construction and behaviour of remote paste barricades. During these tests, paste was pumped in several lifts over a number of days while slumps, mixer truck counts, lift heights and lengths, temperatures and any qualitative data were recorded.

During sea can testing paste was pumped into the top of a modified sea can in order to simulate the pouring of paste barricades in an underground drift. Several lifts were deposited and data was gathered and used to calculate the volumes, weights, and dimensions of these mock barricades. For a drawing showing the modifications and dimension of the sea can please refer to Appendix C.

Pile #1 was done by pumping paste using a boom truck at a height of approximately 3 m above the ground however because the pile was located outside and the weather conditions were approaching -50º C it was not practical to continue with the pile test so the first lift in the sea can was initiated.

During the pouring of the first lift in the sea can the paste froze inside of the boom and the pour was cut short. Due to these technical difficulties the remainder of the testing was moved inside the superdome where operating temperatures were warmer.

Due to the restricted space inside the superdome pile testing was eliminated. Instead paste was pumped into a front end loader, while the recipe was refined. Once satisfied with the recipe each lift was pumped into the sea can. A total of 6 lifts were deposited into the sea can.

When compared to the sea can tests done in October 2013, the lifts of this campaign seemed to stack up quicker and run less horizontally. The paste mix seems stickier than when using 100% NPC as binder material. For more details on the lifts and the resulting data please refer to in Appendix D.

6.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED   ORIGINAL SIGNED

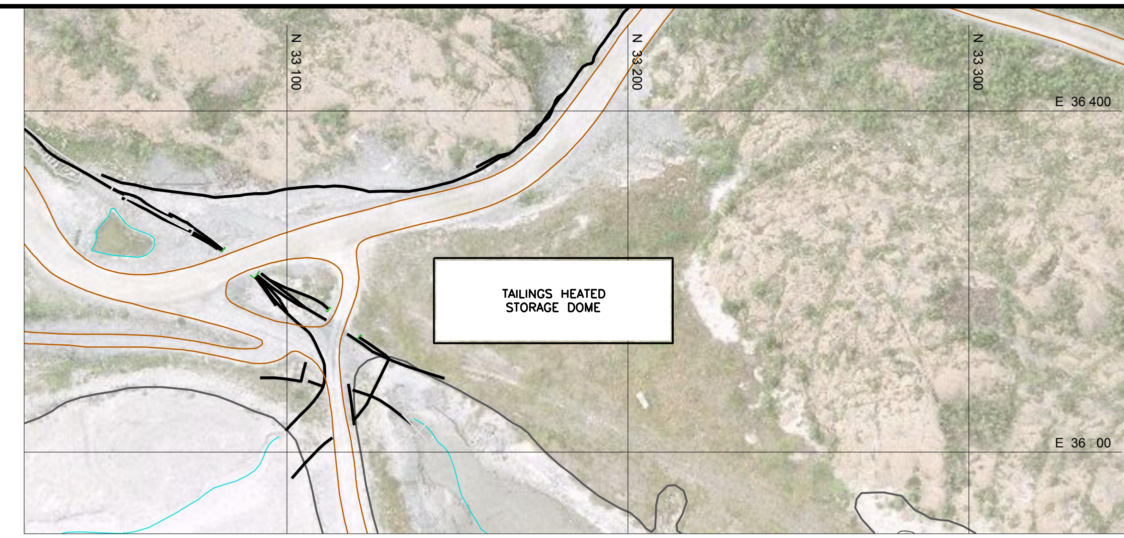
Andrés Quintero
Mechanical Specialist

Sue Longo, P.Eng.
Associate / Mechanical Engineer

JT/TS/SL/ds/md

APPENDIX A

Field Trial Equipment Set Up Layout



KEY PLAN
LOCATION OF TAILINGS HEATED STORAGE DOME
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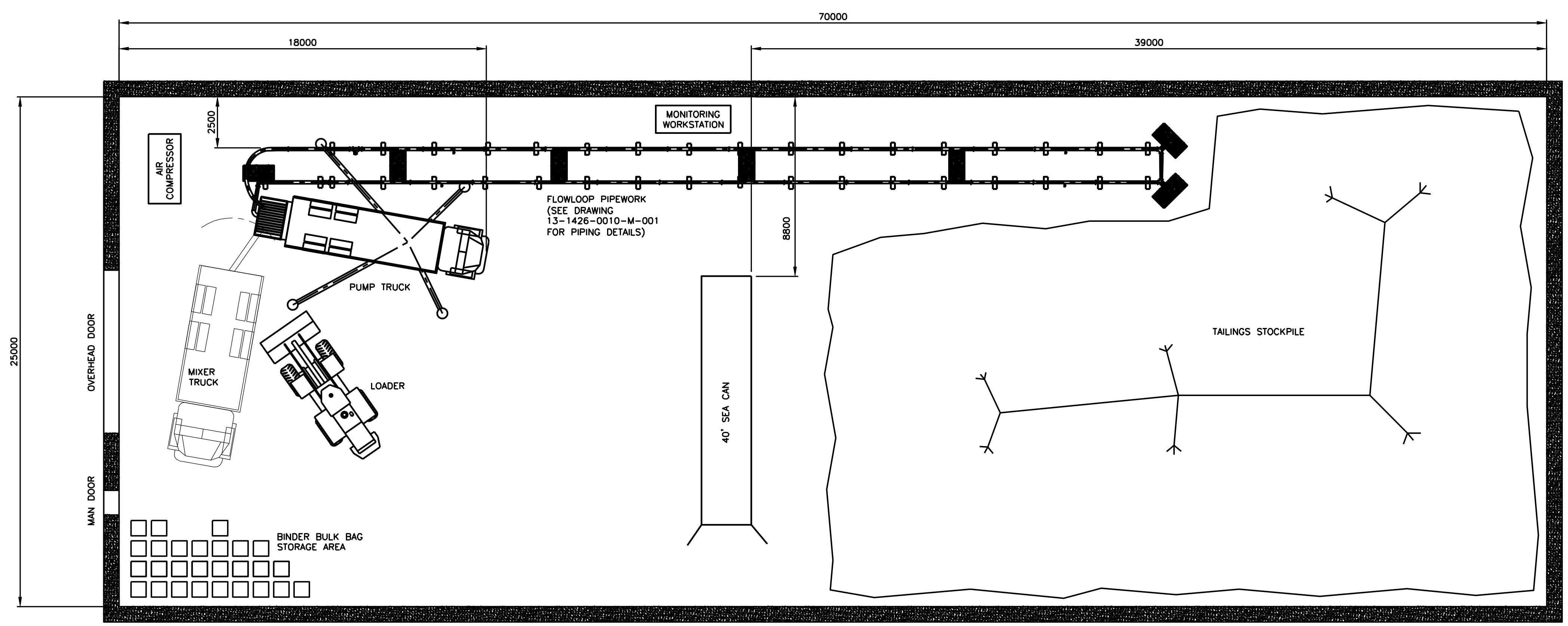

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0	AS-BUILT	14-01-1

Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

Approved by/Approuvé par: S.L.
Designed by/Conçu par: J.S.
Drawn by/Dessiné par: J.S.
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
TAILINGS HEATED STORAGE DOME
ALTERNATIVE BINDER FIELD TRIAL
GENERAL ARRANGEMENT
AS CONSTRUCTED

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	0

AS CONSTRUCTED

PWGSC - A1 - 841X594

13-1426-0010-M-004

APPENDIX B

Flow Loop Data, Material Characterization, Flow Loop Samples UCS

January 31, 2014

PILOT SCALE FLOW LOOP TEST

Giant Mine Backfill Testing - Cemented Tailings

Submitted to:
Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, AB T5J 1S6

Attention: Brad Thompson

REPORT

Reference Number: 1314260010-104-R-Rev0

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The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Table of Contents

APPENDICES

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Golder Associates Ltd. (Golder) to perform an on-site flow loop test at the Giant Mine in Yellowknife, NT. The flow loop testing results provide a basis for the design of the tailings pumping and distribution system.

Transport properties are a function of a number of parameters including tailings characteristics (mineralogy, PSD, chemical composition, slurry pH), slurry densities, volumetric flow rates, temperature, pipeline diameter, degree of shear, pipeline layout. These tests conducted at Giant Mine covered a range of consistencies typical for paste backfill, using cemented material.

The preceding flow loop test work, completed in October 2013, assessed the flow properties of uncemented material. The subject flow loop in this report utilized the same tails, aggregate/tails material mixtures along with added binder to determine the resultant transport properties of the cemented mix.

2.0 SCOPE OF SERVICES

Golder's scope of services included the following.

- On-site flow loop testing:
  - providing instrumentation;
  - monitoring and recording of data; and
  - analysing and reporting of data.
- Bench scale lab testing:
  - material testing; and
  - analysing and reporting of data.

3.0 FLOW LOOP TESTING

3.1 Flow Loop Setup

An instrumented flow loop was constructed by LPR Concrete, RTL Construction, and Golder personnel to determine the transport characteristics of high solids content paste backfill. The loop was a closed circuit pipeline powered by a diesel engine piston pump, specifically a Concord CCP-40X-170 boom truck pump. The pump was capable of delivering up to 170 m^3/hour.

Industrial, high accuracy flush mount pressure transmitters (Endress+Hauser PMC71), provided by Golder, designed for up to 41 bar (600 PSI) were installed in predetermined sections of straight pipe. Pressure data was recorded and the pressure differential between the units was calculated to determine unit pressure gradients. The unit pressure gradients are related to material density, flow velocities and pipeline diameters.

Observations photos are presented in Appendix A.

A magnetic flow meter (Endress Hauser Model Promag 55S) was also provided by Golder for the flow loop test. During the commissioning of the flow loop, using water, the flow meter was used to determine the delivery volume per stroke of the positive displacement pump. As a supplemental check, the efficiency of the pump was also estimated using the number of strokes required to fill the flow loop, a known volume. This was found to be 81.2% which was the result of 14strokes required to fill the 0.992 m^3 loop.

3.2 Test Mixes

Testing was conducted on December 14, 2013 (Day 1) for the cemented tailings paste sample and December 15, 2013 (Day 2) for the cemented tailings and aggregate paste sample.

The tailings from the South Pond that had been stockpiled in the heated dome were transferred into a Reimer mixer truck and the moisture content adjusted to a measureable slump of approximately 5" (125 mm). The material initially used to fill the flow loop on Day 1 and Day 2 had a measured slump of 6" (152 mm) and 5" (125 mm) respectively. A sample of the tailings was collected to determine the moisture content of the starting material. Samples were also collected to determine the moisture content for each of the pulp densities for which flow loop data was collected.

Several paste backfill mixes were prepared from tailings stockpiled and stored onsite next to the flow loop in the South tailings pond storage dome. Table 1 presents the details for each mix tested.

Table 1: Flow Loop Mix Details

Day	Slump (mm)	Material	Binder	Solids Content (%)
1	152 (6")	100% South Pond Tailings	2% (70%NPC/ 30%FA)	81.2
	178 (7")			79.9
	210 (8.25")			78.4
	267 (10.5")			76.9
2	125 (5")	78% South Pond Tailings / 22% Aggregate	15% (70%NPC/ 30%FA)	87.1
	152 (6")			85.3
	203 (8")			84.3
	254 (10")			81.4

Notes: NPC = Normal Portland Cement
FA = Fly Ash

Moisture determinations during the flow loop were completed by Golder's on-site laboratory personnel. Each mix was pumped at variable rates from approximately 20% of maximum flow up to the maximum flow rates possible with the supplied pump. Targeted minimum flow velocity through the Diameter Nominal (DN) 125 mm (National Pipe Size (NPS) (5")) pipe was around 0.5 m/sec to minimize the potential for sliding bed to occur.

3.3 Material Properties

Samples collected during the flow loop test were tested for pH, specific gravity and particle size distribution. Results are presented in Tables 2 to 4 and on Figures 1 to 3.

3.3.1 pH of Samples

Table 2: pH of Samples Received

Sample	pH
13-1426-0010 South Pond Tailings	8.08
13-1426-0010 South Pond Tailings + Aggregate	8.17

3.3.2 Specific Gravity

The specific gravity (SG) of the sample was determined using vacuum de-aired water. Each slurry sample was also vacuum de-aired prior to SG measurement.

Table 3: Specific Gravity Results

Sample	Average
13-1426-0010 South Pond Tailings	2.83
13-1426-0010 South Pond Tailings + Aggregate	2.87

3.3.3 Particle Size Distribution

The particle size distribution (PSD), Specific D-values (% passing a sieve opening). The PSD of the samples were similar to the sample(s) as tested in our Sudbury laboratory in previous phases.

Table 4: Particle Size Distribution

Sample	D10	D30	D50	D60	D80
	(µm)				
13-1426-0010 Aggregate	3438	6281	8299	9308	11936
13-1426-0010 South Pond Tailings	7	45	116	130	188
13-1426-0010 South Pond Tailings + Aggregate	7	41	113	143	561

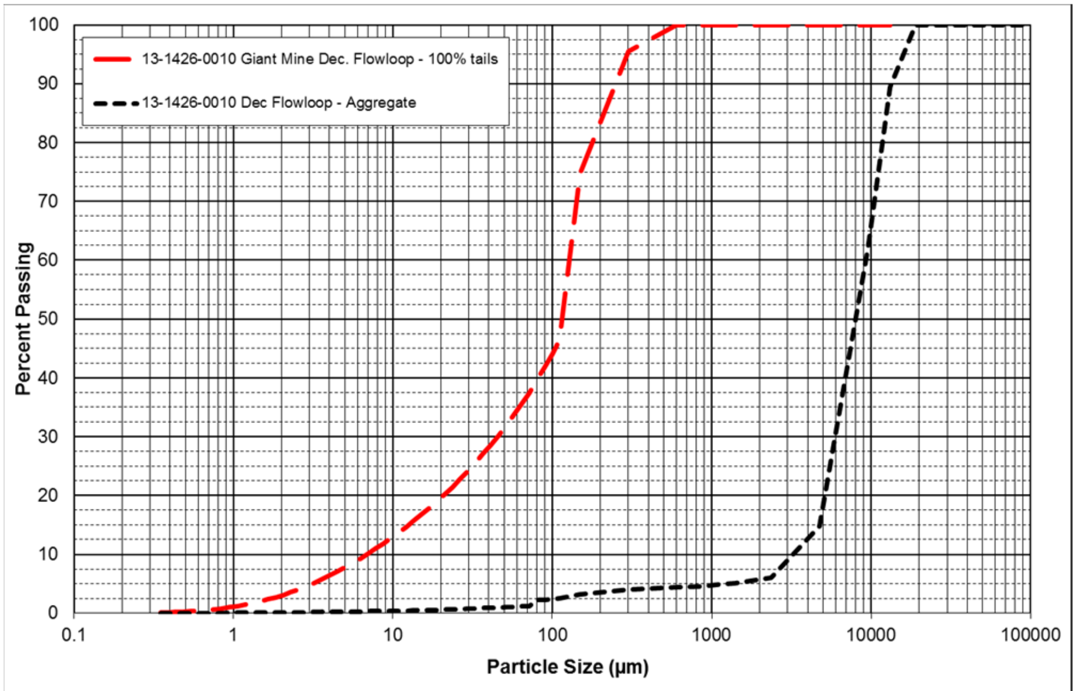

Figure 1: Particle size distribution

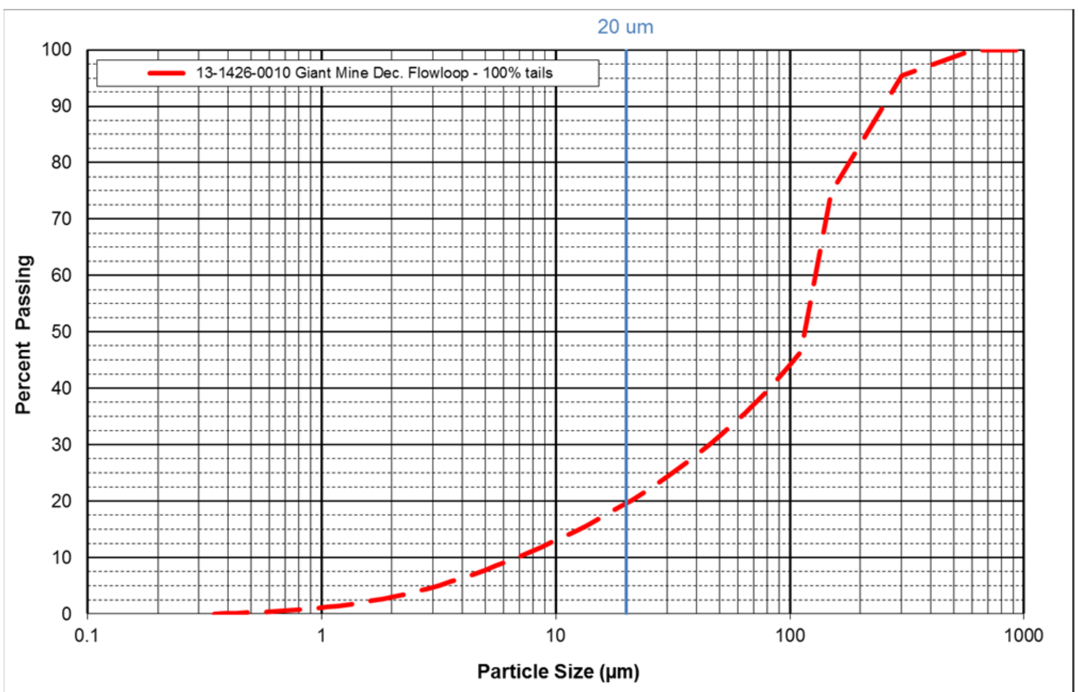

Figure 2: Particle size distribution – South Pond tailings flow loop

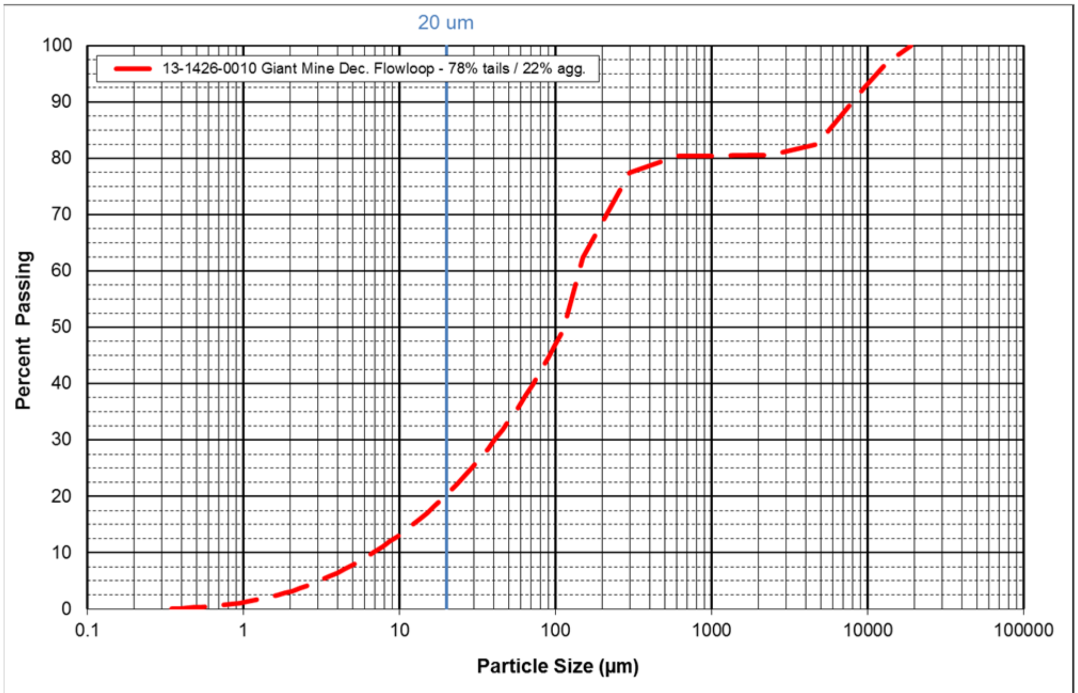

Figure 3: Particle size distribution – South Pond tailings + aggregate flow loop

3.4 Flow Loop Test Results

3.4.1 70%NPC / 30%FA Cemented Paste

Flow loop testing of the cemented paste samples occurred on Day 1 of the flow loop test. The Reimer mixer truck was loaded using an excavator. Once the material was prepared to the target slump, it was discharged via a chute to the concrete pump.

The system was first charged with the thickest material, 152 mm (6") slump, and progressively diluted until 267 mm (10.5") slump was achieved. At the above slumps and each additional interval outlined in Table 1, full data sets were recorded consisting of pressure loss recordings at varying flow rates. To understand possible changes in flow properties (shear sensitivity) from the beginning to end of each run, pressure losses for the ramp up and ramp down were measured.

The results are presented in Table 5 and on Figures 4 to 7.

Table 5: 70%NPC / 30%FA Cemented Paste Pressure Losses

Slump	DN 125 mm (NPS 5") Pipe		DN 100 mm (NPS 4") Pipe	
	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)
152 mm (6")	0.3 – 1.7 m/s	6 - 25	0.5 – 2.4 m/s	14 - 46
	13 – 73 m^3/hr		13 – 73 m^3/hr	
178 mm (7")	0.5 – 1.9 m/s	8 - 20	0.7- – 2.6- m/s	15 - 35
	22 – 79 m^3/hr		22 - 79 m^3/hr	
210 mm (8.25")	0.5 – 1.7 m/s	7 - 14	0.7 – 2.4 m/s	12 - 23
	20 – 73 m^3/hr		20 – 73 m^3/hr	
267 mm (10.5")	0.6 – 1.9 m/s	5 - 7	0.9 – 2.7 m/s	7 - 11
	26 – 81 m^3/hr		26 – 81 m^3/hr	

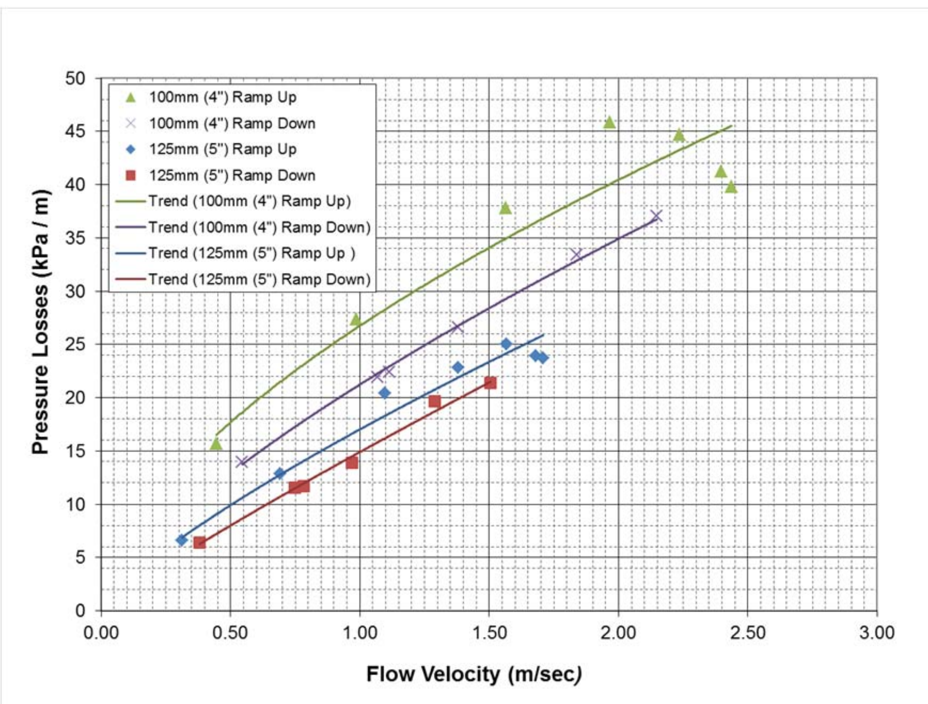

Figure 4: 152 mm (6") slump – 81.2wt% solids, pressure losses vs. flow velocities

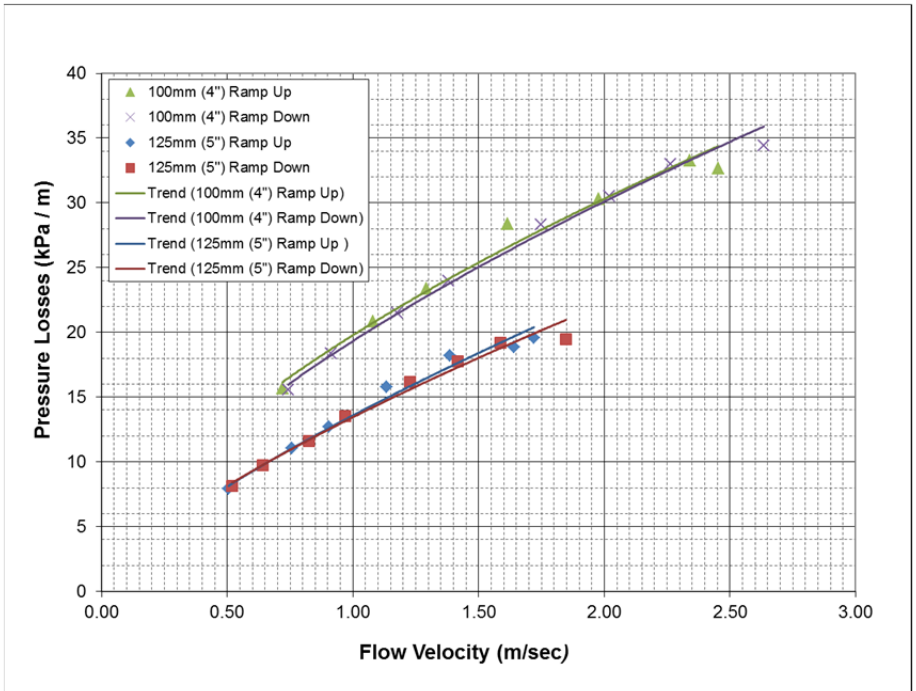

Figure 5: 178 mm (7") slump - 79.9 wt% solids, pressure losses vs. flow velocities

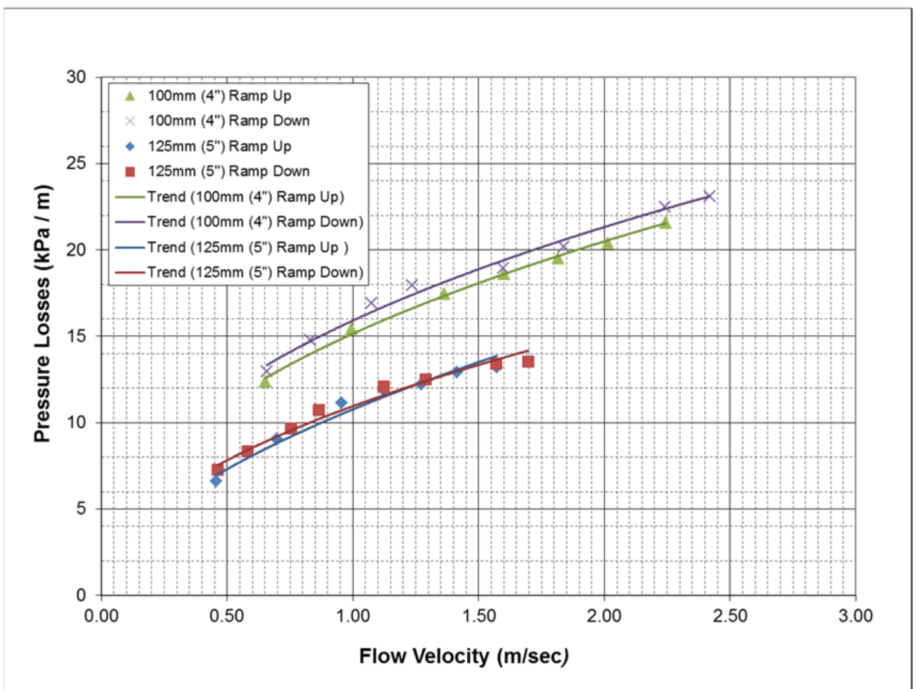

Figure 6: 210 mm (8.25") slump - 78.4 wt% solids, pressure losses vs. flow velocities

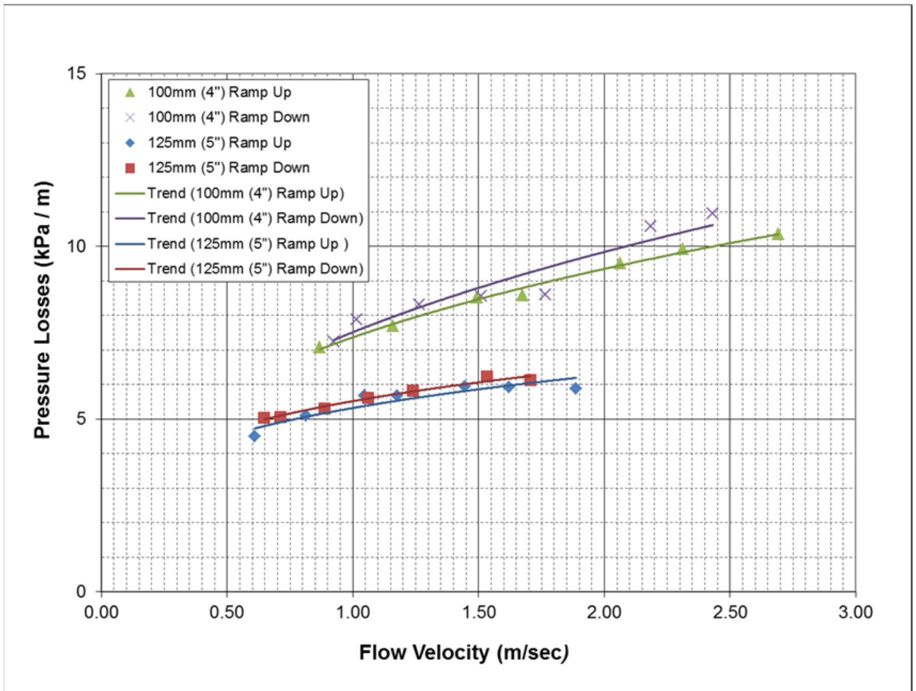

Figure 7: 267 mm (10.5") slump – 76.9 wt% solids, pressure losses vs. flow velocities

3.4.2 70%NPC / 30%FA Cemented Paste + Aggregate

Flow loop testing of the cemented paste and aggregate samples occurred on Day 2 of the flow loop test. A blend of 78 wt% South Pond Tailings and 22 wt% aggregate was prepared using the Reimer mixer truck and added slowly to the pump hopper as the paste circulated through the system. An additive (Eucon 727, mfn. Euclid Chemical Company) was employed to retard the set time of the binder within the loop. Because flow loop material is recycled (re-run through the loop) for an extended period of time, the additive is a must to ensure that the exothermic chemical process of the binder does not play a role in the pressure loss data during the loop trials. A total of 8,050 mL of chemical retardant was added to the mix during the course of the test trials on Day 2.

As with the previous cemented tailings testing, pressure losses for flow rate ramp up and ramp down were measured. The results are presented in Table 6 and on Figures 8 to 11.

Table 6: 70%NPC / 30%FA Cemented 22% Aggregate Paste Pressure Losses

Slump	ND 125 mm (NPS 5") Pipe		ND 100 mm (NPS 4") Pipe	
	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)	Range of Flow Velocities and Rates	Range of Pressure Losses (kPa/m)
125 mm (5")	0.6 – 1.3 m/s	21 - 36	0.8 – 1.8- m/s	37 - 56
	23 - 54 m^3/hr		23 - 54 m^3/hr	
152 mm (6")	0.6 – 1.3- m/s	16 - 38	0.8 – 1.9 m/s	24 - 51
	23 – 56 m^3/hr		23 - 56 m^3/hr	
203 mm (8")	0.4 – 1.8- m/s	14 - 25	0.6- – 2.6 m/s	–19-31
	19 - 77 m^3/hr		19 - 77 m^3/hr	
254 mm (10")	0.4- – 2.0 m/s	11 - 18	0.6 – 2.8 m/s	15 - 24
	18 – 85 m^3/hr		18 – 85 m^3/hr	

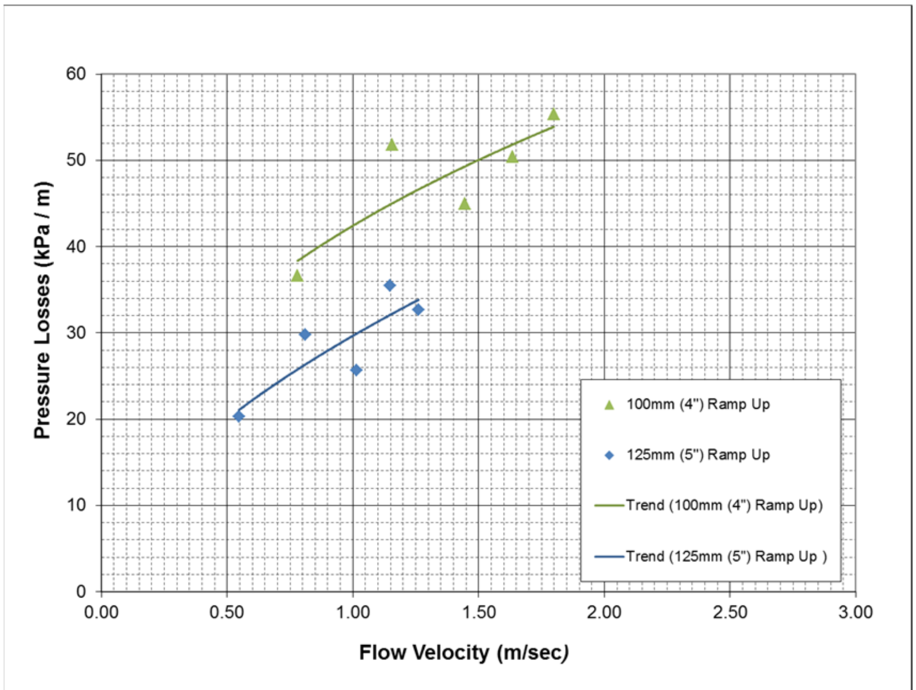

Figure 8: 125 mm (5") slump with aggregate – 87.1 wt% solids, pressure losses vs. flow velocities

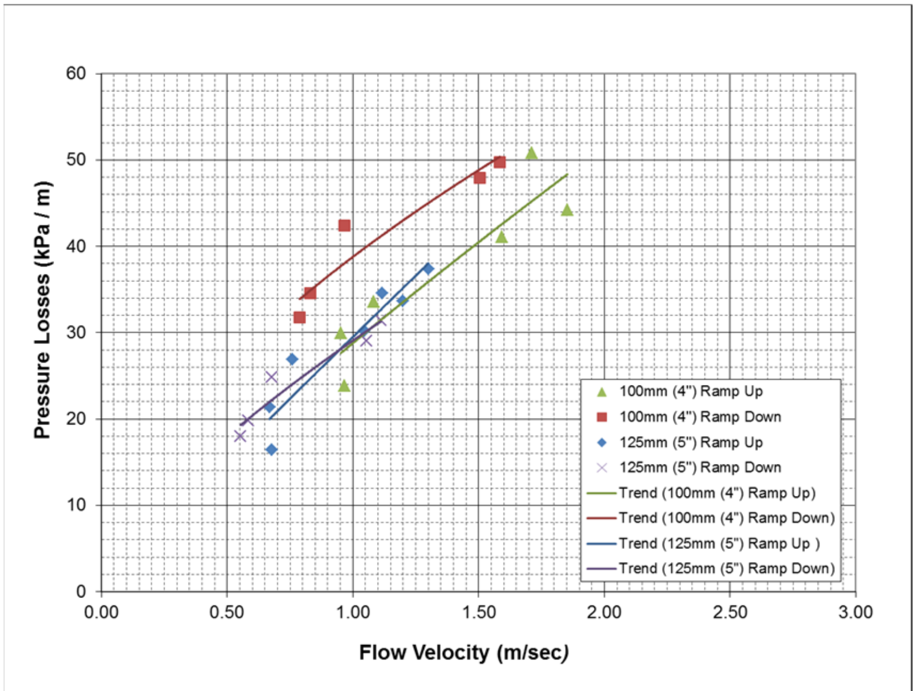

Figure 9: 152 mm (6") slump with aggregate – 85.3 wt% solids, pressure losses vs. flow velocities

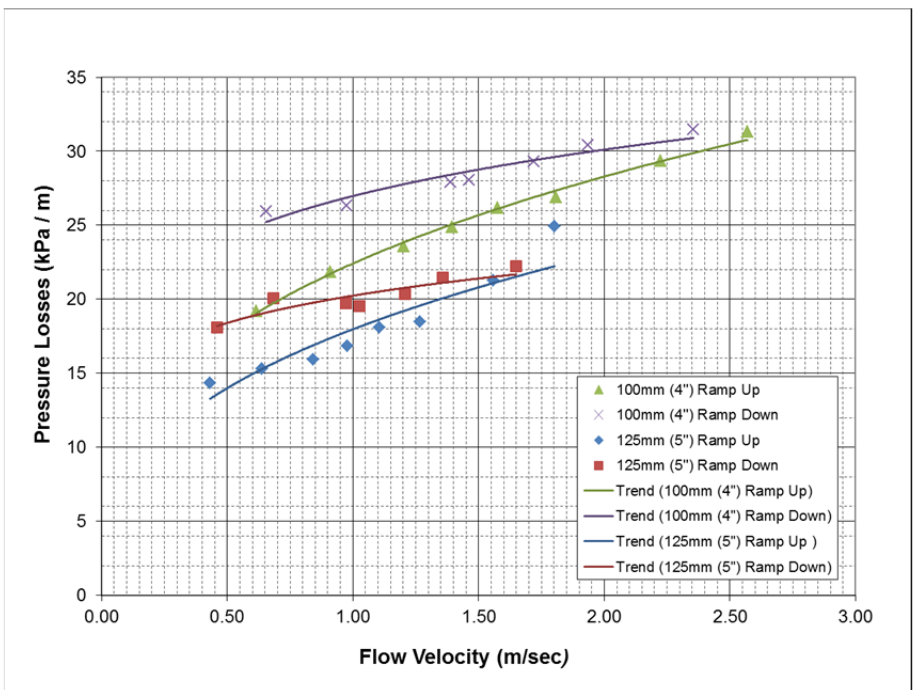

Figure 10: 203 mm (8") slump with aggregate – 84.3 wt% solids, pressure losses vs. flow velocities

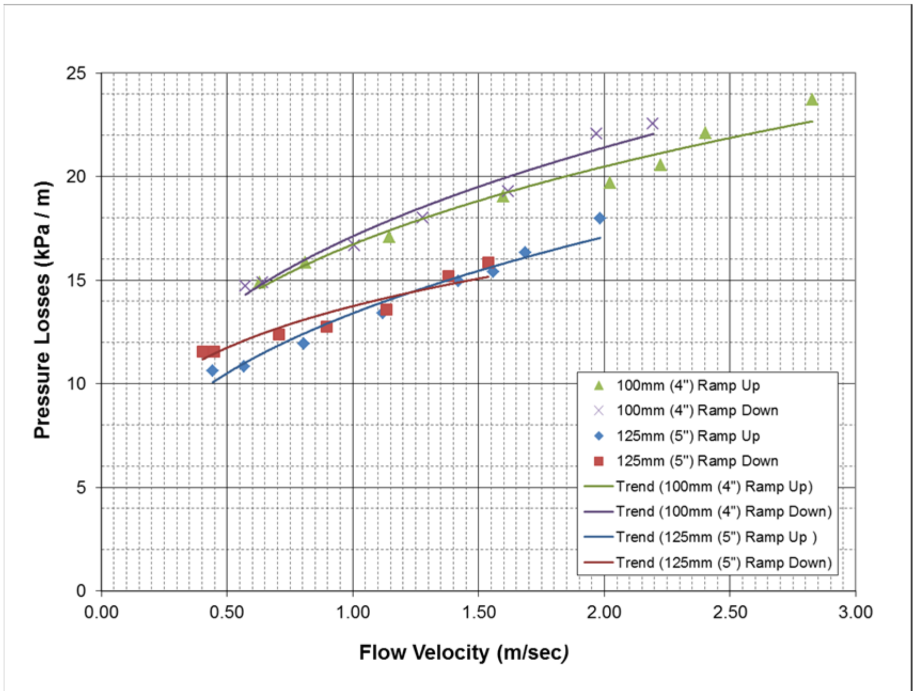

Figure 11: 254 mm (10") slump with aggregate – 81.4wt% solids, pressure losses vs. flow velocities

3.4.3 Unconfined Compressive Strength Testing

Unconfined compressive strength (UCS) testing was carried out using a Sigma 1 GeoTac digital load frame. The load was measured using s-type load cells. Depending on strength, either a 10 kN or 45 kN (2,000 lb or 10,000 lb) load cell was utilized.

The cured cylinder was placed between two platens and during testing the bottom platen advanced at a rate of 2 mm (0.08 inch) per minute. The load was continuously monitored and the peak load was automatically recorded by the instrument.

The UCS program was carried out to assess the backfill strength using 76 x 152 mm (3'' x 6'') cylinders. The cylinders were cured in a humid environment maintained at 15 to 30°C. Three cylinders per curing period were cast and the results were averaged. The results are presented in Tables 7 and 8.

Table 7: 70%NPC / 30%FA 2% Binder UCS Results

Time of Casting	Slump	Average UCS (kPa)				Average Bulk Density (kg/m^3)
		Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Dec 14-13	7" (178 mm)	112	226	264	315	2201
Dec 14-13	10.5" (267 mm)	44	N/A	62	103	2145

Table 8: 70%NPC / 30%FA 15% Binder 22% Aggregate UCS Results

Time of Casting	Slump	Average UCS (kPa)				Average Bulk Density (kg/m^3)
		Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Dec 15-13	8” (203 mm)	N/A	N/A	N/A	4001	2283
Dec 15-13	10” (254 mm)	N/A	N/A	N/A	3160	2401

** 8” slump Avg. bulk density omitting 3 day cylinder mass
** 10” slump Avg. bulk density omitting 7 day cylinder mass

4.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Mark Labelle
Process Laboratory Manager

ORIGINAL SIGNED

Sue Longo, P.Eng.
Associate / Mechanical Engineer

ML/SL/ds/md

APPENDIX A

Observation Photos

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Dome (Day 1)	
Photograph 1 December 14-15 flowloop layout.	
Photograph 2 Concord CCP-40X-170 pump truck pump cylinder spectacle plate. Pre-check to verify plate's smoothness and effective efficiency of pumping unit.	

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 1)	

Photograph 3

Concord CCP-40X-170 pump truck pump cylinder spectacle plate and swing tube. Pre-check to verify gap size between tube and cylinder affecting pumping efficiency.

Photograph 4

Initial leak test of flow loop piping with water. Several joints requiring re-taping to eliminate leakage.

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 1)	

Photograph 5	
December 14-15 flowloop feed line, return line and stand pipe setup.	

Photograph 6	
December 14-15 flowloop pressure transducer #2 (left) and #3 (right).	

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 1)	

Photograph 7

Pressure transducer #3 as installed (December 14)

Photograph 8

December 14-15 flowloop DAQ set-up.

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 1)	

Photograph 9

Sample flowloop slump test (152 mm, 6”).

Flowloop #1 Day 1

Photograph 10

Sample flowloop slump test (152 mm, 10.5”).

Flowloop #4 Day 1

Golder Associates

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 11

Loader transporting tailings from stockpile to Reimer mixer truck.

Photograph 12

Post-calibration mix sample prepared in raised screw feeder chute and discharged through bottom to 5 gal. sample pails.

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 13 Sample pail collected, labelled and shipped to Sudbury lab for further testwork.	
Photograph 14 Initial feed of material into pump truck hopper.	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 15

Initial feed of fairly thick material into pump truck hopper to achieve starting slump of 5" (125 mm)

Photograph 16

Return line into hopper. Used as a sample point.

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 17 Euchlid's Eucon 727 add-mix binder retardant used to prolong the set-up period of binder in high cement applications.	
Photograph 18 Addition of add-mix into hopper (600ml beaker).	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 19 Sample flowloop slump test (125 mm, 5"). Flowloop #1 Day 2	
Photograph 20 Sample flowloop slump test (152 mm, 6"). Flowloop #2 Day 2	

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : South Pond Tailings Dome (Day 2)	

Photograph 21	
Sample flowloop slump test (204 mm, 8”). Flowloop #3 Day 2	
Photograph 22	
Sample flowloop slump test (254 mm, 10.5”). Flowloop #4 Day 2	

END OF DOCUMENT

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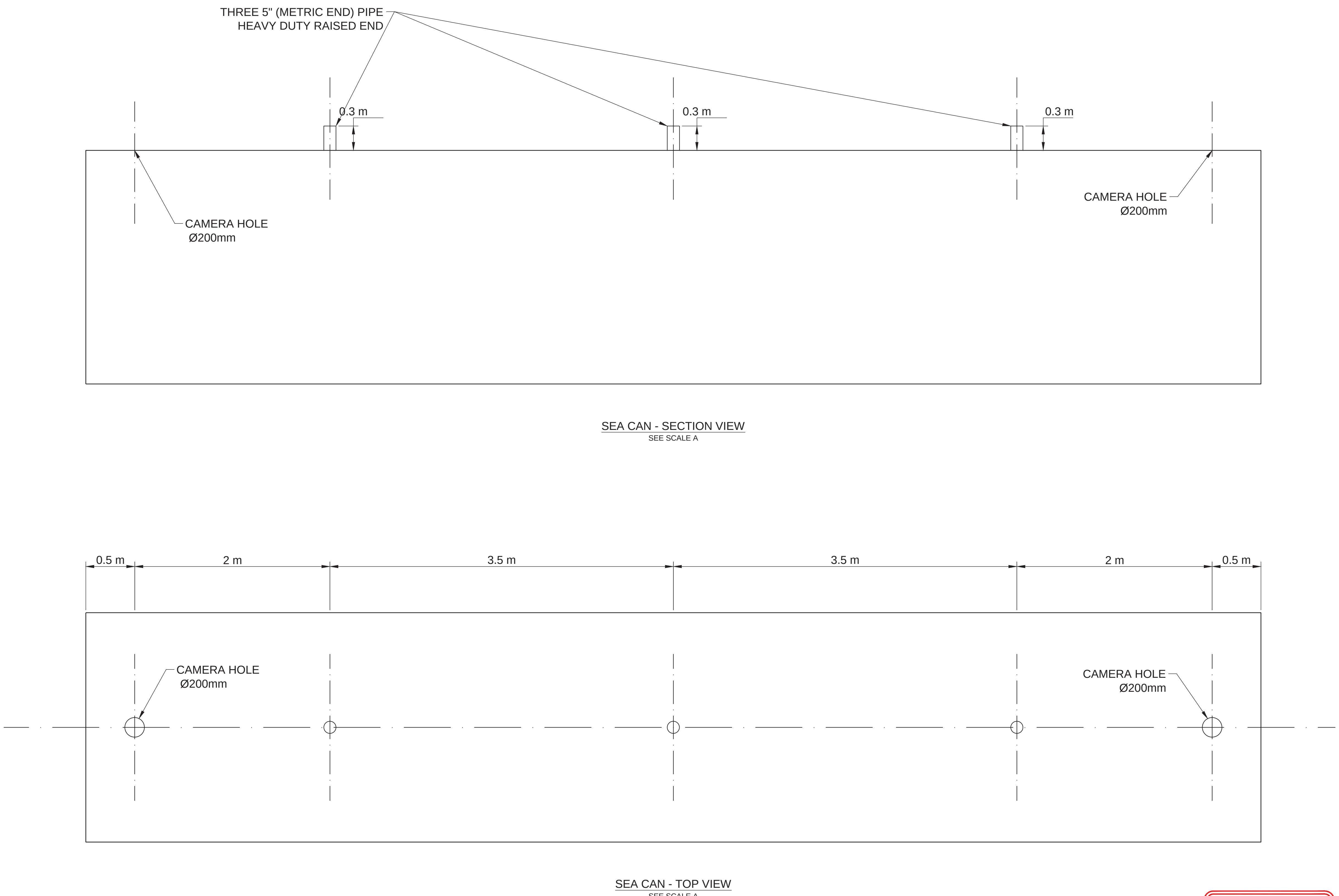
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

APPENDIX C

Pile and Sea Can Testing



AS CONSTRUCTED

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

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

Golder Associates

SCALE A — METRES (0, 0.4, 0.8, 1.2)

Revision/Revision	Description/Description	Date/Date
A	ISSUED FOR REVIEW	2013-10-03

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

UNDERGROUND

Approved by/Approuve par: **SL**

Designed by/Concept par: **AQ**

Drawn by/Dessine par: **TAK**

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

PASTE FIELD TRIAL
SEA CAN MODIFICATIONS

Project No./No. du projet	Sheet/ Feuille	Revision no./La Révision no.
13-1426-0010	1 OF -	A

CADD FILE LOCN: P:\2013\13-1426-0010 PWGSC GIANT MINE - GAL BURNABY\MECHANICAL\13-1426-0010-FG-0041 SEA CAN MODIFICATION.DWG

PWGSC - A1 - 841X594

0 10 20 30 40 50 60 70 80 90 100mm

sea can modifications

APPENDIX D

Pile and Sea Can Testing Summary Sheet

APPENDIX D

Project No.	13-1426-0010	PGWSC GIANT MINE REMEDIATION PROJECT PASTE FIELD TRIAL - ALTERNATE BINDER PILE AND SEA CAN TESTING - SUMMARY SHEET	Golder Associates
Date:	17-Dec-13		
Revision Number:	A		

Lift Number	Pour Date	Pour Time (min)	Slump (in)	Moisture Content (wt%)	Paste Specific Gravity	Weight of Tailings (kg)	Average Length of Lift (m)	Height of Paste Stack (m)	Volume of Paste Pumped (m^3)	Notes
Pile Test (78% Tailings, 22% Aggregate plus 15% Binder)										
Lift 1	11-Dec	20.00	3.75"/5"	80.29%	2.15	2145	3.66	0.36	1.00	Conical, fairly consistent paste, slump tightened during pour
Sea Can Test (78% Tailings, 22% Aggregate plus 15% Binder)										
Lift 1	11-Dec	3.00	3.75"/5"	80.29%	2.15	410	1.80	0.29	0.19	Conical lift, pour cut short due to blockage in pump, lift did not reach walls of sea can. Slump assumed to be the same as pile #2 values
Lift 2	16-Dec	10.06	3"/4.75"	80.51%	2.16	2772	4.50	0.41	1.28	Pour has reached walls of sea can, paste has deposited more on left side of sea can, paste is squishy and sticky, but firm when dimensions were measured
Lift 3	16-Dec	11.80	4.75"/5.75"	79.84%	2.14	2657	5.54	0.59	1.24	Lift fairly symmetrical, paste sticky and wet when dimensions measured
Lift 4	16-Dec	10.15	4"/8"	79.50%	2.13	3533	8.81	0.61	1.66	Paste firm but sticky, FA blend seems sticky and oozes, does not flow, doesn't develop same footprints as NPC
Lift 5	17-Dec	14.38	4.25"/5.5"	80.06%	2.14	2880	6.49	0.9	1.34	Paste very soft, squishy, and wet, toe of lift does not reach toe of last lift
Lift 6	17-Dec	11.62	5.5"/5.5"	79.73%	2.13	2657	unknown	1.09	1.24	

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solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

Golder Associates

APPENDIX 5

Foam Test Report

January 30, 2014 Reference No. 1314260010-075-L-Rev0-5000

Brad Thompson
Public Works and Government Services Canada (PWGSC)
Telus North Tower
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6

PERFORMANCE OF FOAMING RESIN DURING FIELD PROOF-OF-CONCEPT TRIAL

Dear Mr. Thompson,

This letter summarises Golder's appraisal of the foaming resin proof-of-concept trial carried out at the South Tailings Pond at the Giant Mine Remediation Project on October 24, 2013. The outcomes of this test, specifically addressing the questions outlined in the **Work Plan #: 006 Foaming Resins Execution Plan**, are described below.

- The mobility of the un-foamed resin proved satisfactory during the proof-of-concept trial. During the trial, the resin was poured onto the flat floor of a shipping container. The resin did not migrate more than 50 cm from the delivery point before foaming occurred. However, it should be noted that the diameter of the delivery hose was very small and as such, may have limited the mobility of the un-foamed resin. On a production scale, we anticipate that a much larger volume may be delivered and the un-foamed resin, because of its unit weight, may spread further prior to the initiation of foaming.
- The potential distance of migration along an inclined surface prior to the initiation of foaming was not tested as time was limited. While it is not anticipated to be problematic, this portion of the proof-of-concept trial should be tested during an additional trial.
- The proof-of-concept trial was also planned to be undertaken within/onto a sample of underground run-of-mine muck. The aim of this trial was to determine whether the permeability of the muckpile would be sufficient to allow the resin to "soak into" (or saturate) the muck. As the location of the trial was moved from its originally proposed location on the morning of the test, this portion of the proof-of-concept trial could not be completed. It is our opinion that whether or not the saturation of the muck with resin prior to the initiation of foaming is possible should still be tested.
- The equipment supplied to conduct the proof-of-concept trial requires refinement. The suction hoses which extracted the product from the drums frequently recoiled out of the drums which resulted in interruption to resin delivery. As discussed above, the hoses which were to be used to deliver the product to the shipping container were of a small diameter. This limited the rate of resin delivery to the shipping container and resulted in the proof-of-concept trial being cut short due to the loss of daylight. The plug constructed in the shipping container did not reach the full height of the inside of the container. Nevertheless, it is expected that the plug would have been completed, had additional time been available.

The issues described above have been outlined for and discussed with the Contractor, and are currently being addressed. Additional details regarding the trial can be found in the attached report.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Patrick McCann, M.Sc.
Intermediate Rock Mechanics Specialist

ORIGINAL SIGNED

Darren Kennard, P.Eng.
Associate, Geotechnical Engineer

PMcC/DTK/ja/kp

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January 30, 2014

REPORT ON

Foaming Resin Proof-of-Concept Test Report

Submitted to:

Public Works and Government Services Canada (PWGSC)
Telus North Tower
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 1S6

Attention: Brad Thompson

REPORT

Reference Number: 1314260010-076-R-Rev0-5000

Distribution:

1 Electronic Copy - PWGSC
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Table of Contents

1.0 INTRODUCTION

At the request of Public Works and Government Services Canada (PWGSC) a proof-of-concept trial to assess the suitability of using a two-part foaming urea-silicate resin for remote void filling was carried out in a shipping container located in the South Pond tailings impoundment area, at the Giant Mine Remediation Project (GMRP) in Yellowknife, NWT, on October 24, 2013.

The tests were carried out to assess the mobility of the un-foamed resin product, and to develop a pour strategy which will allow for the effective filling of the underground voids. The effectiveness of storage and use of the foaming resin during winter months in a northern climate were also assessed.

2.0 PROOF-OF-CONCEPT TRIAL

2.1 Testing Procedure

Details regarding the proof-of-concept trial were presented in our technical memorandum entitled "WORK PLAN #:006 FOAMING RESIN EXECUTION PLAN" dated October, 23rd, 2013. For completeness, a copy of that TM is included in Appendix A.

Normet Canada Ltd. (Normet) were contracted by Clark Builders to perform the foaming resin proof-of-concept test. An approximately 12.2 m long, 2.5 m wide, 2.5 m high shipping container was provided by Clark Builders to Normet for the purposes of simulating an underground drift on surface. This shipping container was placed on the South Pond tailings impoundment area for the test.

2.2 Materials Used for Test

Prior to the test, calculations were made to estimate the volumes of resin required to construct at least two test plugs within the shipping container during the surface trial. Normet transported three 55 gallon drums of Tampur 117 Part A and three 55 gallon drums of Tampur Part B to site, along with a small positive displacement pneumatic pump and associated hydraulic lines. The equipment was assembled and tested on the day prior to the test and was found to be functioning correctly.

2.3 Pour Strategy

A number of holes were cut into the top of the shipping container to simulate a drill hole intersecting an underground opening. An approximately 15 mm diameter delivery hose was attached to the inline static mixer and inserted into the shipping container through a delivery hole. The flow of resin was controlled from outside the container by a Normet representative.

2.4 Work Carried Out

The test pour commenced at ~14:30 and finished at ~17:30.

The plug constructed in the shipping container was the full width of the container, ~3 m long, and ~1.8 m high with a cone of resin on top extending up to the delivery point (Figure 1). The progress of the foam plug development was monitored using a fixed camera. A shortened montage of this footage has been produced and will be forwarded under separate cover to PWGSC.

During the trial, the resin was poured onto the flat floor of a shipping container. The resin did not migrate more than 50 cm from the delivery point before foaming occurred.

The plug was not entirely completed due to inclement weather conditions and fading daylight, the use of a small diameter delivery line limiting the volume of resin which could be delivered.

Post-curing, a notch was excavated in the face of the plug with a hand axe to obtain samples of the foamed resin. The surface of the plug, which was in contact with air, appeared to be weak and fissile. However, where the foamed product was not in immediate contact with air (i.e., in the face of the excavated notch), it was found to be more coherent and had a closed cellular form.

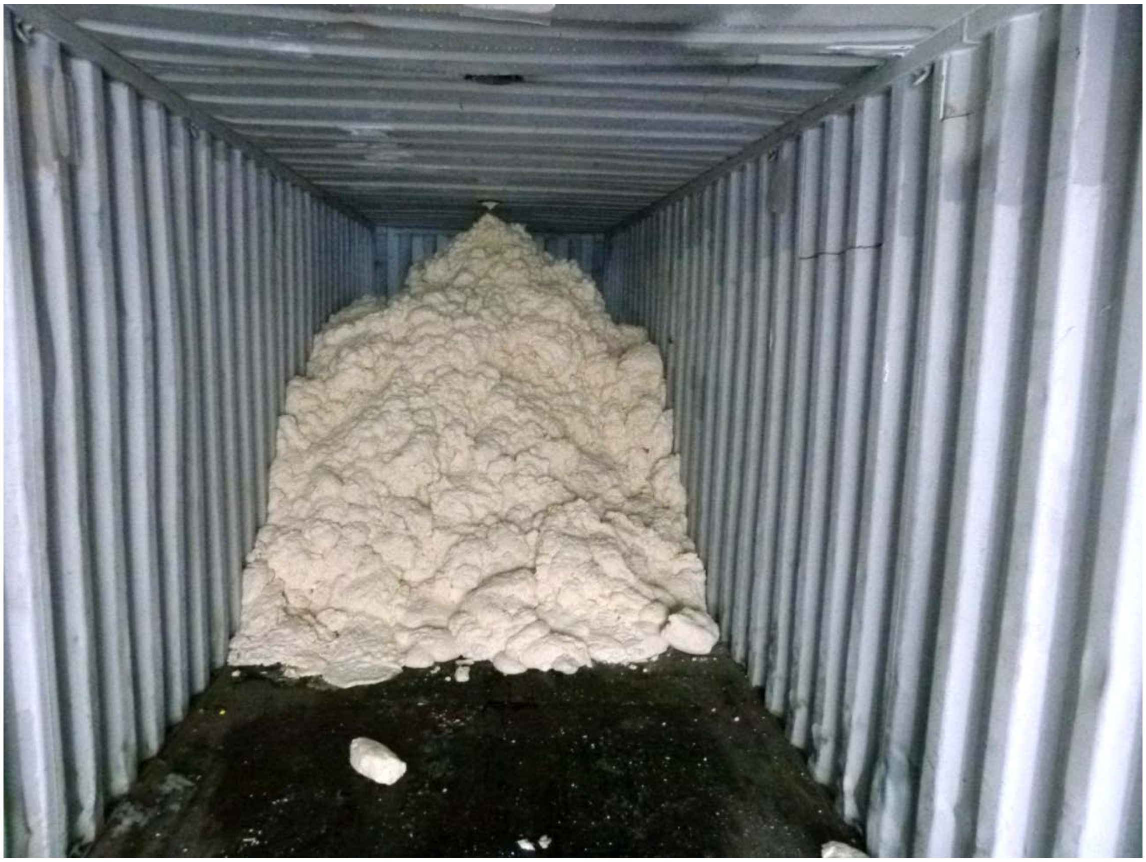

Figure 1: Foamed Resin Plug

3.0 DISCUSSION

3.1 Incomplete Trial

As discussed above, the plug was not completed due to inclement weather conditions and fading daylight.

The suction hoses which extracted the product from the drums frequently recoiled out of the drums which resulted in interruption to resin delivery. The delivery hose which fed the resin into the shipping container was of a smaller diameter than would typically be used. The combination of the two resulted, in our experience, in slower than normal resin delivery for plug construction. Nevertheless, it is expected that even with these problems, with additional time, the plug pour would have been completed and the full width/height of the shipping container completely sealed.

The mobility of the un-foamed resin was satisfactory. However, the small diameter of the delivery line may also have limited the mobility of the un-foamed resin. On a production scale, a larger diameter hose would be used for product delivery. However, because of its unit weight, the un-foamed resin may spread further prior to the initiation of foaming. Additionally, the potential distance of migration along an inclined surface prior to the initiation of foaming was not tested as a trial was not undertaken on an inclined surface.

The use of a larger diameter delivery hose and the potential distance of migration on both a flat and inclined surface should still be tested.

The proof-of-concept trial was also planned to be undertaken within/onto a sample of underground run-of-mine muck. The aim of this trial was to determine whether the permeability of the muckpile would be sufficient to allow the resin to “soak into” (or saturate) the muck. As the location of the trial was moved from its originally proposed location on the morning of the test, this portion of the proof-of-concept trial could not be completed. It is our opinion that whether or not the saturation of the muck with resin prior to the initiation of foaming is possible should still be tested.

3.2 Foam Strength

While no specific strength threshold has been established for the foamed resin plug, from visual inspection and crude field strength tests, it is expected that the foamed plug will be capable of withstanding the modest loads imposed by a small head of paste.

3.3 Other Issues

Several other issues were highlighted during the test which will require resolution before this technique can be used for the construction of underground barricades.

3.3.1 Fumes generated during the reaction

As part of the chemical reaction between Tampur Part A and Part B, a significant volume of chemical fumes were generated. These fumes filled the shipping container and their composition was unknown to Normet. While the fumes were being generated personnel involved in the test moved to a safe distance away from the shipping container to avoid exposure. A wind sock was also installed adjacent to the shipping container to monitor the wind direction.

The composition of these fumes and the hazards associated with their generation, particularly in a confined space such as an underground excavation must be clearly identified. Normet have been requested to provide this information to all concerned parties.

3.3.2 Temperature of resin during storage and use

It is the manufacturer's recommendation that the Tampur 117 components be stored and used above 18°C, or a reduction in the expansion factor can occur. The weather on the day of the test was below freezing with snow falling for most of the day. No suitable location for the storage of the resin components during the test was available and as a result, they remained outside for the duration of the test. It is expected that the low ambient temperature caused the resin components to cool throughout the day. It is likely that this cooling of the resin reduced its expansion factor causing more resin to be required to building the same volume plug.

A method of maintaining constant temperature in the resin components during full scale production use of this foaming resin should be designed for the winter months. This method should encompass both storage of and use of the resin.

3.4 Recommendations

As an initial trial of the usefulness of a foaming resin for remote underground backfill barricade construction, the proof-of-concept trial was successful. However a number of issues were highlighted which will need to be addressed prior to its use underground.

Due to the limited time frame for the proof-of-concept trial the tests of the resin's mobility on an inclined surface and the interaction of the resin with underground mine muck were not completed. It is expected that both of these scenarios will occur if the resin is used underground and so these tests should be undertaken in the future.

The pumping equipment used for the trial restricted the pour rate due to the small diameter of the hoses and the size of the pump used. On a production scale the equipment used should be of a higher flow rate capacity and should be tested for compatibility with the pour methodology.

During the proof-of-concept trial significant fumes were produced during the reaction of the resin. The exact composition of these fumes is unknown by Normet. Normet have been requested to provide a lab report on the chemical composition of these fumes.

The ambient air temperature is of concern for the production scale use of the foaming resin as it can prevent the resin from reacting properly. It is recommended that a method of storage be developed which keeps the component parts of the resin at or above 18°C both prior to and during use.

4.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Patrick McCann, M.Sc.
Intermediate Rock Mechanics Specialist

ORIGINAL SIGNED

Darren Kennard, P.Eng.
Associate, Senior Geotechnical Engineer

PMcC/DTK/ja/kp

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APPENDIX A

1314260010-049-WP-Rev0-1000 Resin Test Plan

October 23, 2013 Reference No. 1314260010-049-WP-Rev0-1000

Brad Thompson
Public Work and Government Services Canada
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6
Ph: (780) 497-3862
Cell: (780) 918-6277
Fax: (780) 497-3842
email: brad.thompson@pwgsc.gc.ca

WORK PLAN #: 006
FOAMING RESINS EXECUTION PLAN

Dear Mr. Thompson,

1.0 INTRODUCTION

A proof-of-concept trial for remote void filling at the Giant Mine Remediation Project (GMRP) in Yellowknife, Northwest Territories (NWT) will be undertaken commencing in the final week of October, 2013

The trial will be undertaken to assess the suitability of using a two-part foaming urea-silicate resin for void filling at the Giant Mine. Tests will be carried out in a number of shipping containers located in the tailings impoundment area to assess the mobility of the un-foamed resin product and determine a pour strategy which allows for the effective filling of the underground voids. The effectiveness of storage and use of the foaming resin in a northern climate in winter will also be assessed.

2.0 SCOPE OF WORK

Representatives from Normet Canada Ltd. (Normet) and Golder will be present on site during the proof-of-concept trials at the tailings impoundment area. The tests will be conducted by experienced Normet staff on behalf of Clark Builders.

2.1 Testing methodology

A series of tests will be carried out during the proof-of-concept trial to assess the suitability of the foaming resin in a number of scenarios including those discussed below.

2.1.1 Filling a shipping container

The desired outcome of the proof of concept testing is to construct a foamed resin plug inside a shipping container at the tailings impoundment area. This test is designed to simulate the construction of a plug in an underground opening of similar dimensions. The surface trial will allow the plug construction to be monitored constantly. This should allow in the design of an effective resin pouring strategy.

2.1.2 Mobility and flow control of un-foamed resin

It is understood that the viscosity of the mixed, un-foamed resin varies with temperature. Once poured into a void underground, the rate at which the un-foamed resin will flow away from the distribution point prior to foaming, because of the anticipated difference in product delivery temperatures (affected by such things as on-site storage conditions, ambient temperature, batching equipment and delivery pipe temperatures, etc.), is at present, unknown. Therefore, to control of the size and location of the foam plug being constructed, a number of pouring methodology trials will be carried out to develop an acceptable technique for foam delivery.

2.1.3 Pouring into existing muckpiles

The effect of pouring resin into underground muckpiles and previously backfilled areas is unknown. A test will be undertaken where mixed resin will be poured onto a mine waste muckpile adjacent to the shipping containers. While somewhat unknown, it is expected that the liquid resin will soak into the muckpile and cause the muckpile itself to expand and fill the void.

2.2 Health and safety

Golder personnel working in the area of the foaming resin test will be subject to a site specific Health and Safety plan that includes specific hazards associated with working with this material.

While the final foamed resin is chemically inert, the component parts do pose health risks. As a result, only those Golder personnel directly involved in the test will be permitted to participate. An eye wash station and appropriate PPE will be provided during the test.

The test will be undertaken on the tailings impoundment area and the existing site specific Health and Safety plan used for the Paste backfill test will be used for this work.

3.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Patrick McCann, B.Sc., M.Sc.
Intermediate Rock Mechanics Specialist

ORIGINAL SIGNED

Darren Kennard, P.Eng.
Associate, Geotechnical Engineer

PMcC/DTK/md

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Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

APPENDIX 6

Tailings Characterization

TECHNICAL MEMORANDUM

DATE January 27, 2014 **REFERENCE No.** 1314260010-013-TM-Rev0-3000

TO Brad Thompson
Public Works and Government Services Canada (PWGSC)

FROM David Caughill and John Hull **EMAIL** dcaughill@golder.com; jhull@golder.com

FIELD INVESTIGATION FOR TAILINGS EXCAVATION PLANNING AT GIANT MINE, YELLOWKNIFE, NORTHWEST TERRITORIES – JULY 2013

Public Works and Government Services Canada (PWGSC) requested Golder Associates Ltd. (Golder) to complete a field investigation program to assist in developing a tailings excavation plan for the Giant Mine, NWT. This technical memorandum was prepared to provide a factual field investigation record of the activities undertaken and observations recorded during the field program. The paste evaluation and testing component of this field program is provided under separate cover. All coordinates listed and shown in this technical memorandum are in GMRP coordinate system.

The reader is referred to the Study Limitations section which follows the text and forms an integral part of this technical memorandum.

1.0 INTRODUCTION

Golder completed a field investigation program between July 9, 2013 and July 11, 2013 to assist in the first phase of tailings excavation and stockpiling strategy planning, for the ultimate purpose of production of underground paste backfill through re-use of existing tailings at the Giant Mine Site. The investigation program was adapted to observations in the field and the overall work covered the following tasks, which were completed in a period of two and one half days:

- Excavation of test pits and visual material characterization in South Pond;
- Excavation of test pits and visual material characterization in Central Pond; and
- Access assessment to South and Central Ponds.

The following section describes each component.

2.0 FIELD PROGRAM

2.1 Tailings Test Pit Program

Test pit program was carried out with assistance from the care and maintenance contactor on site (Det'on-Cho Nuna Joint Venture), which provided an excavator and an operator to excavate a series of test pits in South and Central Ponds. All test pits were excavated with a Hitachi Zaxis 270 LC track-mounted excavator which had sufficient reach for the purposes of the test pit program.

A total of 25 test pits were excavated in the South Pond and a total of eight test pits were excavated in the Central Pond. Test pit locations are shown in Figure 1. Test pit depths varied from 2.4 m to 4.0 m and average depth was 3.6 m. The tailings within test pits were visually assessed and characterized by Golder field staff, GPS coordinate readings were taken, depth measurements were made and photographic records were obtained. Samples were collected from selected test pits for subsequent laboratory testing (reported under separate cover). Observations also included presence of water (or lack of it) in the test pits and whether the test pits collapsed during excavation.

Table 1 summarizes data and observations recorded for each of the test pits opened in South and Central Ponds.

During the program, the excavator operator was instructed to backfill the test pits after the program was completed.

2.1.1 South Pond Test Pits

South Pond test pit locations are shown in Figure 1 and information and data pertaining to these test pits are provided in Table 1. A total of 25 test pits were excavated in the South Pond.

In general, coarser material was observed in the northern part of South Pond than in the southern half of the pond. As test pits progressed towards south, more clay was present in the material at shallower depths and the tailings appeared to show a plastic behavior in much of the material in the southern part of South Pond. It is noted that the tailings in general are interlayered with sandier and or silty seams, based on the depositional history of the tailings. This lensing is not noted in the general descriptions and the material may be more variable than it appears based on the descriptions in Table 1.

With the exception of SP-TP-01, SP-TP-08, SP-TP-09 and SP-TP-25 where the moisture profile typically varied from dry to moist (at shallow depths) to moderately wet (in deeper parts of the test pit), material in all of the South Pond test pits typically varied from dry (at shallow depths) to moist (in deeper parts of the test pit).

No seeping water was observed in any of the test pits at the time of excavation. However, overnight water accumulation was observed in SP-TP-08 and SP-TP-09. SP-TP-08 had also collapsed at 3.3 m depth and water was observed to seep in and accumulate at 3.0 m depth on the following day. SP-TP-09 had also collapsed during excavation (no water observed at that time) and one day later water was present in the test pit at 2.4 m.

Other collapsed test pits were SP-TP-01 (collapsed at 4.0 m) and SP-TP-25 (collapsed at 3.6 m).

A small sinkhole (~45 cm in diameter and ~30 cm deep) was observed a few meters from SP-TP-14; however it is not known when the sinkhole occurred.

2.1.2 Central Pond Test Pits

Central Pond test pit locations are shown in Figure 1 and information and data pertaining to these test pits are provided in Table 1. A total of eight test pits were excavated in the Central Pond.

All of the Central Pond test pits were observed to contain coarser material compared to many of the South Pond test pits (particularly when compared to the central and southern parts of South Pond). Field visual observations indicate that material was predominantly sandy silt. Some trace clay was observed to be intermixed with the coarser matrix of sand and silt. It is noted that the tailings in general are interlayered with sandier and or silty seams, based on the depositional history of the tailings. This lensing is not noted in the general descriptions and the material may be more variable than it appears based on the descriptions in Table 1. In general the tailings did not have a plastic behavior in the excavated material.

No seeping water was observed in any of the test pits at the time of excavation. Excavated material in all of the test pits typically varied from dry (at shallow depths) to moist (in deeper parts of the test pit). Fully saturated tailings were not observed.

Table 1: Central and South Pond Test Pit Summary

Area	Test Pit ID	GMRP (Converted from UTM)		Depth (m)	Visual Description / Comments / Notes
		GMRP Easting	GMRP Northing		
Central Pond	CP-TP-01	36700	33237	0-3.7	Sandy Silt to Silt, trace sand. Material varied from dry (shallow depths) to moist (deeper)
	CP-TP-02	36681	33205	0-3.4	Sandy Silt to Silt, trace sand. Material varied from dry (shallow depths) to moist (deeper)
	CP-TP-03	36682	33265	0-3.6	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	CP-TP-04	36652	33275	0-3.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	CP-TP-05	36684	33292	0-3.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	CP-TP-06	36700	33282	0-2.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.0-3.6	Clayey Silt
	CP-TP-07	36719	33293	0-2.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.5-3.7	Clayey Silt
	CP-TP-08	36718	33266	0-2.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.5-3.7	Clayey Silt

Area	Test Pit ID	GMRP (Converted from UTM)		Depth (m)	Visual Description / Comments / Notes
		GMRP Easting	GMRP Northing		
South Pond	SP-TP-01	36553	33100	0-3.0	Sandy Silt. Material varied from dry to moist (shallow depths) to moderately wet (deeper)
				3.0-4.0	Sandy Clayey Silt. Test pit collapsed at 4.0 m depth
	SP-TP-02	36526	33063	0-2.9	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-03	36535	32968	0-3.4	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-04	36597	32962	0-2.4	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-05	36585	33029	0-3.4	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-06	36624	33056	0-3.0	Sandy Silt intermixed with clayey silt. Material varied from dry (shallow depths) to moist (deeper)
				3.0-4.0	Clayey Silt, trace sand.
	SP-TP-07	36589	33068	0-3.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				3.5-4.0	Clayey Silt, trace sand.
	SP-TP-08	36555	33047	0-2.0	Silty Sand. Material varied from dry to moist (shallow depths) to moderately wet (deeper)
				2.0-3.0	Clayey Silt. Collapse at 3.3 m. Water at 3 m, accumulated overnight.
	SP-TP-09	36551	32998	0-2.0	Sandy Silt. Material varied from dry to moist (shallow depths) to moderately wet (deeper)
				2.0-4.0	Sandy Silt. Collapse at 3.0 m. Water at 2.4 m, accumulated overnight.
	SP-TP-10	36567	32952	0-2.5	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.5-3.5	Sandy Clayey Silt.
	SP-TP-11	36524	32923	0-1.9	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.9-3.7	Sandy Clayey Silt.
	SP-TP-12	36563	32907	0-1.0	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.0-3.7	Sandy Clayey Silt.
	SP-TP-13	36599	32903	0-2.4	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.4-3.4	Clayey Silt
	SP-TP-14	36595	32861	0-4.0	Clayey Silt (small sinkhole observed nearby test pit afterwards, probably existing sinkhole, ~45 cm diameter, 20-30 cm deep). Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-15	36549	32857	0-3.5	Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-16	36509	32855	0-3.7	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)

Area	Test Pit ID	GMRP (Converted from UTM)		Depth (m)	Visual Description / Comments / Notes
		GMRP Easting	GMRP Northing		
	SP-TP-17	36491	32807	0-3.4	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
	SP-TP-18	36545	32794	0-1	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)
				1-3.5	Clayey Silt.
	SP-TP-19	36579	32792	0-1.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.0-3.8	Clayey Silt
	SP-TP-20	36608	32792	0-1.2	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.2-3.5	Clayey Silt
	SP-TP-21	36613	32759	0-1.3	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.3-3.8	Clayey Silt
	SP-TP-22	36582	32745	0-2.3	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.3-3.7	Clayey Silt
	SP-TP-23	36555	32749	0-2.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				2.0-3.7	Clayey Silt
	SP-TP-24	36513	32757	0-1.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)
				1.0-3.7	Sandy Silt
	SP-TP-25	36627	32877	0-1.5	Sandy Silt. Material varied from dry to moist (shallow depths) to moderately wet (deeper)
				1.5-3.6	Clayey Silt. Collapse at 3.6 m

Table 2: Grain Size Analysis of Selected Samples

Area	Test Pit ID	Depth (m)	Sand Content (%)	Silt Content (%)	Clay Content (%)
Central Pond	CP-TP-01	0-3.7	42	53	5
	CP-TP-02	0-3.4	40	55	5
South Pond	SP-TP-01	0-3.0	39	57	4
	SP-TP-02	0-2.9	43	54	3
	SP-TP-03	0-3.4	42	54	4
	SP-TP-04	0-2.4	15	79	6
	SP-TP-05	0-3.4	45	51	4
	SP-TP-06	0-3.0	37	58	5

2.2 Access Assessment

Access to both South Pond and Central Pond was evaluated. Both ponds can be accessed from the embankment between the two ponds (Figure 1). For the South Pond another access point is available at the southwest corner of the pond and two other smaller roads are present on the central west side of South Pond (Figure 1). Field observations indicated that the most feasible option for South Pond is access from the embankment in the north. However, access planning needs to be considered in conjunction with the excavation plan, which is outside the scope of this document.

3.0 CLOSURE

We trust that the information provided in this technical memorandum meets your present needs. Should you have any questions or require additional information, please feel free to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED AND SEALED

Dave Caughill, M.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

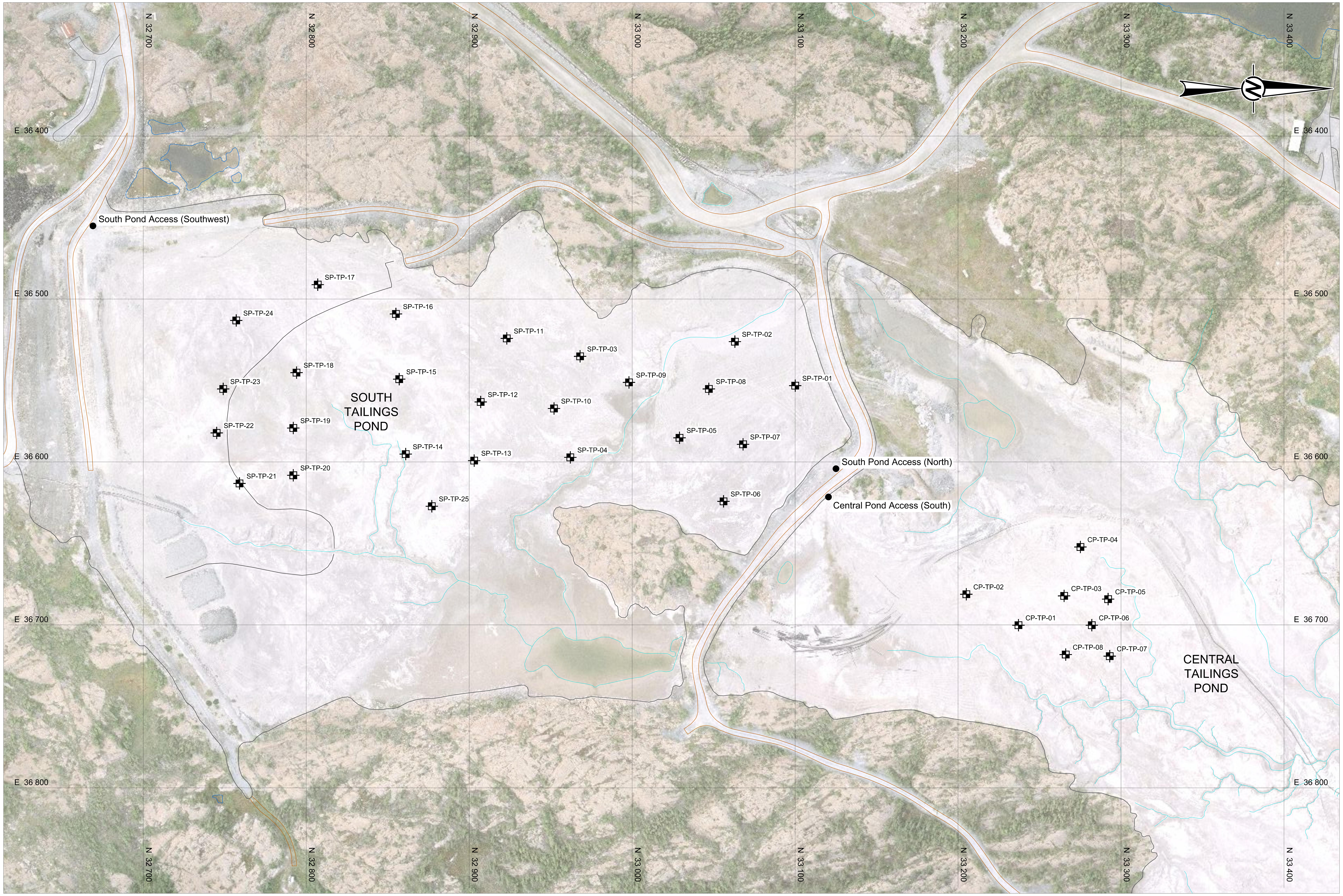
ORIGINAL SIGNED

John Hull, M.Sc., P.Eng.
Principal, Mining Division

DC/JAH/rs/kp

Attachment: Figure 1: South and Central Pond Test Pit Locations

o:\final\2013\1426\13-1426-0010\1314260010-013-tm-rev0-3000\1314260010-013-tm-rev0-3000-south and central pond investigation 27jan_14.docx



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

Revision/Revision	Description/Description	Date/Date
0	ISSUED WITH DOC. #013 REV 0	2014-01-24

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuve par: JH
Designed by/Concept par: DC
Drawn by/Dessine 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
SOUTH AND CENTRAL PONDS TEST PIT LOCATIONS

Project No./No. du projet: 13-1426-0010 DOC. #013
Sheet/Feuille: FIGURE 1 OF 1
Revision no./La Révision no.: 0

PLAN VIEW
SCALE A

0 50 100 150
SCALE A METRES

LEGEND
- TEST PIT LOCATION (GOLDER 2013)
- ACCESS POINT

NOTES
ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS THE GMRP COORDINATE SYSTEM.

REFERENCES
AERIAL PHOTO DATED 2009, PROVIDED BY PUBLIC WORKS GOVERNMENT SERVICES CANADA

PWGSC – A1 – 841X594

REPORT

January 28, 2014

LABORATORY REPORT FOR

Giant Mine Backfill Testing - South Pond

Submitted to:

Public Works and Government Services Canada (PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta
T5J 1S6

Attention: Brad Thompson

Reference Number: 1314260010-094-R-Rev0-5000

Distribution:

1 Electronic Copy - Public Works and Government Services Canada (PWGSC)

2 Hard Copies - Golder Associates Ltd., Sudbury, Ontario

Golder Associates

Study Limitations

This report was prepared for the exclusive use of Public Works and Government Services Canada (PWGSC) on the Giant Mine Project. The report, which specifically includes all tables, figures and appendices, is based on measurements and observations made and data and information collected during the laboratory studies conducted by Golder Associates Ltd. (Golder) for PWGSC. The test results are based solely on the ambient conditions of the laboratory at the time the measurements and tests were conducted.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Table of Contents

TABLES

Table of Contents (cont.)

FIGURES

Table of Contents (cont.)

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Golder Associates Ltd. (Golder) to carry out laboratory testing on Giant Mine tailings to assess the rheological and strength properties of the tailings for the purpose of using them as feed material for underground paste backfill.

2.0 SAMPLE RECEIPT AND PREPARATION

2.1 Sample Receipt

Samples received by Golder's Sudbury laboratory are summarized in Table 1. All samples were received in good condition with all seals intact. The total weight of the shipment was 1308 kg. The samples were shipped via Canadian North Cargo.

Table 1: Sample Receipt Summary

Date	Amount/Container	Label as Received	Golder Sample ID
July 23, 2013	1 – 20L pail	Aggregate Sample - 1/2" sample 1 of 2	13-1426-0010 Aggregate
	1 – 20L pail	Aggregate Sample Giant Mine - 1/2" 2 of 2	
	1 – 20L pail	SPTP-1 TP-1 Giant Mine July 9/13	13-1426-0010 SPTP-1 TP1
	1 – 20L pail	SPTP-2 TP2 Giant Mine July 9/13	13-1426-0010 SPTP-2 TP2
	1 – 20L pail	SPTP3 Giant Mine July 9/13	13-1426-0010 SPTP 3
	1 – 20L pail	SPTP-4 Giant Mine July 9/13	13-1426-0010 SPTP 4
	1 – 20L pail	SPTP 5	13-1426-0010 SPTP 5
	1 – 20L pail	SPTP-6 Giant Mine July 9/13	13-1426-0010 SPTP 6
	1 – 20L pail	Giant Mine Central Pond CPTP01 July 09/13 collected July 11/13	13-1426-0010 CPTP 01
	1 – 20L pail	Giant Mine Central Pond CPTP02 July 9/13 collected July 11/13	13-1426-0010 CPTP 02
	1 – 200L drum	July 10/13 SP- TP 1+2+3 (3x 5g pails each) Giant Mine	13-1426-0010 SP-TP 1+2+3
	1 – 200L drum	July 10/13 SP TP 4+5+6 (3x 5gal pails each) Giant Mine	13-1426-0010 SP-TP 4+5+6
	1 – 200L drum	Giant Mine Water Sample Barrel 1 of 2 July 10, 2013	13-1426-0010 Water
	1 – 200L drum	Giant Mine Water Sample Barrel 2 of 2 July 10, 2013	

All samples received by Golder are subjected to material property characterization tests to establish properties and allow for comparison should future testing be required.

2.2 Hazard Assessment

Prior to handling the Giant Mine samples each pail and drums were assessed separately for hazardous gases. The gas analysis results are presented in Table 2.

Table 2: Sample Hazard Assessment

Date	Label as Received	Golder Sample ID	VOC (ppm)	HCN (ppm)	H_2S (ppm)
July 23, 2013	Aggregate Sample - 1/2" sample 1 of 2	13-1426-0010 Aggregate	0	0	0
	Aggregate Sample Giant Mine - 1/2" 2 of 2		0	0	0
	SPTP-1 TP-1 Giant Mine July 9/13	13-1426-0010 SPTP-1 TP1	0	0	0
	SPTP-2 TP2 Giant Mine July 9/13	13-1426-0010 SPTP-2 TP2	0	0	0
	SPTP3 Giant Mine July 9/13	13-1426-0010 SPTP 3	0	0	0
	SPTP-4 Giant Mine July 9/13	13-1426-0010 SPTP 4	0	0	0
	SPTP 5	13-1426-0010 SPTP 5	0	0	0
	SPTP-6 Giant Mine July 9/13	13-1426-0010 SPTP 6	0	0	0
	Giant Mine Central Pond CPTP01 July 09/13 collected July 11/13	13-1426-0010 CPTP 01	0	0	0
	Giant Mine Central Pond CPTP02 July 9/13 collected July 11/13	13-1426-0010 CPTP 02	0	0	0
	July 10/13 SP- TP 1+2+3 (3x 5g pails each) Giant Mine	13-1426-0010 SP-TP 1+2+3	0	0	0
	July 10/13 SP TP 4+5+6 (3x 5gal pails each) Giant Mine	13-1426-0010 SP-TP 4+5+6	0	0	0
	Giant Mine Water Sample Barrel 1 of 2 July 10, 2013	13-1426-0010 Water	0	0	0
	Giant Mine Water Sample Barrel 2 of 2 July 10, 2013		0	0	0

VOC: Volatile Organic Compounds
HCN: Hydrogen Cyanide gas
H_2S: Hydrogen Sulphide gas

Metals analysis using Inductively Coupled Plasma with a Mass Spectrometer detector (ICP-MS) was performed on a composite sample obtained via individual pipe samples from each pail. In addition cyanide levels were also examined. This testing helps to identify health and safety hazards such as heavy metals or cyanide which may be present. The sample was sent to an external laboratory for ICP-MS analysis. Figure 1, Table 3, and Appendix A present the results.

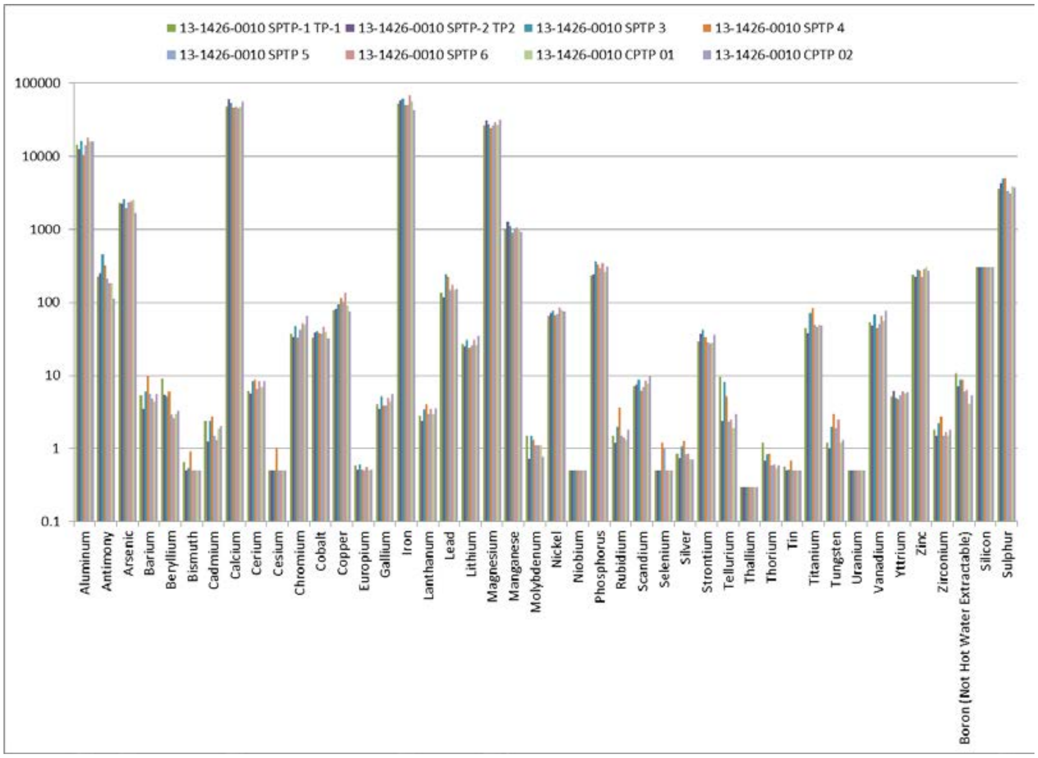


Figure 1: ICP-MS Results

Table 3: Cyanide Analysis Results

Sample	Result (mg/kg)
13-1426-0010 SPTP-1 TP1	0.79
13-1426-0010 SPTP-2 TP2	0.59
13-1426-0010 SPTP 3	0.48
13-1426-0010 SPTP 4	0.40
13-1426-0010 SPTP 5	1.24
13-1426-0010 SPTP 6	0.2
13-1426-0010 CPTP 01	0.67
13-1426-0010 CPTP 02	0.77

No hazardous gases were detected in any of the samples. The concentrations of heavy metals and cyanide present in the samples were considered to be acceptable to handle according to Golder’s established protocols.

2.3 Sample Preparation

Proper sample preparation is a critical first step to ensure proper homogenization of solids, representative sub-sampling and reproducibility of results.

The first step was to mix all of the samples individually with the available 13-1426-0010 Water in order to achieve homogenized samples.

The two barrels of 13-1426-0010 Water were combined and treated as one sample.

3.0 MATERIAL CHARACTERIZATION

3.1 pH Analysis

Table 4 presents the pH of each sample and the temperature at which it was measured.

Table 4: pH Analysis

Sample	pH	Temperature (°Celsius)
13-1426-0010 SPTP-1 TP1	8.5	20
13-1426-0010 SPTP-2 TP2	8.6	20
13-1426-0010 SPTP 3	8.5	20
13-1426-0010 SPTP 4	8.7	20
13-1426-0010 SPTP 5	8.5	19
13-1426-0010 SPTP 6	8.5	19
13-1426-0010 CPTP 01	8.4	19
13-1426-0010 CPTP 02	8.5	20
13-1426-0010 SP-TP 1+2+3	8.3	19
13-1426-0010 SP-TP 4+5+6	8.5	20
13-1426-0010 Water	7.5	20

3.2 Particle Size Distribution

Particle size distribution (PSD) was determined using mechanical sieving and a Fritsch laser particle size analyzer according to ASTM D4464.

Specific values are presented in Table 5, as well as on Figures 2 and 3. The gradation parameter DXX, tabulated in microns, refers to the average particle diameter that XX% by weight of material is smaller than.

Table 5: Particle Size Distribution

Sample	D10 (µm)	D30 (µm)	D50 (µm)	D60 (µm)	D80 (µm)
13-1426-0010 SPTP-1 TP1	4	17	42	69	135
13-1426-0010 SPTP-2 TP2	5	22	54	86	133
13-1426-0010 SPTP 3	4	20	51	82	133
13-1426-0010 SPTP 4	3	9	20	27	58
13-1426-0010 SPTP 5	5	22	59	92	133
13-1426-0010 SPTP 6	4	15	39	63	125
13-1426-0010 CPTP 01	4	19	50	83	134
13-1426-0010 CPTP 02	4	17	43	72	135
13-1426-0010 SP-TP 1+2+3	5	23	58	93	137
13-1426-0010 SP-TP 4+5+6	3	9	21	30	74
13-1426-0010 Aggregate	525	2737	5265	6839	10217

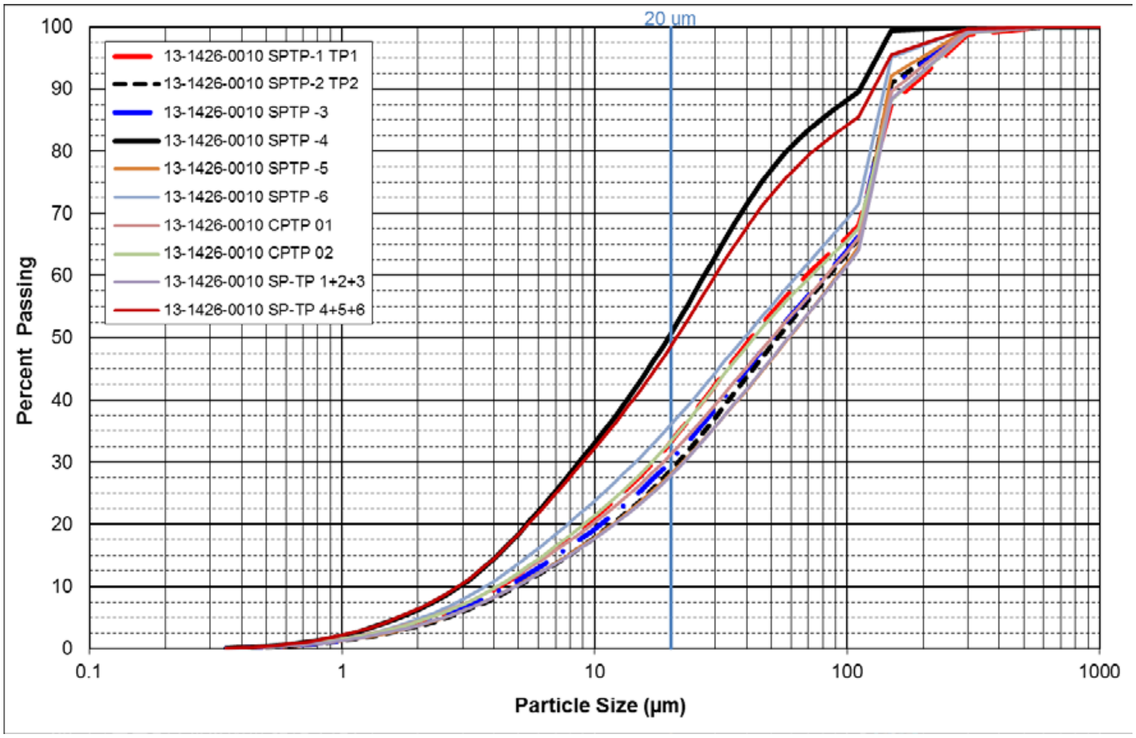


Figure 2: PSD Results – Tailings

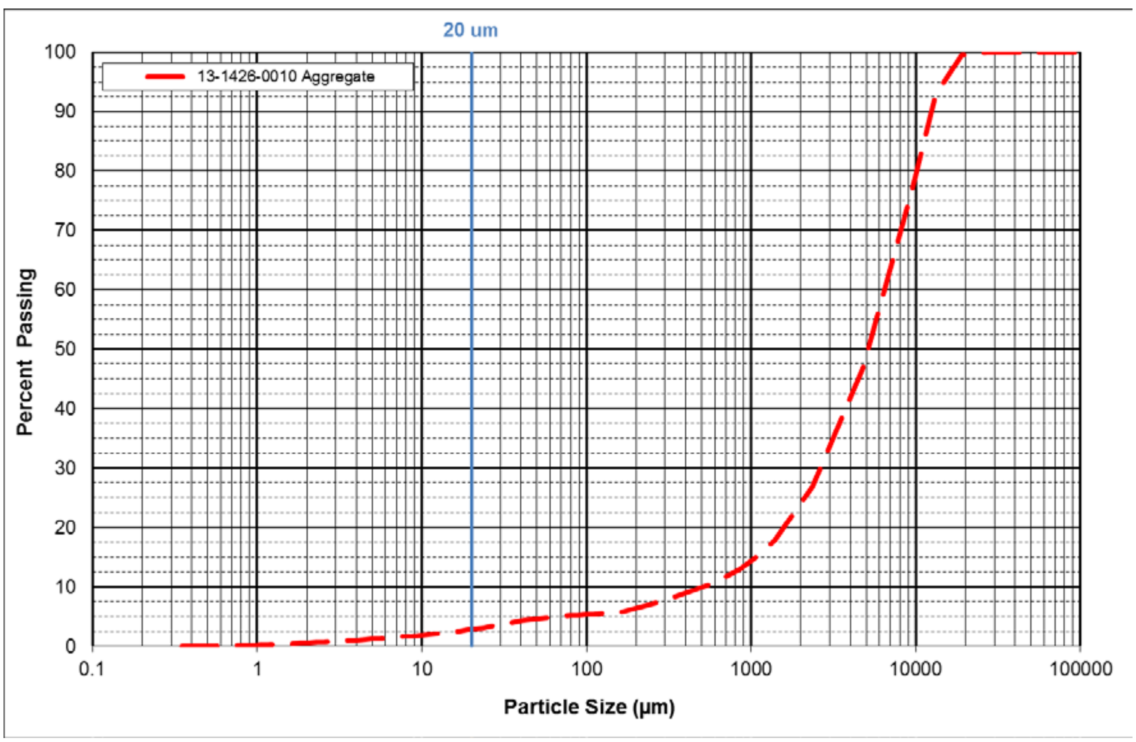


Figure 3: PSD Results - Aggregate

3.3 Specific Gravity

The specific gravity (SG) of the sample was determined using vacuum de-aired water. Each slurry sample was also vacuum de-aired prior to SG measurement. The results are presented in Table 6.

Table 6: Specific Gravity Results

Sample	Trial 1	Trial 2	Average
13-1426-0010 SPTP-1 TP1	2.86	2.82	2.84
13-1426-0010 SPTP-2 TP2	2.85	2.85	2.85
13-1426-0010 SPTP 3	2.86	2.86	2.86
13-1426-0010 SPTP 4	2.82	2.78	2.80
13-1426-0010 SPTP 5	2.85	2.85	2.85
13-1426-0010 SPTP 6	2.90	2.86	2.88
13-1426-0010 CPTP 01	2.84	2.85	2.85
13-1426-0010 CPTP 02	2.87	2.86	2.86
13-1426-0010 SP-TP 1+2+3	2.84	2.88	2.86
13-1426-0010 SP-TP 4+5+6	2.86	2.86	2.86
13-1426-0010 Aggregate	3.01	3.02	3.01

4.0 RHEOLOGICAL CHARACTERIZATION

Rheological testing was carried out to evaluate flow and handling properties. These tests provide an indication regarding the material's behaviour in the course of mixing, slump adjustment, pumping, flowing and also while sitting idle. Rheological characterization provides data for the selection of process equipment such as mixers, pumps and pipelines.

4.1 Slump vs. Solids Content

To gauge sensitivity to water additions, small increments of water were added to the bulk sample. After each addition, slump and solids content was determined. This generates a relationship between slump and solids content which is typically used to determine the degree of process control required to maintain slump control of the final product. Photos are presented in Appendix C and the results are presented on Figure 4.

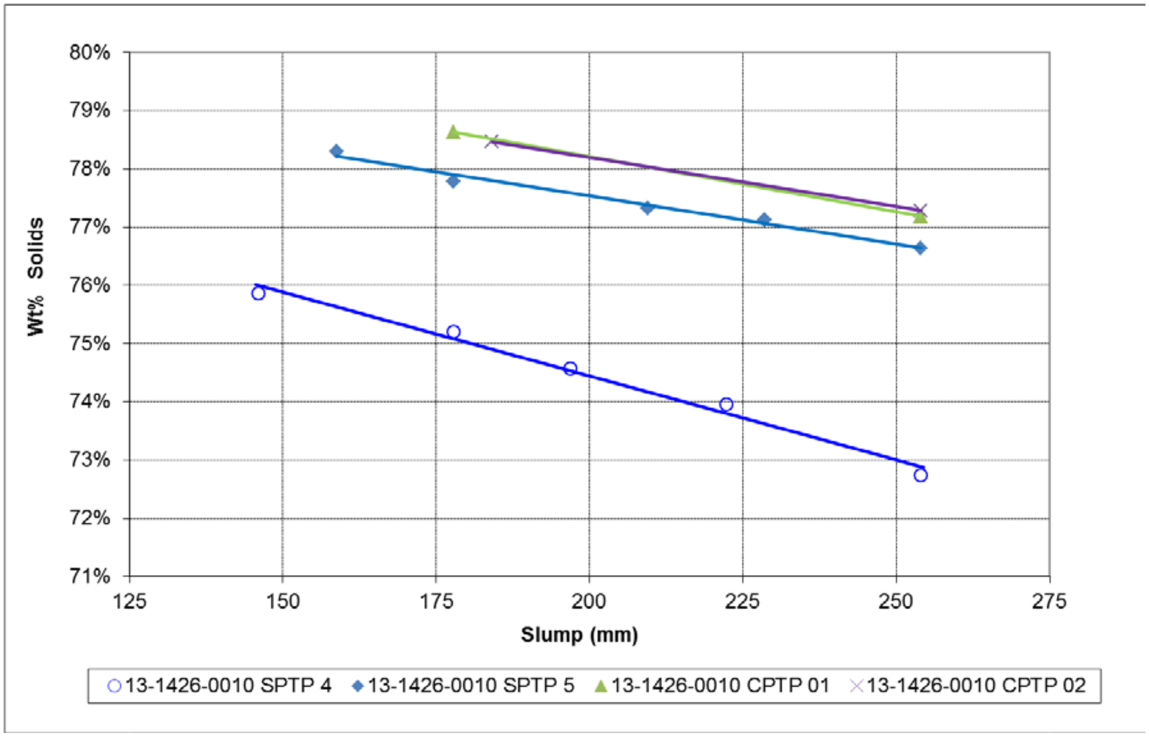


Figure 4: Solids Content vs. Slump

4.2 Static Yield Stress Testing

Yield stress is defined as the minimum force required to initiate flow. Static yield stress was determined by using a very slow moving (0.2 RPM) vane spindle attached to a torque spring. The spindle was immersed in the sample and measurements were taken at various solids contents. There are different test methods to determine yield stress, one termed ‘static’ and the other ‘dynamic’. Figure 5 presents the static yield stress testing results.

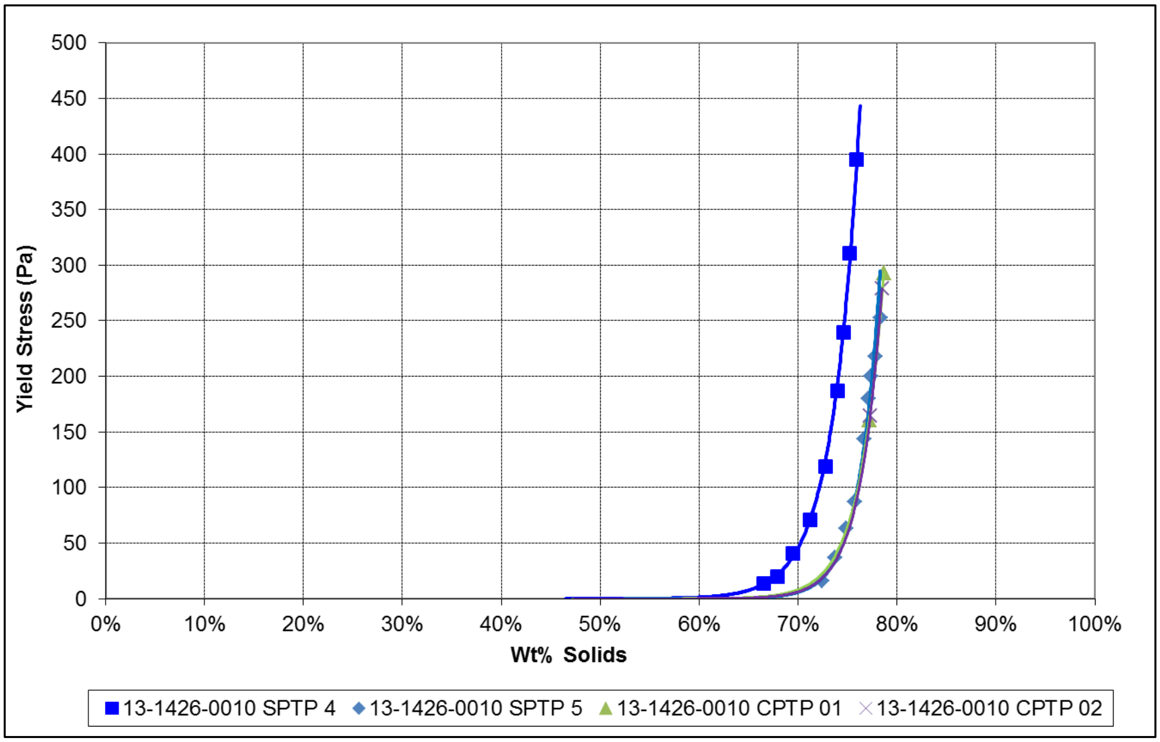


Figure 5: Static Yield Stress vs. wt% Solids

4.3 Water Bleed and Yield Stress vs. Time

Moisture retention testing was carried out to assess the water bleed properties of the paste while sitting idle in test beakers. Two slump consistencies were tested at four time intervals. At each time interval the water bleed and yield stress were measured. Figures 6 to 9 present the results.

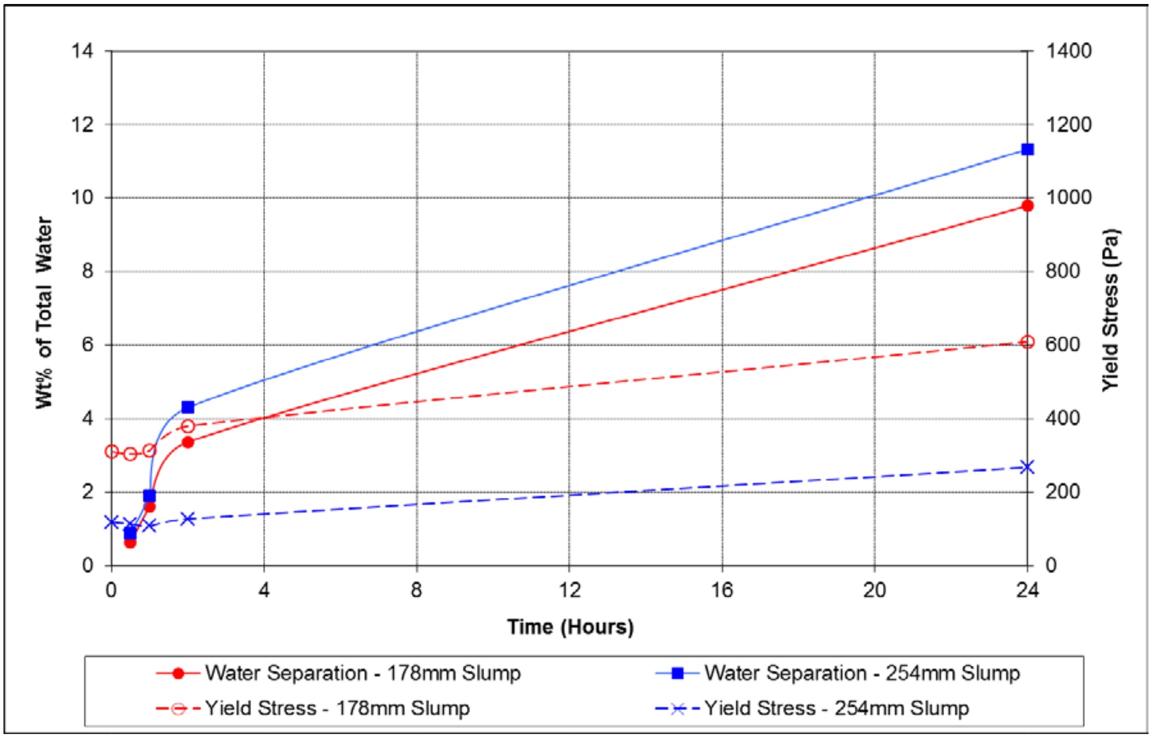


Figure 6: Water Bleed and Yield Stress vs. Time - 13-1426-0010 SPTP 4

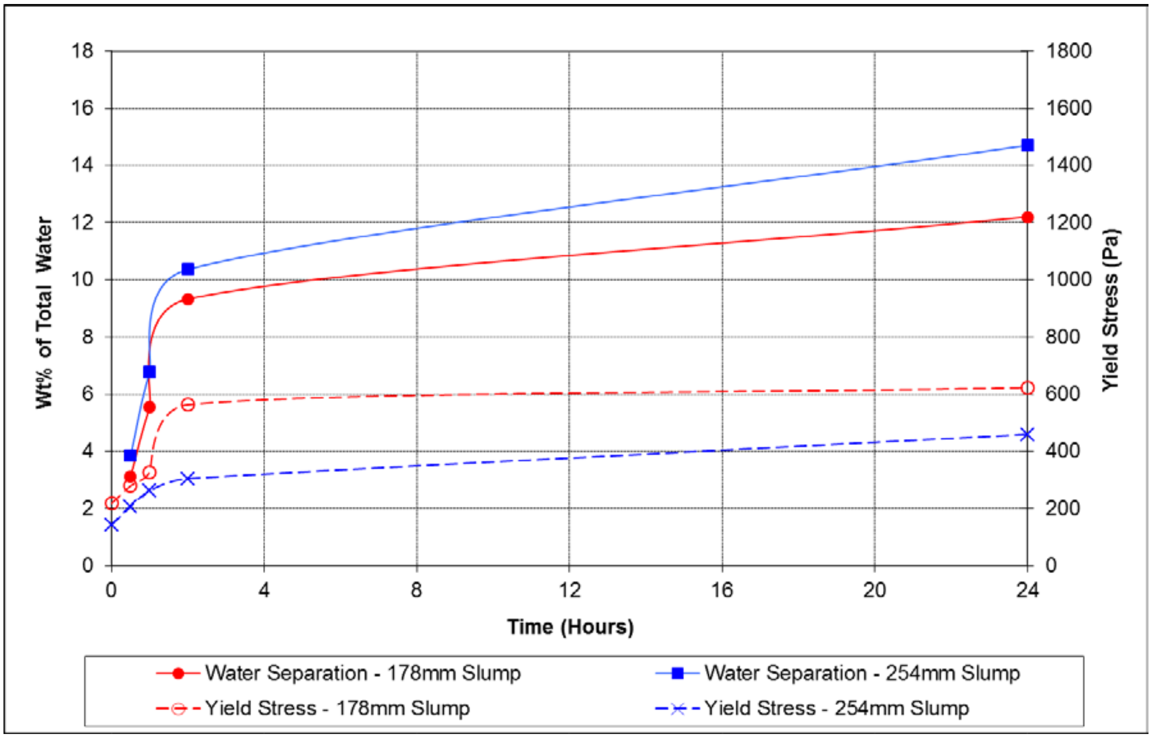


Figure 7: Water Bleed and Yield Stress vs. Time - 13-1426-0010 SPTP 5

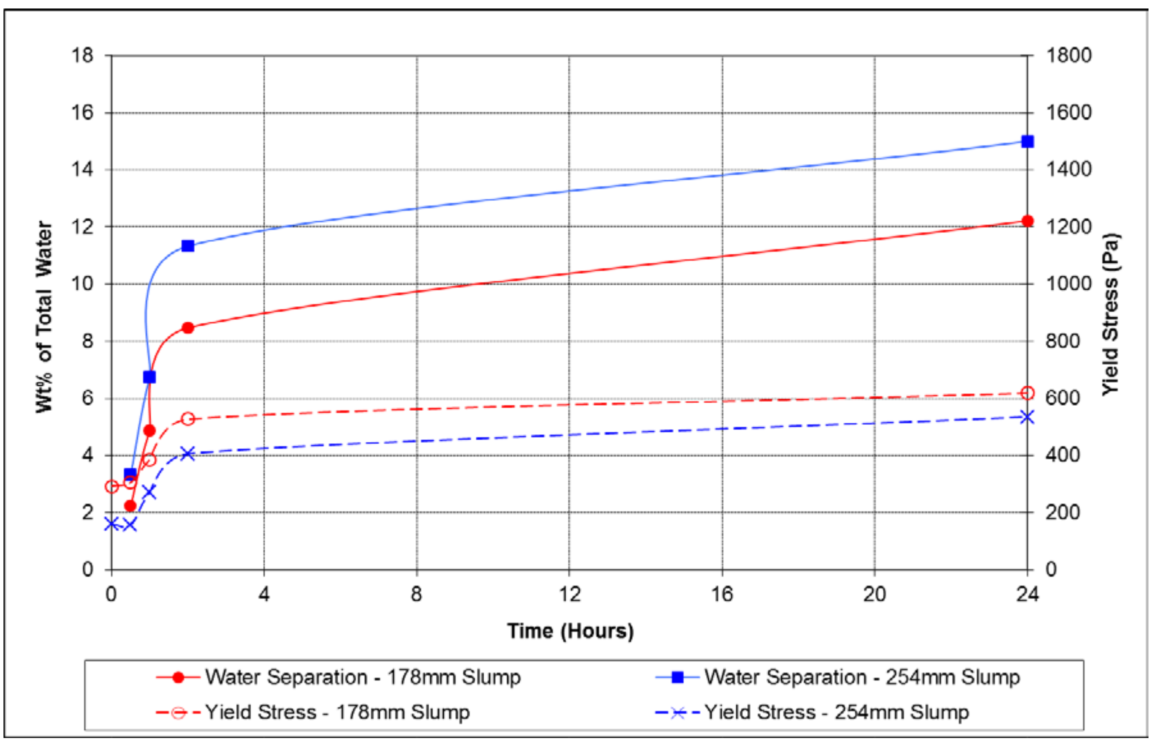


Figure 8: Water Bleed and Yield Stress vs. Time - 13-1426-0010 CPTP 01

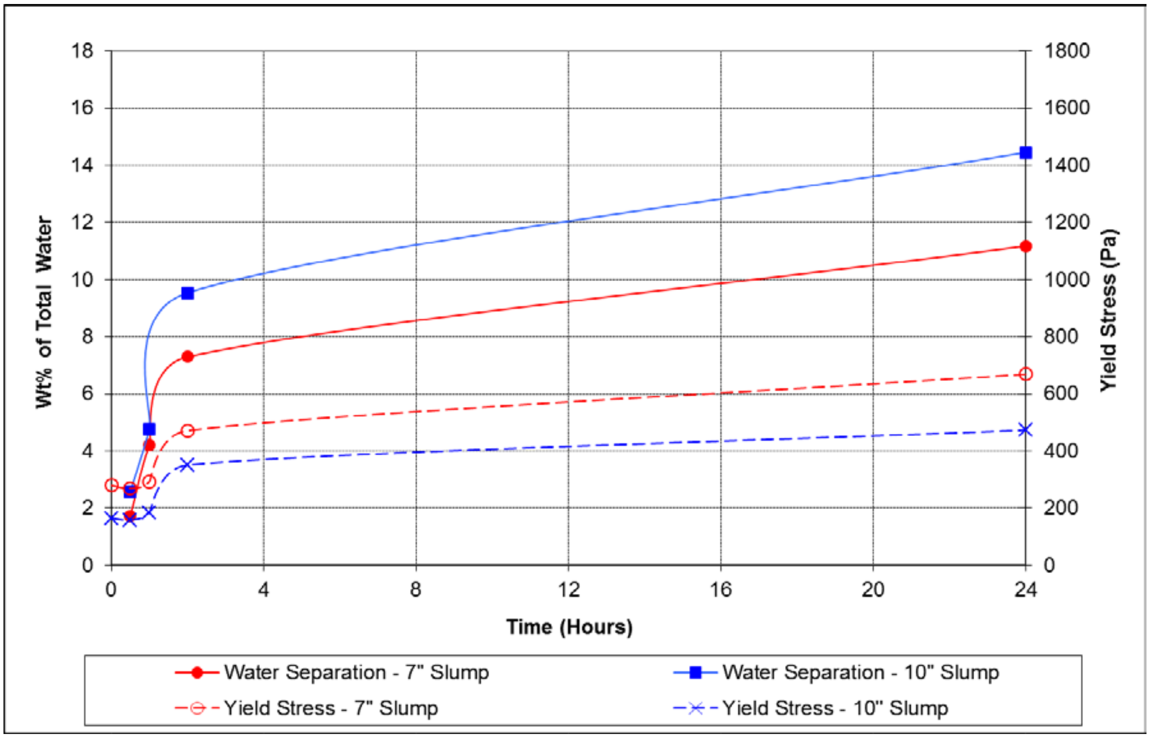


Figure 9: Water Bleed and Yield Stress vs. Time - 13-1426-0010 CPTP 02

4.4 Plug Yield Stress

Plug yield stress analysis was performed to determine if consolidation has occurred throughout a cross-section of idle paste material, as may be present in a pipeline's cross-section. Two slump consistencies of material were allowed to sit idle for two hours, and a specially designed vane spindle was immersed at three depths to measure yield stress. Figures 10 to 13 present the results.

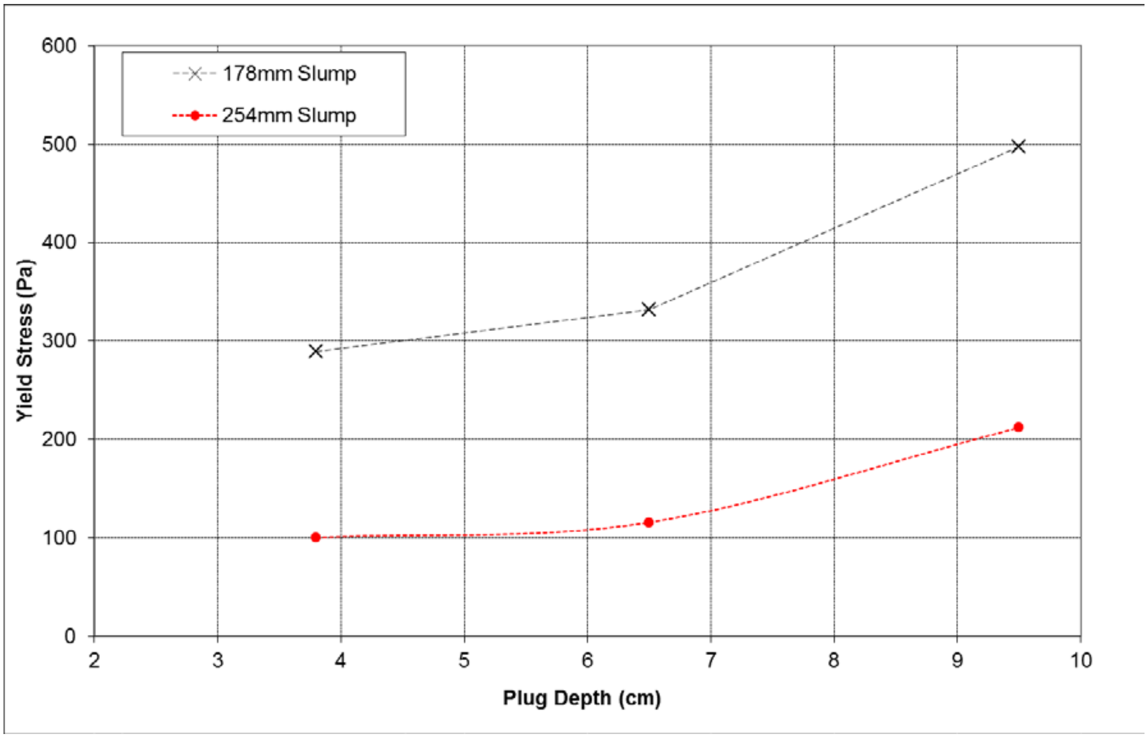


Figure 10: Plug Yield Stress Results - 13-1426-0010 SPTP 4

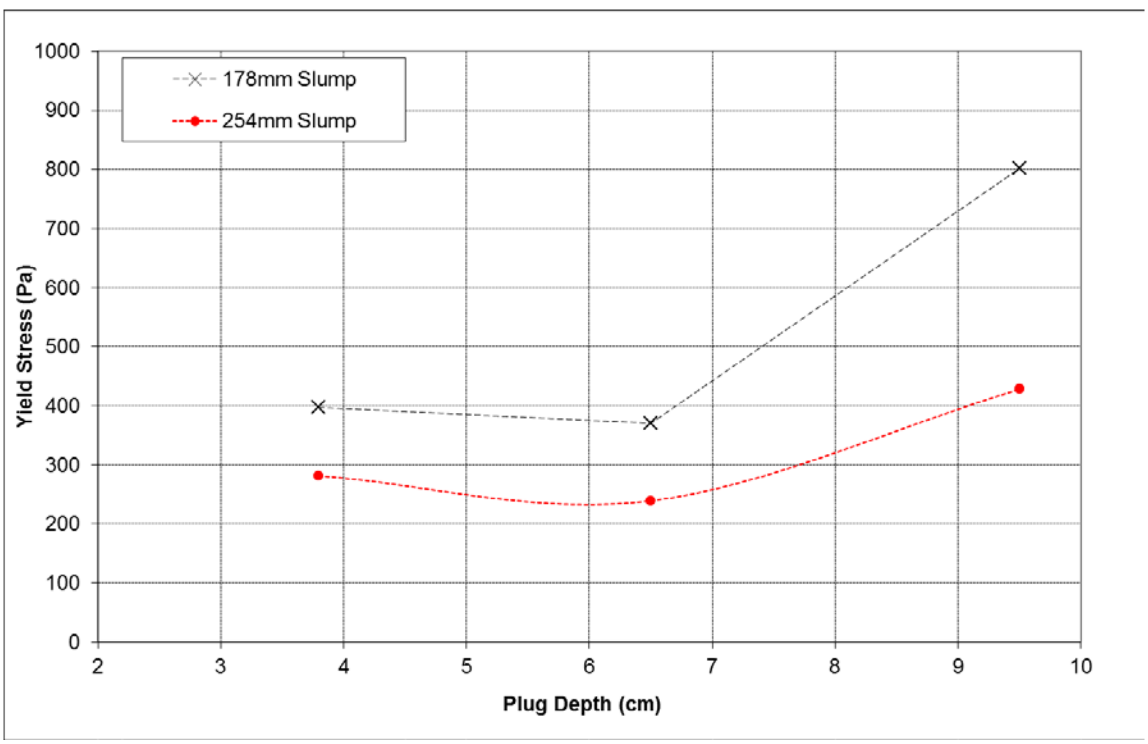


Figure 11: Plug Yield Stress Results - 13-1426-0010 SPTP 5

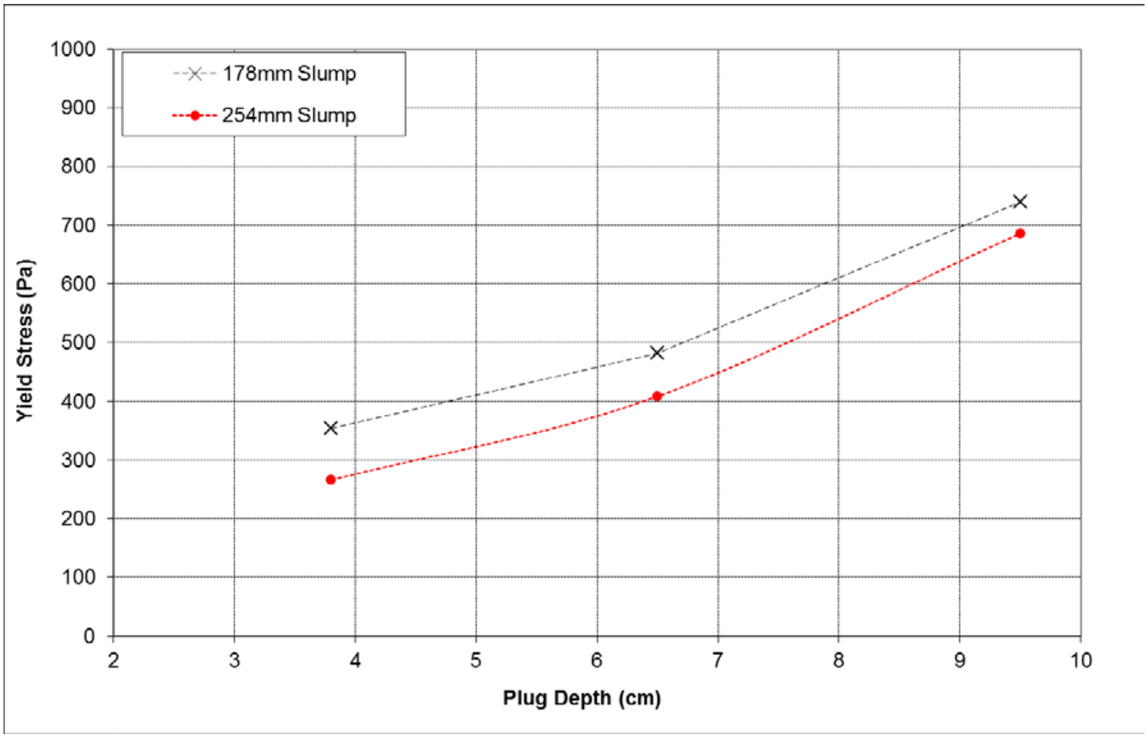


Figure 12: Plug Yield Stress Results - 13-1426-0010 CPTP 01

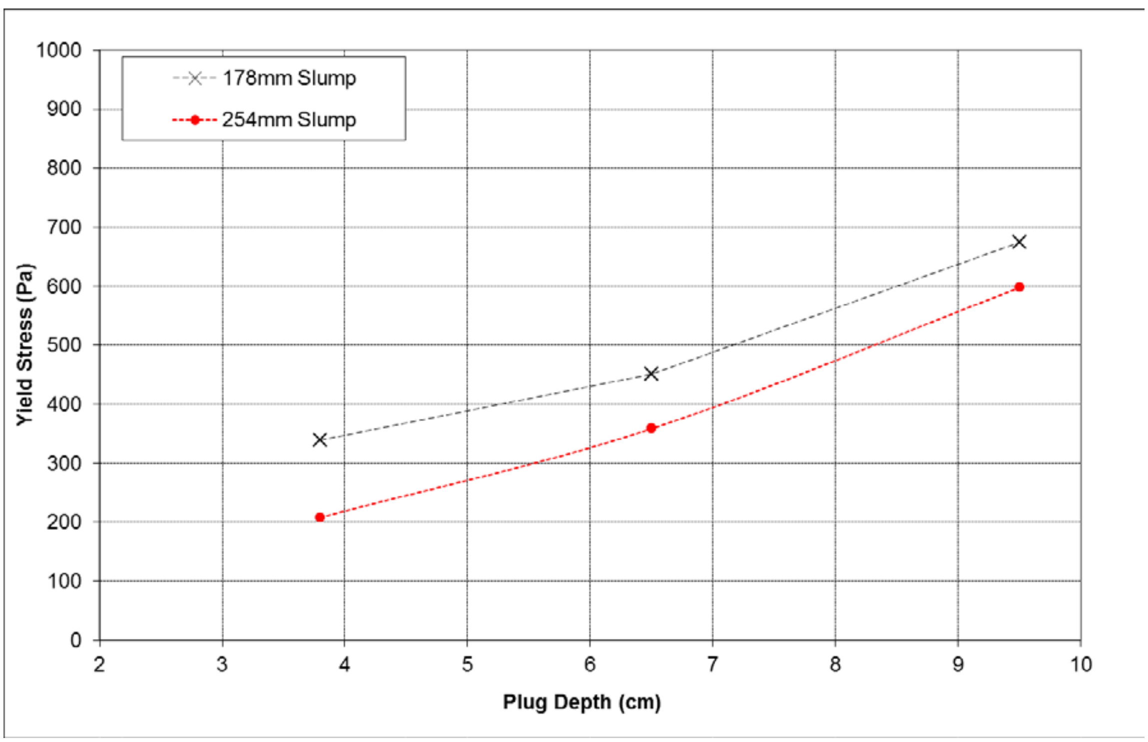


Figure 13: Plug Yield Stress Results - 13-1426-0010 CPTP 02

4.5 Viscosity and Dynamic Yield Stress Determination

Viscosity testing provides bench scale flow properties and fluid characterization. Dynamic viscosity and yield stress data is essential for mixer, pump and pipeline design. In order to compare or duplicate viscosity results of non-Newtonian fluids, it is important to test according to the same conditions. Test conditions and parameters such as cycle time and instrument sensor configuration are critical to producing usable data from bench scale viscometers.

The yield stress determined through this testing is referred to as dynamic yield stress since it is extrapolated from dynamic shear stress data to zero shear. The instrument sensor or bob rotated inside the cup which contained the sample and torque measurements were recorded at several incremental speeds or shear rates.

The rheograms are presented in Appendix B and summarized test results are presented in Tables 7 to 10 as well as on Figures 14 to 21.

Table 7: Bingham Viscosity and Yield Stress Summary - 13-1426-0010 SPTP 4

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
75.2	422	423	1.433	1.405
74.3	275	271	0.968	0.975
73.4	196	194	0.642	0.638
72.3	136	138	0.363	0.356
70.2	73	74	0.146	0.141
66.6	27	27	0.046	0.047

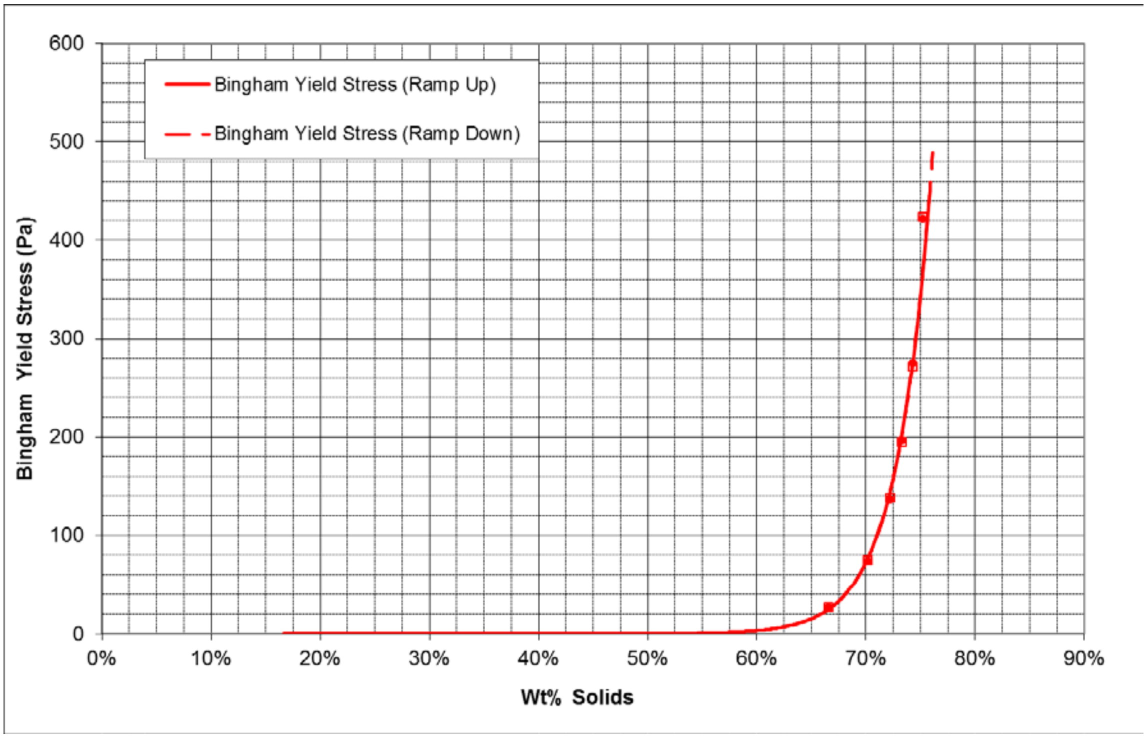


Figure 14: Bingham Yield Stress Results - 13-1426-0010 SPTP 4

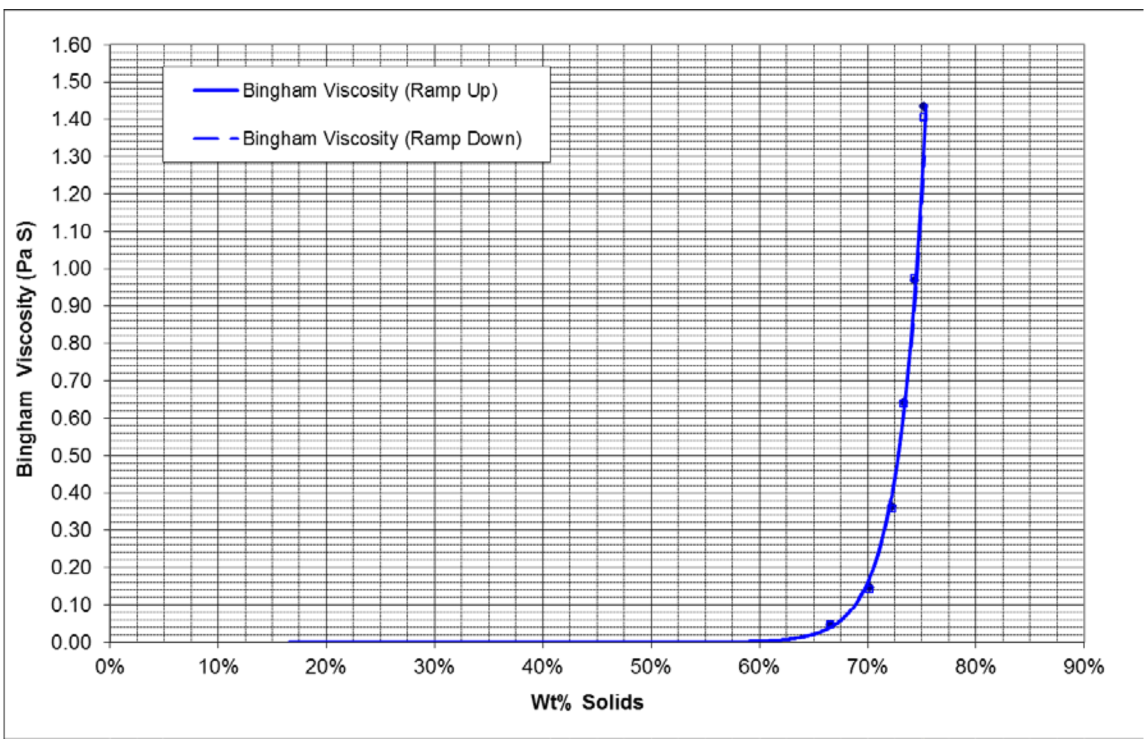


Figure 15: Bingham Viscosity Results - 13-1426-0010 SPTP 4

Table 8: Bingham Viscosity and Yield Stress Summary - 13-1426-0010 SPTP 5

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
77.4	124	72	0.612	0.696
75.9	100	56	0.489	0.548
74.4	51	32	0.262	0.290
72.3	26	17	0.111	0.122
69.5	11	8	0.045	0.052

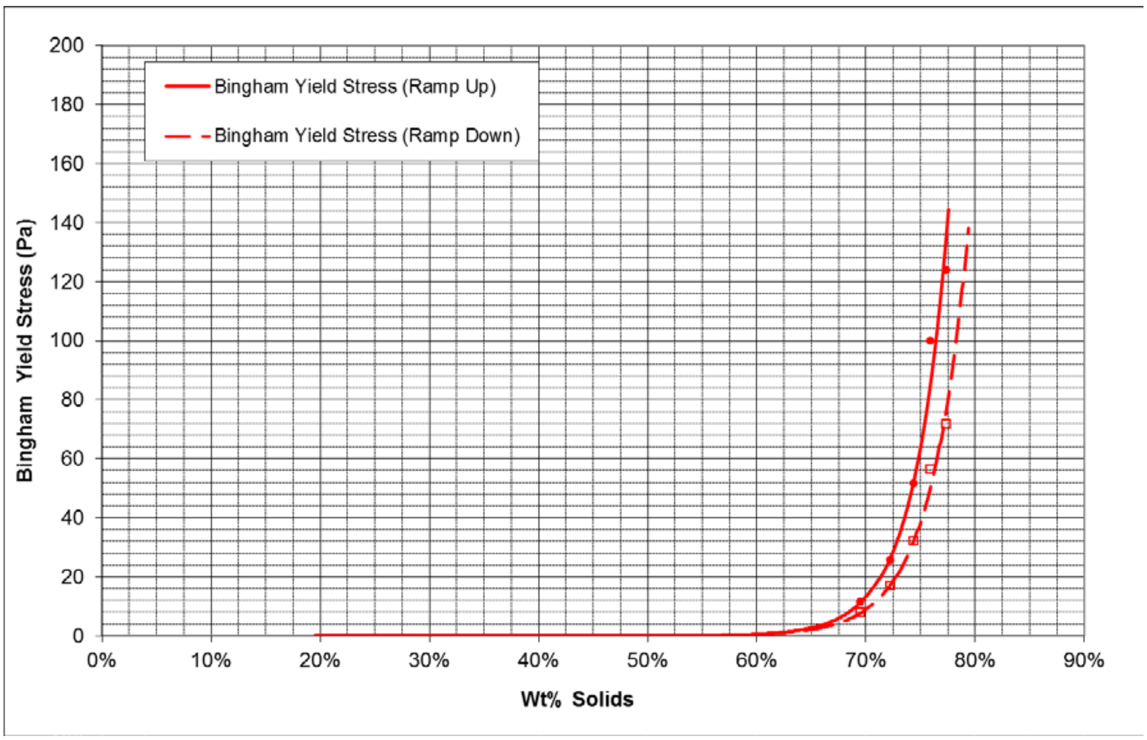


Figure 16: Bingham Yield Stress Results - 13-1426-0010 SPTP 5

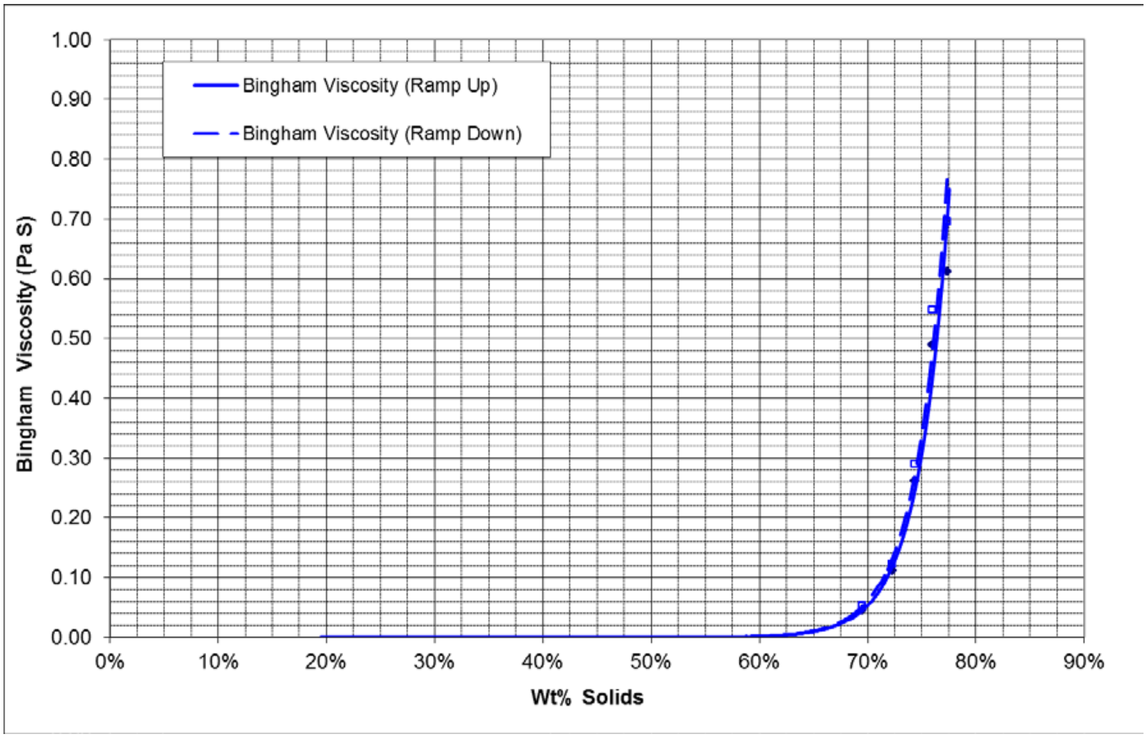


Figure 17: Bingham Viscosity Results - 13-1426-0010 SPTP 5

Table 9: Bingham Viscosity and Yield Stress Summary - 13-1426-0010 CPTP 01

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
78.5	110	83	0.694	0.743
77.3	79	64	0.549	0.574

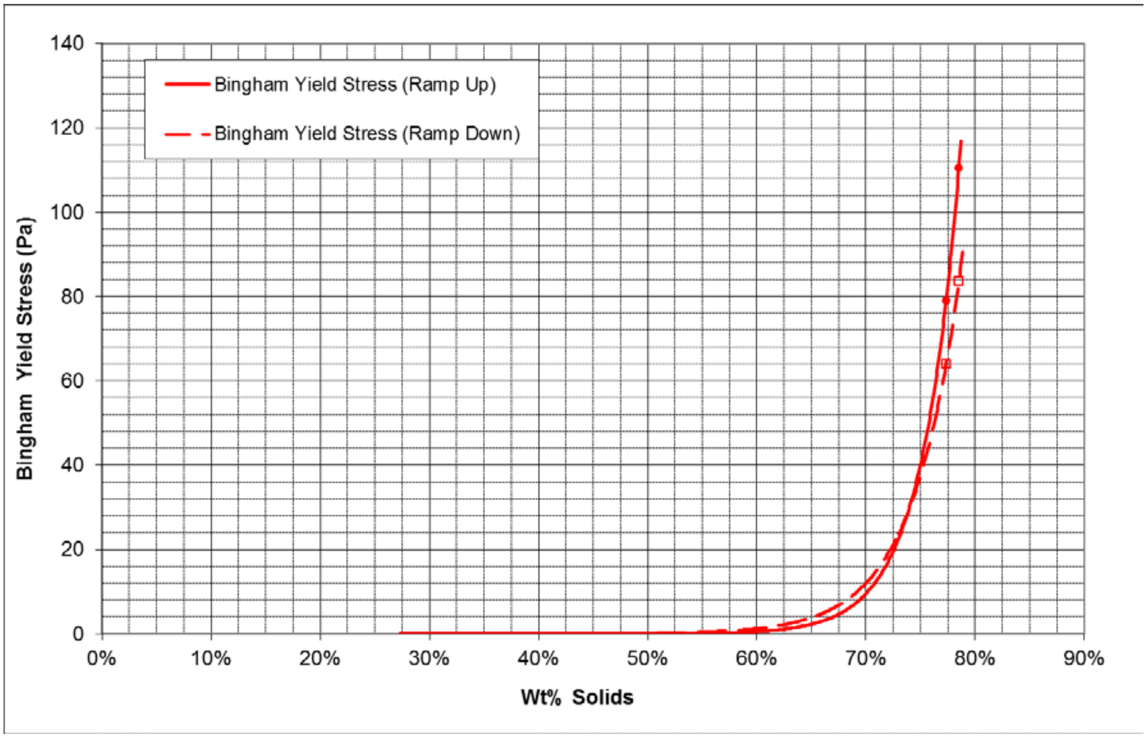


Figure 18: Bingham Yield Stress Results - 13-1426-0010 CPTP 01

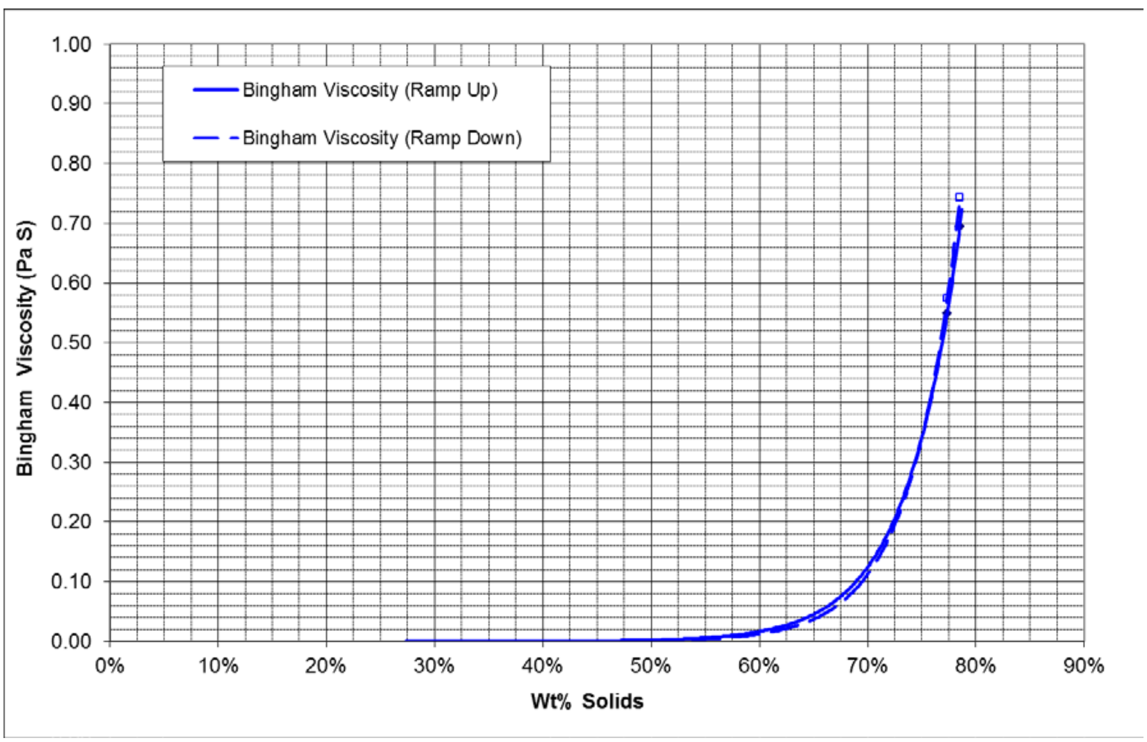


Figure 19: Bingham Viscosity Results - 13-1426-0010 CPTP 01

Table 10: Bingham Viscosity and Yield Stress Summary - 13-1426-0010 CPTP 02

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
78.4	198	139	0.878	1.028
77.4	165	103	0.766	0.892

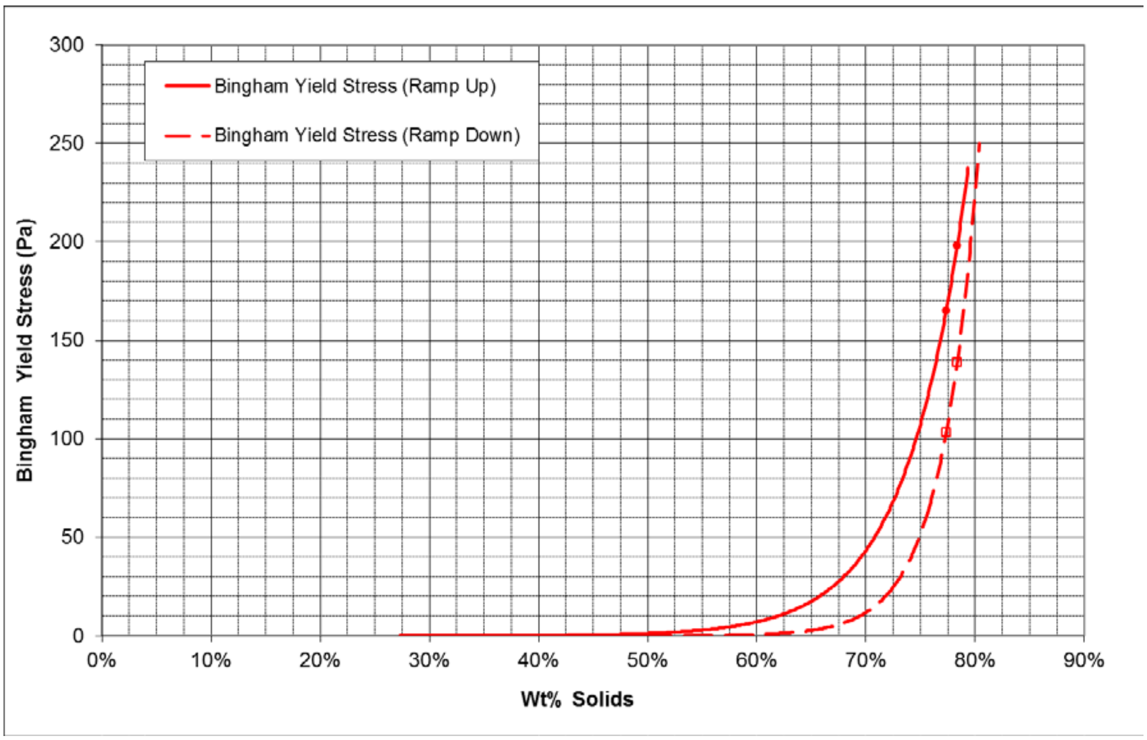


Figure 20: Bingham Yield Stress Results - 13-1426-0010 CPTP 02

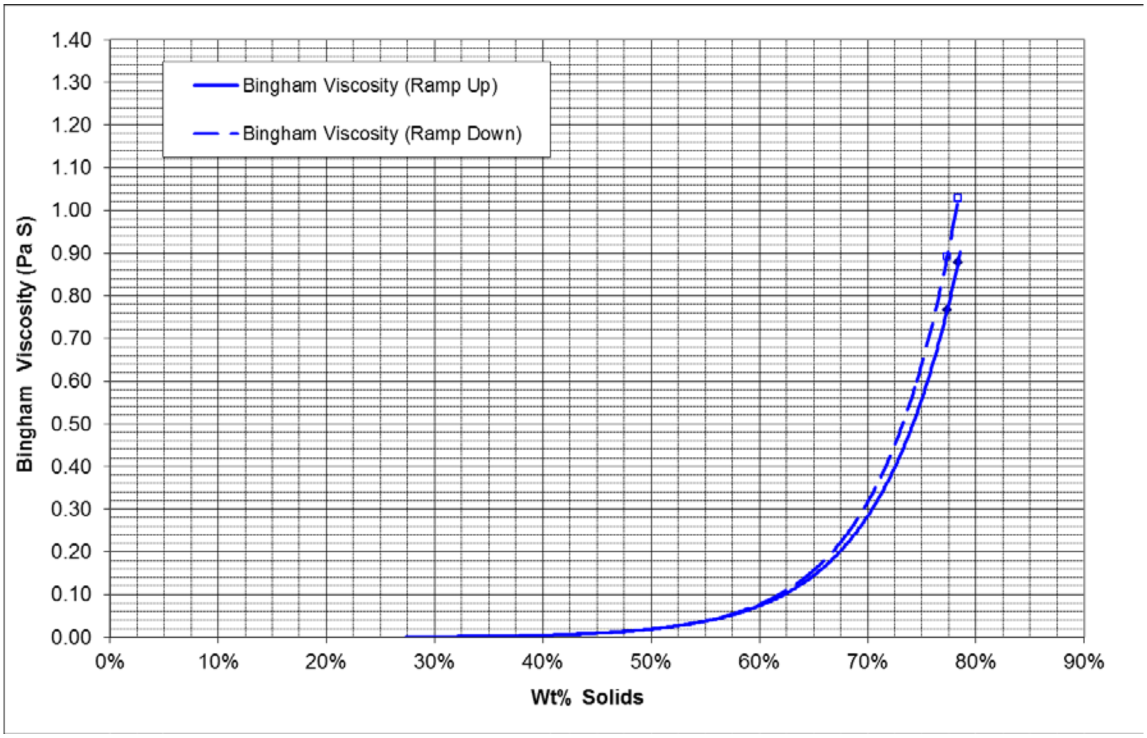


Figure 21: Bingham Viscosity Results - 13-1426-0010 CPTP 02

5.0 UNCONFINED COMPRESSIVE STRENGTH TESTING

Unconfined compressive strength (UCS) testing was carried out using a Humboldt HM2800 digital load frame. The load was measured using s-type load cells. Depending on strength, either a 10 kN or 45 kN (2,000 lb or 10,000 lb) load cell was utilized.

The cured cylinder was placed between two platens and during testing the bottom platen advanced at a rate of 2 mm (0.08 inch) per minute. The load was continuously monitored and the peak load was automatically recorded by the instrument.

5.1 UCS Program and Results

The UCS program was carried out to assess the backfill strength using 76 x 152 mm (3'' x 6'') cylinders. The cylinders were cured in a high humidity environment maintained at 20 to 25°C. Three cylinders per curing period were cast and the results were averaged. The test program is presented in Tables 11 and 12; the results are presented in Tables 13 and 14, as well as on Figures 22 to 27.

Table 11: UCS Testing Program

Mix	Wt% Binder	Binder	Material	Slump (mm)	Curing Days			Total
					7	28	56	
1	1	NPC	13-1426-0010 SP-TP 1+2+3	178	3	3	3	9
2	3			254	3	3	3	9
3	1		13-1426-0010 SP-TP 4+5+6	178	3	3	3	9
4	3			254	3	3	3	9
5	2	90% BFS / 10% NPC	13-1426-0010 SP-TP 4+5+6	178	3	3	3	9
6	2	NPC	13-1426-0010 SP-TP 1+2+3	178	3	3	3	9
7	7	90% BFS / 10% NPC		178	3	3	3	9
8	15	NPC		178	3	3	3	9
9	8		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	127	3	3	3	9
10	5			127	3	3	3	9
11	8		13-1426-0010 SP-TP 4+5+6	127	3	3	3	9
12	3		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	254	3	3	3	9
13	1			178	3	3	3	9
14	3	90% BFS / 10% NPC	13-1426-0010 SP-TP 4+5+6	254	3	3	3	9
15	1			178	3	3	3	9

Notes: NPC = Normal Portland Cement
BFS = Blast Furnace Slag

Table 12: UCS Testing Program

Mix	Wt% Binder	Binder	Material	Slump (mm)	Curing Days			Total
					1	3	7	
16	1	NPC	13-1426-0010 SP-TP 4+5+6	254	3	3	3	9
17	3			254	3	3	3	9
18	3			178	3	3	3	9
19	15		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	127	3	3	3	9
20	12			127	3	3	3	9
21	15		13-1426-0010 SP-TP 4+5+6	127	3	3	3	9
22	3			254	3	3	3	9
23	3			254	3	3	3	9

Notes: NPC = Normal Portland Cement
BFS = Blast Furnace Slag

Table 13: UCS Results

Mix	Wt% Binder	Binder	Material	Slump (mm)	Average UCS (kPa)			Average Bulk Density (kg/m^3)
					Curing 7 days	Curing 28 days	Curing 56 days	
1	1	NPC	13-1426-0010 SP-TP 1+2+3	178	145	149	150	2122
2	3			254	225	313	369	2120
3	1		13-1426-0010 SP-TP 4+5+6	178	58	72	81	2045
4	3			254	135	183	192	1999
5	2	90/10	13-1426-0010 SP-TP 4+5+6	178	165	530	644	2109
6	2	NPC	13-1426-0010 SP-TP 1+2+3	178	179	212	236	2143
7	7	90/10		178	1459	3678	4895	2129
8	15	NPC		178	5785	6875	6812	2157
9	8		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	127	1161	1435	1543	2097
10	5			127	483	621	684	2086
11	8		13-1426-0010 SP-TP 4+5+6	127	1056	1333	1371	2082
12	3		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	254	145	194	217	2059
13	1			178	69	82	96	2103
14	3	90% BFS / 10% NPC	13-1426-0010 SP-TP 4+5+6	254	202	850	1104	2053
15	1			178	4	66	69	2086

Table 14: UCS Results

Mix	Wt% Binder	Binder	Material	Slump (mm)	Average UCS (kPa)			Average Bulk Density (kg/m^3)
					Curing 1 day	Curing 3 days	Curing 7days	
16	1	NPC	13-1426-0010 SP-TP 4+5+6	254	Too Soft	38	---	2026
17	3			254	59	118	---	2041
18	3			178	75	137	---	2090
19	15		90% 13-1426-0010 SP-TP 4+5+6 – 10% Aggregate	127	1403	3773	4678	2127
20	12			127	714	2214	2755	2115
21	15		13-1426-0010 SP-TP 4+5+6	127	1319	3411	4822	2123
22 Counter	3			254	41	97	164	1985
23 (4 Degree ^oC)	3			254	Too Soft	48	72	1981

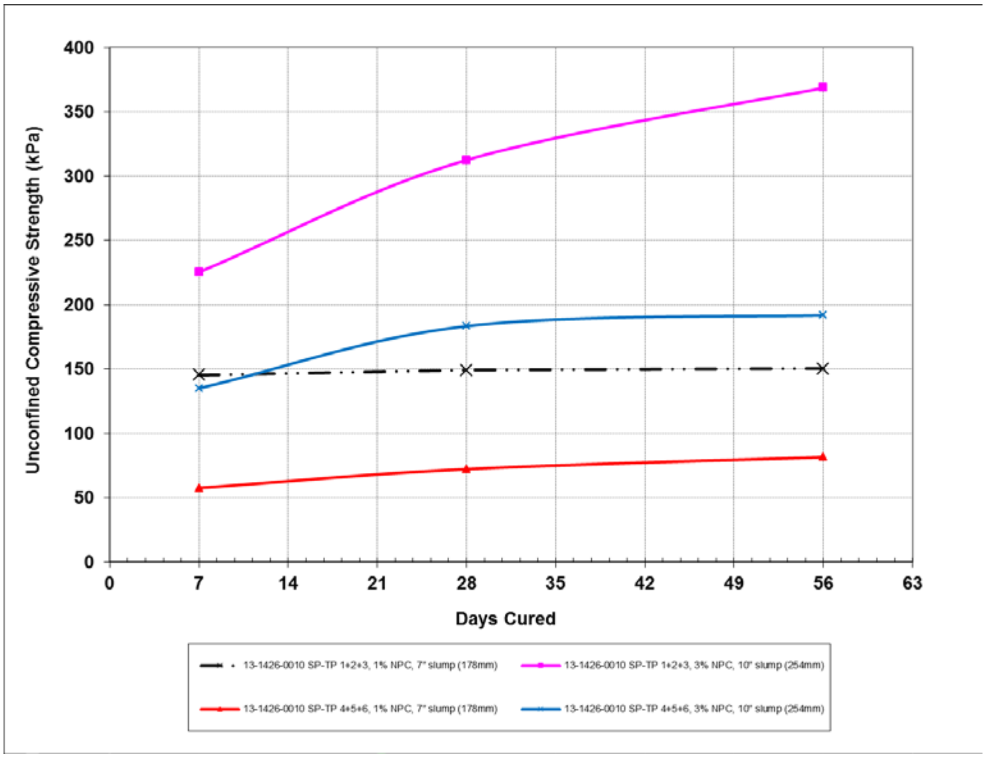


Figure 22: UCS Results- Mix 1 to Mix 4

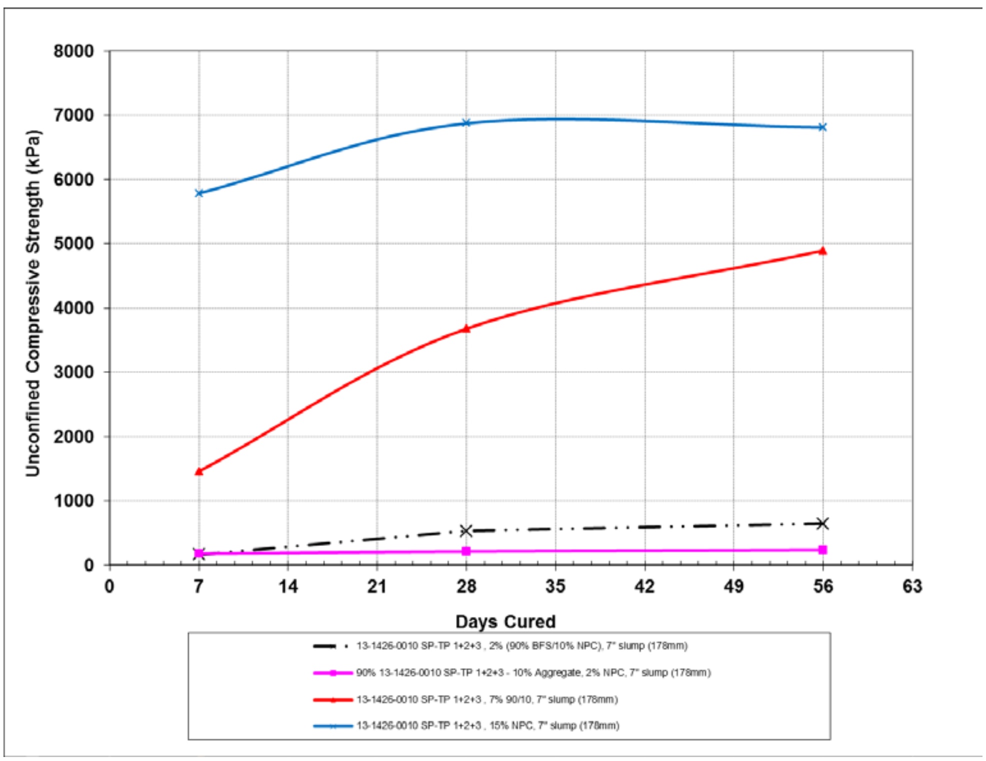


Figure 23: UCS Results – Mix 5 to Mix 8

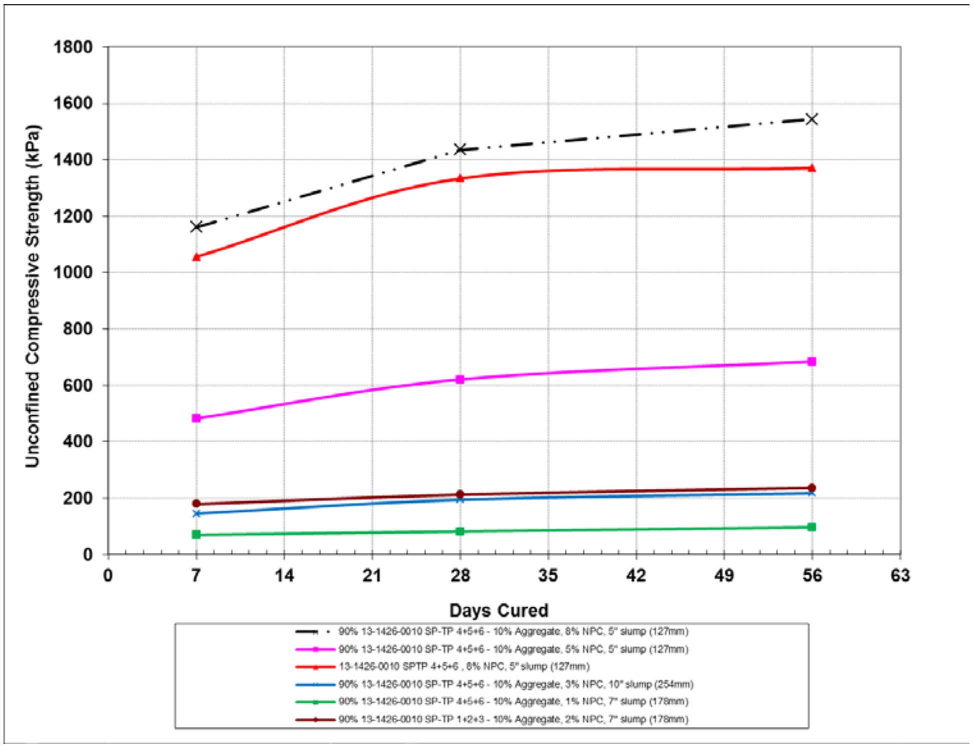


Figure 24: UCS Results - Mix 8 to Mix 13

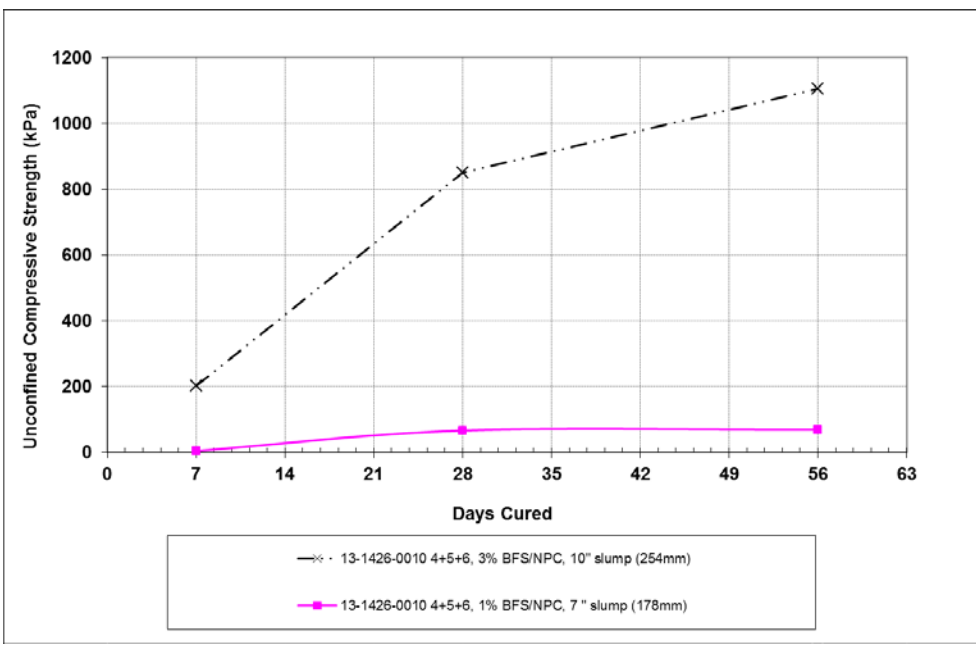


Figure 25: UCS Results - Mix 14 to Mix 15

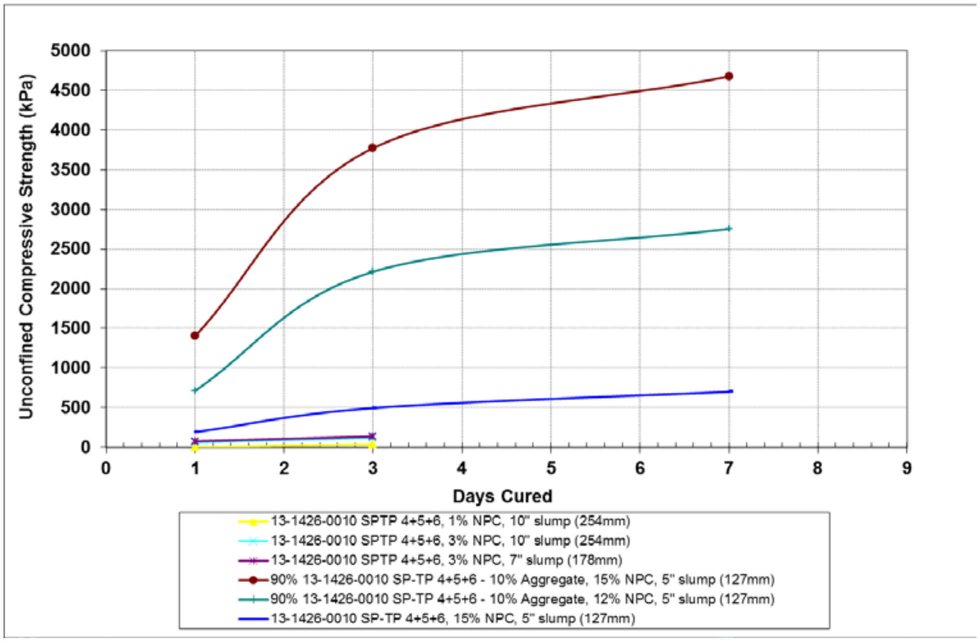


Figure 26: UCS Results - Mix 16 to Mix 21

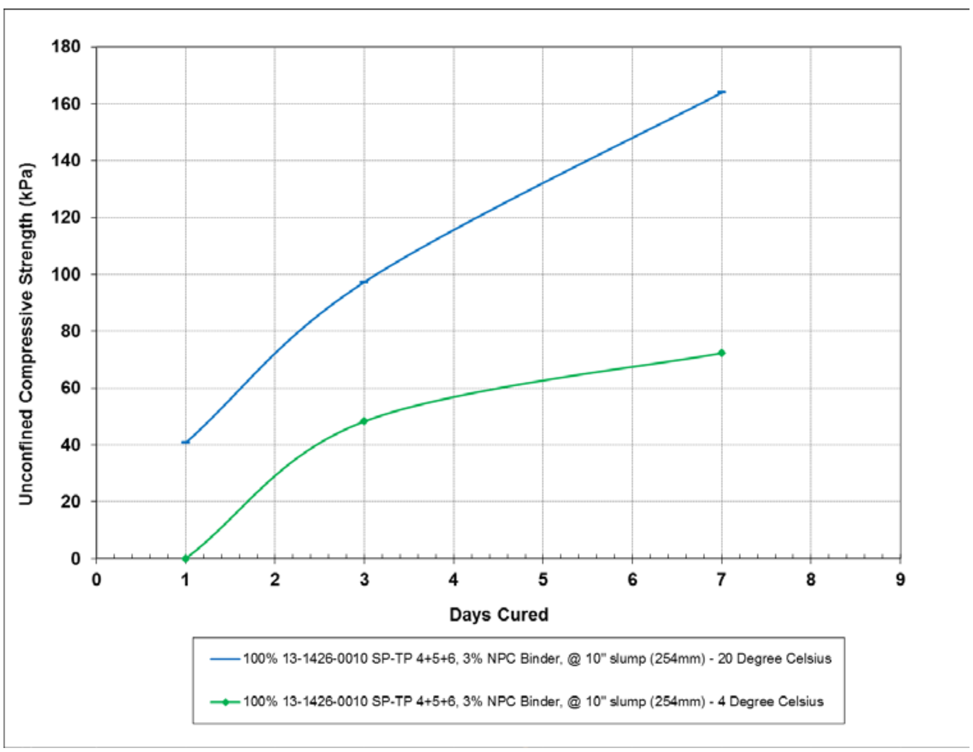


Figure 27: UCS Results - Mix 22 to Mix 23

6.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Mark Labelle
Process Laboratory Manager

ORIGINAL SIGNED

Sue Longo, P.Eng.
Associate, Mechanical Engineer

ML/SL/ds/kp

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APPENDIX A

ICP-MS results

TESTMARK Laboratories Ltd.

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Analytical Report

Client:	Mark Labelle	**Work Order Number:**	**188101**
Company:	Golder Associates Ltd - Paste Engineering Lab	**Date Order Received:**	07/23/13
Address:	1010 Lorne St.	**Regulation:**	Information not provided
	Sudbury, ON, P3A 4S4	**PO #:**	
Phone:	(705) 524-6861	**Project #:**	
Fax:	(705) 524-9636		
Email:	mlabelle@golder.com		

Analyses were performed on the following samples submitted with your order.

The results relate only to the items tested.

Sample Name	Lab #	Matrix	Type	Comments	Date Collected	Time Collected
GPTLS12 1539	499066	Soil	Grab		07/23/13	
GPTLS12 1540	499067	Soil	Grab		07/23/13	
GPTLS12 1541	499068	Soil	Grab		07/23/13	
GPTLS12 1542	499069	Soil	Grab		07/23/13	
GPTLS12 1543	499070	Soil	Grab		07/23/13	
GPTLS12 1544	499071	Soil	Grab		07/23/13	
GPTLS12 1545	499072	Soil	Grab		07/23/13	
GPTLS12 1546	499073	Soil	Grab		07/23/13	
GPTLS12 1549/1550	499074	Water	Comp		07/23/13	

The following instrumentation and reference methods were used for your sample(s)

Method Name	Description	Reference
CN WAD Soil	Determination of Weak Acid Dissociable Cyanide in Soil **Instrument group:** UV/Vis Spectrophotometer	Based on APHA-4500
ICPMS Soil	Determination of Metals in Soil by ICP/MS and BCSALM Method **Instrument group:** Perkin Elmer ICPMS	Based on SW846-6020A
ICPMS Water	Determination of Metals in Water by ICP/MS **Instrument group:** Perkin Elmer ICPMS	Based on SW846-6020A
KL-WAD CN/W	Determination of Weak Acid Dissociable (WAD) Cyanide in Water **Instrument group:** Subcontracted	OIA-1677

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 188101

This report has been approved by:

Adam Tam, M.Sc.
Inorganic Section Head

TESTMARK Laboratories Ltd.

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Golder Associates Ltd - Paste Engineering Lab Work Order: 188101

Sample Data:

Sample Name: GPTLS12 1539 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499066**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.79	mg/kg	20130724.R43.7A
Weak Acid Dissociable Cyanide (Dup)	0.1	0.72	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	14200	µg/g	20130724.R13na3
Antimony	0.5	224	µg/g	20130724.R13na3
Arsenic	5	2300	µg/g	20130724.R13na3
Barium	0.5	5.23	µg/g	20130724.R13na3
Beryllium	0.5	8.92	µg/g	20130724.R13na3
Bismuth	0.5	0.64	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	10.8	µg/g	20130724.R13na3
Cadmium	0.05	2.35	µg/g	20130724.R13na3
Calcium	30	47900	µg/g	20130724.R13na3
Cerium	0.5	6.24	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	36.9	µg/g	20130724.R13na3
Cobalt	0.05	32.9	µg/g	20130724.R13na3
Copper	0.5	79.1	µg/g	20130724.R13na3
Europium	0.5	0.59	µg/g	20130724.R13na3
Gallium	0.5	4	µg/g	20130724.R13na3
Iron	100	52500	µg/g	20130724.R13na3
Lanthanum	0.5	2.8	µg/g	20130724.R13na3
Lead	0.5	136	µg/g	20130724.R13na3
Lithium	3	27	µg/g	20130724.R13na3
Magnesium	2	26500	µg/g	20130724.R13na3
Manganese	5	1020	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.5	µg/g	20130724.R13na3
Nickel	0.5	64.9	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	232	µg/g	20130724.R13na3
Potassium	10	282	µg/g	20130724.R13na3
Rubidium	0.5	1.5	µg/g	20130724.R13na3
Scandium	0.5	7.04	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.857	µg/g	20130724.R13na3
Sodium	10	68	µg/g	20130724.R13na3
Strontium	0.5	29.6	µg/g	20130724.R13na3
Sulphur	400	3510	µg/g	20130724.R13na3
Tellurium	0.5	9.53	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	1.2	µg/g	20130724.R13na3
Tin	0.5	0.56	µg/g	20130724.R13na3

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 188101

Sample Name: GPTLS12 1539 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499066**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Titanium	0.5	44	µg/g	20130724.R13na3
Tungsten	0.5	1.2	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	53.3	µg/g	20130724.R13na3
Yttrium	0.5	5.2	µg/g	20130724.R13na3
Zinc	5	237	µg/g	20130724.R13na3
Zirconium	0.5	1.8	µg/g	20130724.R13na3

Sample Name: GPTLS12 1540 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499067**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.59	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	12500	µg/g	20130724.R13na3
Antimony	5	253	µg/g	20130724.R13na3
Arsenic	5	2230	µg/g	20130724.R13na3
Barium	0.5	3.5	µg/g	20130724.R13na3
Beryllium	0.5	5.4	µg/g	20130724.R13na3
Bismuth	0.5	<0.5	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	7.1	µg/g	20130724.R13na3
Cadmium	0.05	1.24	µg/g	20130724.R13na3
Calcium	30	60400	µg/g	20130724.R13na3
Cerium	0.5	5.63	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	33.8	µg/g	20130724.R13na3
Cobalt	0.05	38.5	µg/g	20130724.R13na3
Copper	0.5	82.1	µg/g	20130724.R13na3
Europium	0.5	0.51	µg/g	20130724.R13na3
Gallium	0.5	3.5	µg/g	20130724.R13na3
Iron	100	58200	µg/g	20130724.R13na3
Lanthanum	0.5	2.4	µg/g	20130724.R13na3
Lead	0.5	119	µg/g	20130724.R13na3
Lithium	3	25.1	µg/g	20130724.R13na3
Magnesium	2	30800	µg/g	20130724.R13na3
Manganese	5	1280	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	0.72	µg/g	20130724.R13na3
Nickel	0.5	71.1	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	246	µg/g	20130724.R13na3
Potassium	10	220	µg/g	20130724.R13na3
Rubidium	0.5	1.2	µg/g	20130724.R13na3
Scandium	0.5	7.46	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3

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Sample Name: GPTLS12 1540 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499067**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.738	µg/g	20130724.R13na3
Sodium	10	46	µg/g	20130724.R13na3
Strontium	0.5	37.2	µg/g	20130724.R13na3
Sulphur	400	4220	µg/g	20130724.R13na3
Tellurium	0.5	2.4	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.67	µg/g	20130724.R13na3
Tin	0.5	<0.5	µg/g	20130724.R13na3
Titanium	0.5	37.7	µg/g	20130724.R13na3
Tungsten	0.5	1	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	48.8	µg/g	20130724.R13na3
Yttrium	0.5	6.15	µg/g	20130724.R13na3
Zinc	5	223	µg/g	20130724.R13na3
Zirconium	0.5	1.5	µg/g	20130724.R13na3

Sample Name: GPTLS12 1541 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499068**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.48	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	16500	µg/g	20130724.R13na3
Antimony	5	452	µg/g	20130724.R13na3
Arsenic	5	2570	µg/g	20130724.R13na3
Barium	0.5	6.1	µg/g	20130724.R13na3
Beryllium	0.5	5.11	µg/g	20130724.R13na3
Bismuth	0.5	0.54	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	8.8	µg/g	20130724.R13na3
Cadmium	0.05	2.37	µg/g	20130724.R13na3
Calcium	30	54200	µg/g	20130724.R13na3
Cerium	0.5	8.29	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	47.7	µg/g	20130724.R13na3
Cobalt	0.05	40	µg/g	20130724.R13na3
Copper	0.5	93.7	µg/g	20130724.R13na3
Europium	0.5	0.6	µg/g	20130724.R13na3
Gallium	0.5	5.19	µg/g	20130724.R13na3
Iron	100	61200	µg/g	20130724.R13na3
Lanthanum	0.5	3.4	µg/g	20130724.R13na3
Lead	0.5	247	µg/g	20130724.R13na3
Lithium	3	30.8	µg/g	20130724.R13na3
Magnesium	2	28000	µg/g	20130724.R13na3
Manganese	5	1120	µg/g	20130724.R13na3

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Sample Name: GPTLS12 1541 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499068**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.5	µg/g	20130724.R13na3
Nickel	0.5	75.7	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	362	µg/g	20130724.R13na3
Potassium	10	369	µg/g	20130724.R13na3
Rubidium	0.5	2	µg/g	20130724.R13na3
Scandium	0.5	8.69	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	1.08	µg/g	20130724.R13na3
Sodium	10	111	µg/g	20130724.R13na3
Strontium	0.5	42.3	µg/g	20130724.R13na3
Sulphur	400	4930	µg/g	20130724.R13na3
Tellurium	0.5	8.22	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.84	µg/g	20130724.R13na3
Tin	0.5	0.51	µg/g	20130724.R13na3
Titanium	0.5	71.9	µg/g	20130724.R13na3
Tungsten	0.5	2	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	68.2	µg/g	20130724.R13na3
Yttrium	0.5	4.9	µg/g	20130724.R13na3
Zinc	5	281	µg/g	20130724.R13na3
Zirconium	0.5	2.2	µg/g	20130724.R13na3

Sample Name: GPTLS12 1542 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499069**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.4	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	10500	µg/g	20130724.R13na3
Antimony	5	323	µg/g	20130724.R13na3
Arsenic	5	1980	µg/g	20130724.R13na3
Barium	0.5	9.92	µg/g	20130724.R13na3
Beryllium	0.5	6.06	µg/g	20130724.R13na3
Bismuth	0.5	0.9	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	8.7	µg/g	20130724.R13na3
Cadmium	0.05	2.71	µg/g	20130724.R13na3
Calcium	30	47200	µg/g	20130724.R13na3
Cerium	0.5	8.69	µg/g	20130724.R13na3
Cesium	0.5	1	µg/g	20130724.R13na3
Chromium	0.5	32.8	µg/g	20130724.R13na3
Cobalt	0.05	37.9	µg/g	20130724.R13na3

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Sample Name: GPTLS12 1542 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499069**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Copper	5	116	µg/g	20130724.R13na3
Europium	0.5	0.52	µg/g	20130724.R13na3
Gallium	0.5	3.8	µg/g	20130724.R13na3
Iron	100	50000	µg/g	20130724.R13na3
Lanthanum	0.5	4	µg/g	20130724.R13na3
Lead	0.5	224	µg/g	20130724.R13na3
Lithium	3	23.8	µg/g	20130724.R13na3
Magnesium	2	24300	µg/g	20130724.R13na3
Manganese	5	911	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.3	µg/g	20130724.R13na3
Nickel	0.5	66.2	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	329	µg/g	20130724.R13na3
Potassium	10	637	µg/g	20130724.R13na3
Rubidium	0.5	3.7	µg/g	20130724.R13na3
Scandium	0.5	6.22	µg/g	20130724.R13na3
Selenium	0.5	1.2	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	1.29	µg/g	20130724.R13na3
Sodium	10	95	µg/g	20130724.R13na3
Strontium	0.5	33.7	µg/g	20130724.R13na3
Sulphur	400	4980	µg/g	20130724.R13na3
Tellurium	0.5	5.2	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.85	µg/g	20130724.R13na3
Tin	0.5	0.67	µg/g	20130724.R13na3
Titanium	0.5	83.2	µg/g	20130724.R13na3
Tungsten	0.5	3	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	44.1	µg/g	20130724.R13na3
Yttrium	0.5	4.7	µg/g	20130724.R13na3
Zinc	5	275	µg/g	20130724.R13na3
Zirconium	0.5	2.7	µg/g	20130724.R13na3

Sample Name: GPTLS12 1543 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499070**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	1.24	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	14000	µg/g	20130724.R13na3
Antimony	0.5	211	µg/g	20130724.R13na3
Arsenic	5	2350	µg/g	20130724.R13na3
Barium	0.5	5.47	µg/g	20130724.R13na3

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Sample Name: GPTLS12 1543 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499070**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Beryllium	0.5	2.9	µg/g	20130724.R13na3
Bismuth	0.5	<0.5	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	6.1	µg/g	20130724.R13na3
Cadmium	0.05	1.5	µg/g	20130724.R13na3
Calcium	30	47500	µg/g	20130724.R13na3
Cerium	0.5	6.54	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	42.5	µg/g	20130724.R13na3
Cobalt	0.05	36.9	µg/g	20130724.R13na3
Copper	5	103	µg/g	20130724.R13na3
Europium	0.5	<0.5	µg/g	20130724.R13na3
Gallium	0.5	3.8	µg/g	20130724.R13na3
Iron	100	50000	µg/g	20130724.R13na3
Lanthanum	0.5	3	µg/g	20130724.R13na3
Lead	0.5	149	µg/g	20130724.R13na3
Lithium	3	25.8	µg/g	20130724.R13na3
Magnesium	2	26600	µg/g	20130724.R13na3
Manganese	5	997	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.1	µg/g	20130724.R13na3
Nickel	0.5	69.9	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	293	µg/g	20130724.R13na3
Potassium	10	307	µg/g	20130724.R13na3
Rubidium	0.5	1.5	µg/g	20130724.R13na3
Scandium	0.5	7.02	µg/g	20130724.R13na3
Selenium	0.5	1	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.827	µg/g	20130724.R13na3
Sodium	10	76	µg/g	20130724.R13na3
Strontium	0.5	28.5	µg/g	20130724.R13na3
Sulphur	400	3410	µg/g	20130724.R13na3
Tellurium	0.5	2.3	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.59	µg/g	20130724.R13na3
Tin	0.5	<0.5	µg/g	20130724.R13na3
Titanium	0.5	50.1	µg/g	20130724.R13na3
Tungsten	0.5	1.9	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	50.6	µg/g	20130724.R13na3
Yttrium	0.5	5.23	µg/g	20130724.R13na3
Zinc	5	222	µg/g	20130724.R13na3
Zirconium	0.5	1.5	µg/g	20130724.R13na3

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 188101

Sample Name: GPTLS12 1544 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499071**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.2	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18000	µg/g	20130724.R13na3
Antimony	0.5	183	µg/g	20130724.R13na3
Arsenic	5	2430	µg/g	20130724.R13na3
Barium	0.5	4.8	µg/g	20130724.R13na3
Beryllium	0.5	2.6	µg/g	20130724.R13na3
Bismuth	0.5	<0.5	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	6.3	µg/g	20130724.R13na3
Cadmium	0.05	1.32	µg/g	20130724.R13na3
Calcium	30	46000	µg/g	20130724.R13na3
Cerium	0.5	8.27	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	52.4	µg/g	20130724.R13na3
Cobalt	0.05	45.8	µg/g	20130724.R13na3
Copper	5	134	µg/g	20130724.R13na3
Europium	0.5	0.55	µg/g	20130724.R13na3
Gallium	0.5	4.9	µg/g	20130724.R13na3
Iron	100	67400	µg/g	20130724.R13na3
Lanthanum	0.5	3.5	µg/g	20130724.R13na3
Lead	0.5	173	µg/g	20130724.R13na3
Lithium	3	30.8	µg/g	20130724.R13na3
Magnesium	2	28900	µg/g	20130724.R13na3
Manganese	5	1060	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.1	µg/g	20130724.R13na3
Nickel	0.5	85.9	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	345	µg/g	20130724.R13na3
Potassium	10	294	µg/g	20130724.R13na3
Rubidium	0.5	1.4	µg/g	20130724.R13na3
Scandium	0.5	8.48	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.85	µg/g	20130724.R13na3
Sodium	10	104	µg/g	20130724.R13na3
Strontium	0.5	27.4	µg/g	20130724.R13na3
Sulphur	400	3060	µg/g	20130724.R13na3
Tellurium	0.5	2.5	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.6	µg/g	20130724.R13na3
Tin	0.5	<0.5	µg/g	20130724.R13na3
Titanium	0.5	46.1	µg/g	20130724.R13na3
Tungsten	0.5	2.5	µg/g	20130724.R13na3

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 188101

Sample Name: GPTLS12 1544 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499071**

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	65.7	µg/g	20130724.R13na3
Yttrium	0.5	6.08	µg/g	20130724.R13na3
Zinc	5	289	µg/g	20130724.R13na3
Zirconium	0.5	1.7	µg/g	20130724.R13na3

Sample Name: GPTLS12 1545 **Date: 07/23/13** **Matrix: Soil** **Lab #: 499072**

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.67	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	16200	µg/g	20130724.R13na3
Antimony	0.5	184	µg/g	20130724.R13na3
Arsenic	5	2500	µg/g	20130724.R13na3
Barium	0.5	4.4	µg/g	20130724.R13na3
Beryllium	0.5	3	µg/g	20130724.R13na3
Bismuth	0.5	<0.5	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	4.1	µg/g	20130724.R13na3
Cadmium	0.05	1.86	µg/g	20130724.R13na3
Calcium	30	47800	µg/g	20130724.R13na3
Cerium	0.5	7.01	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	49.3	µg/g	20130724.R13na3
Cobalt	0.05	39.7	µg/g	20130724.R13na3
Copper	0.5	90.3	µg/g	20130724.R13na3
Europium	0.5	<0.5	µg/g	20130724.R13na3
Gallium	0.5	4.4	µg/g	20130724.R13na3
Iron	100	55900	µg/g	20130724.R13na3
Lanthanum	0.5	3	µg/g	20130724.R13na3
Lead	0.5	149	µg/g	20130724.R13na3
Lithium	3	25.7	µg/g	20130724.R13na3
Magnesium	2	26900	µg/g	20130724.R13na3
Manganese	5	1020	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	1.1	µg/g	20130724.R13na3
Nickel	0.5	78.2	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	262	µg/g	20130724.R13na3
Potassium	10	258	µg/g	20130724.R13na3
Rubidium	0.5	1.3	µg/g	20130724.R13na3
Scandium	0.5	7.62	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.716	µg/g	20130724.R13na3

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 188101

Sample Name: GPTLS12 1545 — Date: 07/23/13 — Matrix: Soil — Lab #: 499072

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Sodium	10	108	µg/g	20130724.R13na3
Strontium	0.5	28.2	µg/g	20130724.R13na3
Sulphur	400	3850	µg/g	20130724.R13na3
Tellurium	0.5	1.9	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.54	µg/g	20130724.R13na3
Tin	0.5	<0.5	µg/g	20130724.R13na3
Titanium	0.5	49	µg/g	20130724.R13na3
Tungsten	0.5	1.2	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	55.8	µg/g	20130724.R13na3
Yttrium	0.5	5.72	µg/g	20130724.R13na3
Zinc	5	304	µg/g	20130724.R13na3
Zirconium	0.5	1.5	µg/g	20130724.R13na3

Sample Name: GPTLS12 1546 — Date: 07/23/13 — Matrix: Soil — Lab #: 499073

CN WAD Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.1	0.77	mg/kg	20130724.R43.7A

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	16200	µg/g	20130724.R13na3
Antimony	0.5	114	µg/g	20130724.R13na3
Arsenic	5	1660	µg/g	20130724.R13na3
Barium	0.5	5.54	µg/g	20130724.R13na3
Beryllium	0.5	3.3	µg/g	20130724.R13na3
Bismuth	0.5	<0.5	µg/g	20130724.R13na3
Boron (Not Hot Water Extractable)	1	5.3	µg/g	20130724.R13na3
Cadmium	0.05	2.04	µg/g	20130724.R13na3
Calcium	30	56800	µg/g	20130724.R13na3
Cerium	0.5	8.28	µg/g	20130724.R13na3
Cesium	0.5	<0.5	µg/g	20130724.R13na3
Chromium	0.5	65.9	µg/g	20130724.R13na3
Cobalt	0.05	32.2	µg/g	20130724.R13na3
Copper	0.5	74.8	µg/g	20130724.R13na3
Europium	0.5	0.52	µg/g	20130724.R13na3
Gallium	0.5	5.57	µg/g	20130724.R13na3
Iron	100	42900	µg/g	20130724.R13na3
Lanthanum	0.5	3.6	µg/g	20130724.R13na3
Lead	0.5	151	µg/g	20130724.R13na3
Lithium	3	35.5	µg/g	20130724.R13na3
Magnesium	2	32000	µg/g	20130724.R13na3
Manganese	5	927	µg/g	20130724.R13na3
Mercury	0.05	<0.05	µg/g	20130724.R13na3
Molybdenum	0.5	0.78	µg/g	20130724.R13na3

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Golder Associates Ltd - Paste Engineering Lab　　Work Order: 188101

Sample Name: GPTLS12 1546　　Date: 07/23/13　　Matrix: Soil　　Lab #: 499073

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Nickel	0.5	74.5	µg/g	20130724.R13na3
Niobium	0.5	<0.5	µg/g	20130724.R13na3
Phosphorus	30	311	µg/g	20130724.R13na3
Potassium	10	380	µg/g	20130724.R13na3
Rubidium	0.5	1.8	µg/g	20130724.R13na3
Scandium	0.5	10.1	µg/g	20130724.R13na3
Selenium	0.5	<0.5	µg/g	20130724.R13na3
Silicon	300	<300	µg/g	20130724.R13na3
Silver	0.05	0.703	µg/g	20130724.R13na3
Sodium	10	99	µg/g	20130724.R13na3
Strontium	0.5	36.2	µg/g	20130724.R13na3
Sulphur	400	3720	µg/g	20130724.R13na3
Tellurium	0.5	3	µg/g	20130724.R13na3
Thallium	0.3	<0.3	µg/g	20130724.R13na3
Thorium	0.5	0.59	µg/g	20130724.R13na3
Tin	0.5	<0.5	µg/g	20130724.R13na3
Titanium	0.5	48.1	µg/g	20130724.R13na3
Tungsten	0.5	1.3	µg/g	20130724.R13na3
Uranium	0.5	<0.5	µg/g	20130724.R13na3
Vanadium	0.5	76	µg/g	20130724.R13na3
Yttrium	0.5	5.86	µg/g	20130724.R13na3
Zinc	5	268	µg/g	20130724.R13na3
Zirconium	0.5	1.8	µg/g	20130724.R13na3

Sample Name: GPTLS12 1549/1550　　Date: 07/23/13　　Matrix: Water　　Lab #: 499074

ICPMS Water				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	1	222	ug/L	20130724.R13nr2
Antimony	0.5	169	ug/L	20130724.R13nr2
Arsenic	1	34.3	ug/L	20130724.R13nr2
Barium	1	17.1	ug/L	20130724.R13nr2
Beryllium	0.5	<0.5	ug/L	20130724.R13nr2
Bismuth	1	<1	ug/L	20130724.R13nr2
Boron	2	364	ug/L	20130724.R13nr2
Cadmium	0.1	0.92	ug/L	20130724.R13nr2
Calcium	50	307000	ug/L	20130724.R13nr2
Cerium	1	<1	ug/L	20130724.R13nr2
Cesium	1	<1	ug/L	20130724.R13nr2
Chromium	1	1.2	ug/L	20130724.R13nr2
Cobalt	0.1	2.24	ug/L	20130724.R13nr2
Copper	1	<1	ug/L	20130724.R13nr2
Europium	1	<1	ug/L	20130724.R13nr2
Gallium	1	<1	ug/L	20130724.R13nr2
Iron	20	2790	ug/L	20130724.R13nr2
Lanthanum	1	<1	ug/L	20130724.R13nr2

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 188101

Sample Name: GPTLS12 1549/1550 **Date: 07/23/13** **Matrix: Water** **Lab #: 499074**

ICPMS Water				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Lead	0.1	2.23	ug/L	20130724.R13nr2
Lithium	5	25.9	ug/L	20130724.R13nr2
Magnesium	4	71500	ug/L	20130724.R13nr2
Manganese	1	66.5	ug/L	20130724.R13nr2
Mercury	0.1	<0.1	ug/L	20130724.R13nr2
Molybdenum	0.5	14.7	ug/L	20130724.R13nr2
Nickel	1	12.2	ug/L	20130724.R13nr2
Niobium	1	<1	ug/L	20130724.R13nr2
Potassium	100	9360	ug/L	20130724.R13nr2
Rubidium	1	8.4	ug/L	20130724.R13nr2
Scandium	1	<1	ug/L	20130724.R13nr2
Selenium	1	6.9	ug/L	20130724.R13nr2
Silicon	600	1050	ug/L	20130724.R13nr2
Silver	0.1	<0.1	ug/L	20130724.R13nr2
Sodium	100	123000	ug/L	20130724.R13nr2
Strontium	1	2820	ug/L	20130724.R13nr2
Sulphur	800	304000	ug/L	20130724.R13nr2
Tellurium	1	<1	ug/L	20130724.R13nr2
Thallium	0.1	0.65	ug/L	20130724.R13nr2
Thorium	1	<1	ug/L	20130724.R13nr2
Tin	1	87.2	ug/L	20130724.R13nr2
Titanium	1	3.7	ug/L	20130724.R13nr2
Tungsten	1	<1	ug/L	20130724.R13nr2
Uranium	1	1.8	ug/L	20130724.R13nr2
Vanadium	0.5	<0.5	ug/L	20130724.R13nr2
Yttrium	1	<1	ug/L	20130724.R13nr2
Zinc	1	10.9	ug/L	20130724.R13nr2
Zirconium	1	<1	ug/L	20130724.R13nr2

KL-WAD CN/W				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Weak Acid Dissociable Cyanide	0.001	0.014	mg/L	20130724.K43W

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MDL Method detection limit or minimum reporting limit.
% Rec Surrogate compounds are added to the sample in some cases and the recovery is reported as a percent recovered.
QAQCID This is a unique reference to the quality control data set used to generate the reported value.
Data reported for organic analysis in soil samples are corrected for moisture content
Matrix If the matrix is a leachate, the sample was extracted according to regulation 558.
INT Interferences
TNTC Too numerous to count
ND Not detected

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 188101

Quality Control Data:

ICPMS Soil

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	0.5	µg/g	<0.5	<0.5	2	20130724.R13na3
Antimony	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Arsenic	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Barium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Beryllium	0.5	µg/g	<0.5	<0.5	2.5	20130724.R13na3
Bismuth	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Cadmium	0.05	µg/g	<0.05	<0.05	0.5	20130724.R13na3
Calcium	30	µg/g	<30	<30	50	20130724.R13na3
Cerium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Cesium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Chromium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Cobalt	0.05	µg/g	<0.05	<0.05	0.5	20130724.R13na3
Copper	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Europium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Gallium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Iron	10	µg/g	<10	<10	10	20130724.R13na3
Lanthanum	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Lead	0.05	µg/g	<0.05	<0.05	0.5	20130724.R13na3
Magnesium	2	µg/g	<2	<2	3	20130724.R13na3
Manganese	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Mercury	0.05	µg/g	<0.05	<0.05	0.5	20130724.R13na3
Molybdenum	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Nickel	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Niobium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Phosphorus	30	µg/g	<30	<30	30	20130724.R13na3
Potassium	10	µg/g	<10	<10	50	20130724.R13na3
Rubidium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Scandium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Selenium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Silver	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Sodium	10	µg/g	<10	<10	50	20130724.R13na3
Strontium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Thallium	0.3	µg/g	<0.3	<0.3	0.5	20130724.R13na3
Thorium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Tin	0.5	µg/g	<0.5	<0.5	2.5	20130724.R13na3
Titanium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Tungsten	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Uranium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Vanadium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Yttrium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3
Zinc	0.5	µg/g	<0.5	<0.5	1	20130724.R13na3
Zirconium	0.5	µg/g	<0.5	<0.5	0.5	20130724.R13na3

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ICPMS Soil

SS2 CRM						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	5	µg/g	6743	13700	19787	20130724.R13na3
Antimony	0.5	µg/g	3	4.2	5.3	20130724.R13na3
Arsenic	0.5	µg/g	25	83.2	125	20130724.R13na3
Barium	0.5	µg/g	149	220	281	20130724.R13na3
Cadmium	0.05	µg/g	1.2	2.73	3.2	20130724.R13na3
Calcium	30	µg/g	87443	104000	138279	20130724.R13na3
Chromium	0.5	µg/g	14	36.3	54	20130724.R13na3
Cobalt	0.05	µg/g	9	11.7	15	20130724.R13na3
Copper	5	µg/g	139	187	243	20130724.R13na3
Iron	100	µg/g	12831	21400	29261	20130724.R13na3
Lead	0.5	µg/g	68	118	184	20130724.R13na3
Lithium	3	µg/g	5	15.8	23	20130724.R13na3
Magnesium	2	µg/g	7628	11000	14502	20130724.R13na3
Manganese	5	µg/g	324	504	590	20130724.R13na3
Molybdenum	0.5	µg/g	1.94	2.9	3.94	20130724.R13na3
Nickel	0.5	µg/g	33	55	75	20130724.R13na3
Silver	0.5	µg/g	0.5	0.55	2	20130724.R13na3
Strontium	0.5	µg/g	156	216	272	20130724.R13na3
Titanium	5	µg/g	298	919	1402	20130724.R13na3
Uranium	0.5	µg/g	1	1.3	1.9	20130724.R13na3
Vanadium	0.5	µg/g	17	40.6	51	20130724.R13na3
Zinc	5	µg/g	337	464	597	20130724.R13na3

ICPMS Water

EU-L-3						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Antimony	0.5	ug/L	12.8	20.1	24	20130724.R13nr2
Arsenic	1	ug/L	73.2	80.9	93.8	20130724.R13nr2
Barium	1	ug/L	103	119	145	20130724.R13nr2
Cadmium	0.1	ug/L	18.6	21	27	20130724.R13nr2
Calcium	50	ug/L	1720	2320	2450	20130724.R13nr2
Chromium	1	ug/L	48.7	57.2	76.6	20130724.R13nr2
Cobalt	0.1	ug/L	76.2	81.5	88.8	20130724.R13nr2
Copper	1	ug/L	87.1	90.8	125	20130724.R13nr2
Lead	1	ug/L	36.1	39.6	47.5	20130724.R13nr2
Magnesium	4	ug/L	753	852	1124	20130724.R13nr2
Manganese	1	ug/L	107	117	138	20130724.R13nr2
Molybdenum	1	ug/L	32.7	37.3	46.7	20130724.R13nr2
Nickel	1	ug/L	73.1	78.5	93.8	20130724.R13nr2
Phosphorus	50	ug/L	874	876	1105	20130724.R13nr2
Potassium	0.1	ug/L	1680	1950	2470	20130724.R13nr2
Selenium	1	ug/L	13.7	27.7	42.2	20130724.R13nr2
Sodium	100	ug/L	4480	4500	5950	20130724.R13nr2
Thallium	0.1	ug/L	72.3	76.4	95.1	20130724.R13nr2
Uranium	1	ug/L	89.7	96.4	115	20130724.R13nr2

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ICPMS Water

EU-L-3						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Vanadium	1	ug/L	43.4	47.7	55.7	20130724.R13nr2
Zinc	1	ug/L	12.5	28.9	48.4	20130724.R13nr2

Lab Control Sample						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Arsenic	N/A	%	80	90	120	20130724.R13nr2
Barium	N/A	%	80	95	120	20130724.R13nr2
Cadmium	N/A	%	80	86	120	20130724.R13nr2
Calcium	N/A	%	80	84	120	20130724.R13nr2
Cobalt	N/A	%	80	92	120	20130724.R13nr2
Copper	N/A	%	80	88	120	20130724.R13nr2
Iron	N/A	%	80	90	120	20130724.R13nr2
Lead	N/A	%	80	93	120	20130724.R13nr2
Magnesium	N/A	%	80	84	120	20130724.R13nr2
Manganese	N/A	%	80	89	120	20130724.R13nr2
Molybdenum	N/A	%	80	91	120	20130724.R13nr2
Nickel	N/A	%	80	89	120	20130724.R13nr2
Sodium	N/A	%	80	82	120	20130724.R13nr2
Thallium	N/A	%	80	93	120	20130724.R13nr2
Vanadium	N/A	%	80	87	120	20130724.R13nr2
Zinc	N/A	%	80	99	120	20130724.R13nr2

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	1	ug/L	<1	<1	1	20130724.R13nr2
Antimony	0.5	ug/L	<0.5	<0.5	0.5	20130724.R13nr2
Arsenic	1	ug/L	<1	<1	1	20130724.R13nr2
Barium	0.5	ug/L	<0.5	<0.5	0.5	20130724.R13nr2
Beryllium	1	ug/L	<1	<1	1	20130724.R13nr2
Bismuth	1	ug/L	<1	<1	3	20130724.R13nr2
Boron	1	ug/L	<1	<1	1	20130724.R13nr2
Cadmium	1	ug/L	<1	<1	1	20130724.R13nr2
Calcium	50	ug/L	<50	<50	150	20130724.R13nr2
Cerium	0.1	ug/L	<0.1	<0.1	0.1	20130724.R13nr2
Cesium	1	ug/L	<1	<1	1	20130724.R13nr2
Chromium	1	ug/L	<1	<1	1	20130724.R13nr2
Cobalt	1	ug/L	<1	<1	1	20130724.R13nr2
Europium	1	ug/L	<1	<1	1	20130724.R13nr2
Gallium	1	ug/L	<1	<1	1	20130724.R13nr2
Iron	20	ug/L	<20	<20	20	20130724.R13nr2
Lanthanum	1	ug/L	<1	<1	1	20130724.R13nr2
Lead	1	ug/L	<1	<1	1	20130724.R13nr2
Lithium	5	ug/L	<5	<5	5	20130724.R13nr2
Magnesium	4	ug/L	<4	<4	4	20130724.R13nr2
Manganese	1	ug/L	<1	<1	1	20130724.R13nr2
Mercury	0.1	ug/L	<0.1	<0.1	0.1	20130724.R13nr2
Molybdenum	1	ug/L	<1	<1	1	20130724.R13nr2

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ICPMS Water

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Nickel	1	ug/L	<1	<1	1	20130724.R13nr2
Niobium	1	ug/L	<1	<1	1	20130724.R13nr2
Phosphorus	50	ug/L	<50	<50	50	20130724.R13nr2
Rubidium	1	ug/L	<1	<1	1	20130724.R13nr2
Scandium	1	ug/L	<1	<1	1	20130724.R13nr2
Selenium	1	ug/L	<1	<1	1	20130724.R13nr2
Silver	0.1	ug/L	<0.1	<0.1	0.1	20130724.R13nr2
Strontium	1	ug/L	<1	<1	1	20130724.R13nr2
Tellurium	1	ug/L	<1	<1	1	20130724.R13nr2
Thallium	1	ug/L	<1	<1	1	20130724.R13nr2
Thorium	1	ug/L	<1	<1	1	20130724.R13nr2
Tin	1	ug/L	<1	<1	1	20130724.R13nr2
Titanium	0.1	ug/L	<0.1	<0.1	0.1	20130724.R13nr2
Tungsten	1	ug/L	<1	<1	1	20130724.R13nr2
Uranium	1	ug/L	<1	<1	1	20130724.R13nr2
Vanadium	1	ug/L	<1	<1	1	20130724.R13nr2
Yttrium	1	ug/L	<1	<1	1	20130724.R13nr2
Zinc	1	ug/L	<1	<1	1	20130724.R13nr2
Zirconium	1	ug/L	<1	<1	1	20130724.R13nr2

KL-WAD CN/W

%RPD						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Weak Acid Dissociable Cyanide	N/A	%	0	0	20	20130724.K43W

Lab Control Sample						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Weak Acid Dissociable Cyanide	0.001	mg/L	0.09	0.105	0.11	20130724.K43W

Matrix Spike						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Weak Acid Dissociable Cyanide	N/A	% Rec	80	104	120	20130724.K43W

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Weak Acid Dissociable Cyanide	0.001	mg/L	<0.001	<0.001	0.003	20130724.K43W

UCL Upper Control Limit
LCL Lower Control Limit

APPENDIX B

Rheograms

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mine
Project Number:	13-1426-0010
Date:	8/1/2013
Technologist	KC

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**KC**	**8/2/2013**
Data Review	**1st Review**	**Complete**	**KC**	**8/2/2013**
	2nd Review	**Complete**	**am**	**8/7/2013**

Sample ID:	13-1426-0010 SPTP 4
Sample Description:	fine grey material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	material sticks to itself
Specific Gravity	2.8

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	1.4402	1.4751	1.3851	1.433
2	0.9567	0.9343	1.0144	0.968
3	0.6247	0.6616	0.6394	0.642
4	0.3671	0.3648	0.3574	0.363
5	0.1475	0.1445	0.1474	0.146
6	0.0471	0.0457	0.0449	0.046
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
1.5021	1.3486	1.3645	1.405
0.9736	0.9514	0.9987	0.975
0.6281	0.6446	0.6417	0.638
0.3570	0.3534	0.3584	0.356
0.1407	0.1407	0.1413	0.141
0.0479	0.0467	0.0474	0.047

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	437.0973	402.7189	424.9784	422
2	271.0842	274.9252	280.1724	275
3	199.4283	192.2763	197.5775	196
4	135.1464	133.6241	139.9822	136
5	73.2401	73.5876	72.5182	73
6	26.8036	26.6005	27.9790	27
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
380.5812	451.8005	437.2177	423
262.5644	267.5689	282.6542	271
193.2052	195.3254	194.1806	194
137.7607	137.1868	139.0976	138
74.9144	74.0590	73.8479	74
26.4894	26.1948	26.9976	27

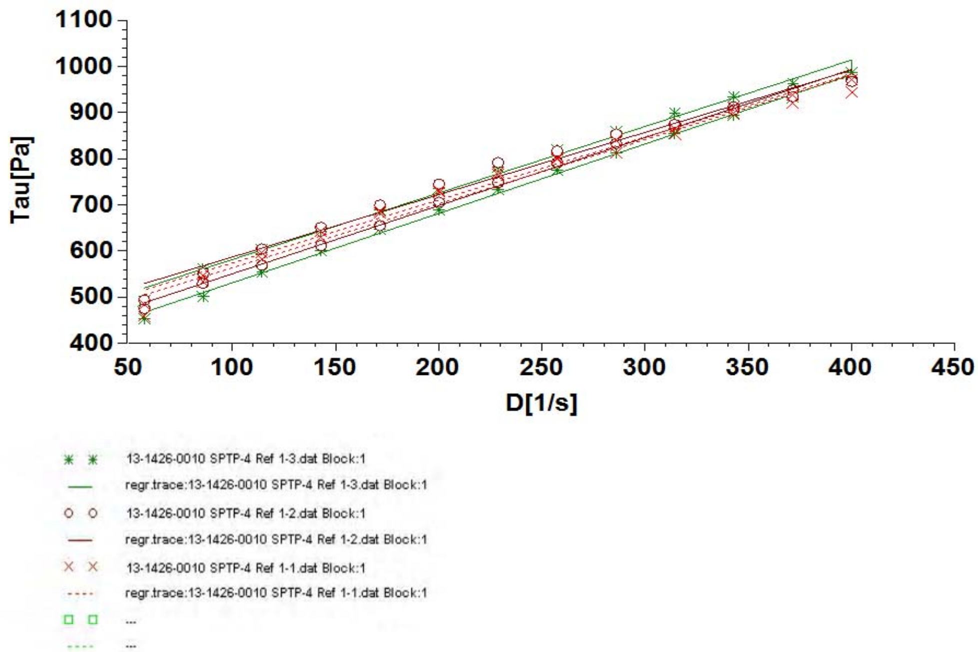
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	4	30.52	65.26	56.65	75.22%	0.52
2	24	31.60	74.49	63.48	74.33%	0.51
3	68	30.49	77.38	64.89	73.36%	0.50
4	z6	31.50	67.10	57.23	72.28%	0.48
5	25	30.56	68.29	57.04	70.18%	0.46
6	z13	31.35	64.76	53.60	66.60%	0.42
7						

Additional Notes:

multiple data sources

10:14 01/08/13
Manual Report Analysis/Regression

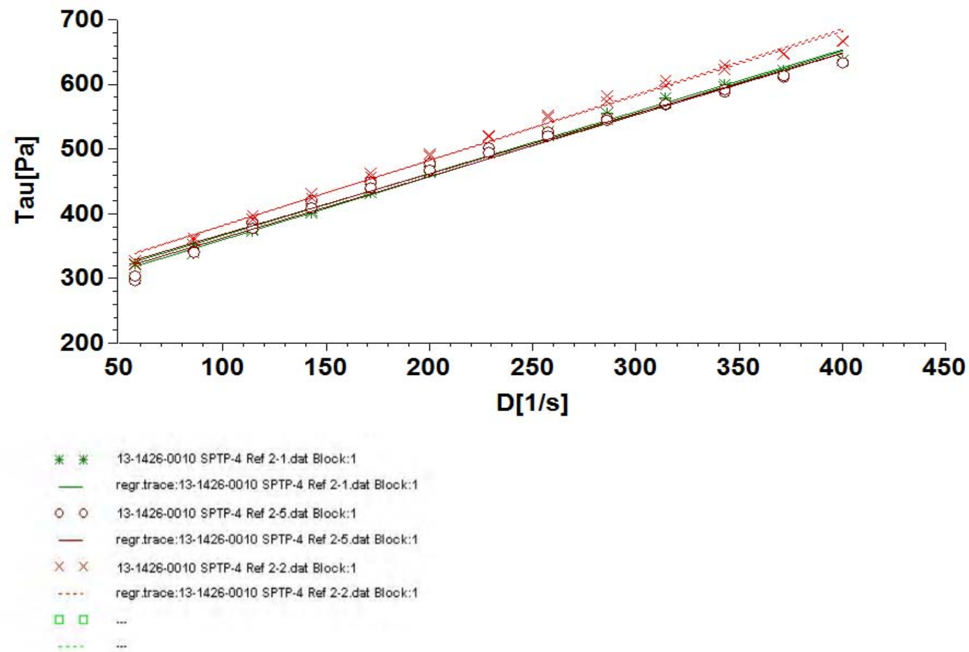


Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 1-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=437.1+1.4402*X ;B=0.99282; S=14.2
step1: Bingham yieldstress[Pa]=437.0973
step1: Bingham viscosity[Pas]=1.4402
step2: Bingham: Y=380.58+1.5021*X ;B=0.99771; S=8.36
step2: Bingham yieldstress[Pa]=380.5812
step2: Bingham viscosity[Pas]=1.5021

filter activated: D[1/s]>40
step1: Bingham: Y=402.72+1.4751*X ;B=0.9971; S=9.25
step1: Bingham yieldstress[Pa]=402.7189
step1: Bingham viscosity[Pas]=1.4751
step2: Bingham: Y=451.8+1.3486*X ;B=0.98235; S=21
step2: Bingham yieldstress[Pa]=451.8005
step2: Bingham viscosity[Pas]=1.3486

filter activated: D[1/s]>40
step1: Bingham: Y=424.98+1.3851*X ;B=0.97829; S=24
step1: Bingham yieldstress[Pa]=424.9784
step1: Bingham viscosity[Pas]=1.3851
step2: Bingham: Y=437.22+1.3645*X ;B=0.98923; S=16.5
step2: Bingham yieldstress[Pa]=437.2177
step2: Bingham viscosity[Pas]=1.3645
End of report

11:11 01/08/13
Manual Report Analysis/Regression



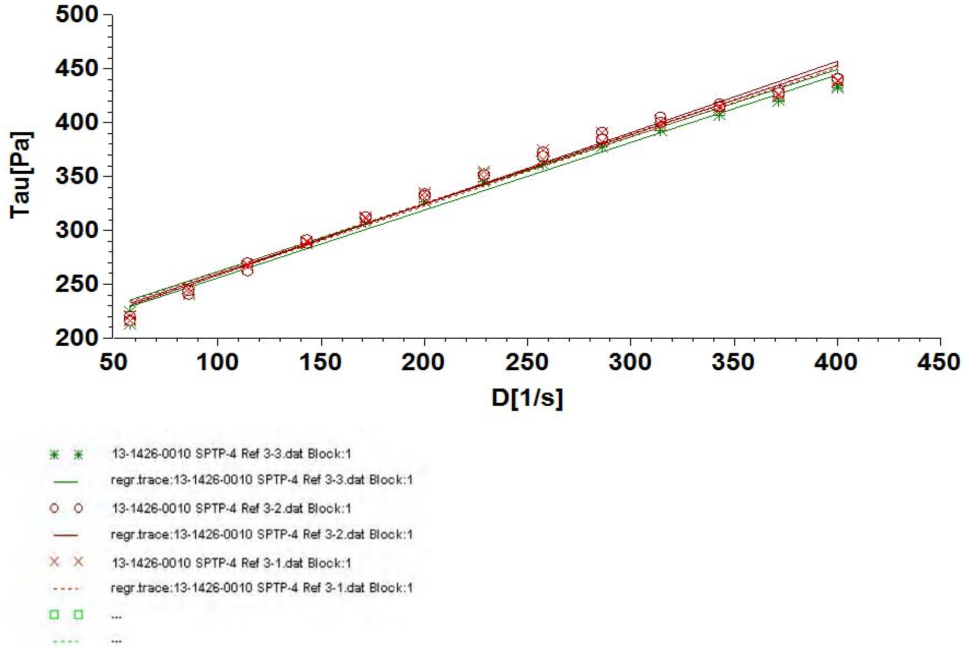
Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 2-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=271.08+0.95671*X ;B=0.9948; S=8.04
step1: Bingham yieldstress[Pa]=271.0842
step1: Bingham viscosity[Pas]=0.9567
step2: Bingham: Y=262.56+0.97356*X ;B=0.99353; S=9.13
step2: Bingham yieldstress[Pa]=262.5644
step2: Bingham viscosity[Pas]=0.9736

filter activated: D[1/s]>40
step1: Bingham: Y=274.93+0.93425*X ;B=0.9814; S=14.9
step1: Bingham yieldstress[Pa]=274.9252
step1: Bingham viscosity[Pas]=0.9343
step2: Bingham: Y=267.57+0.95141*X ;B=0.99179; S=10.1
step2: Bingham yieldstress[Pa]=267.5689
step2: Bingham viscosity[Pas]=0.9514

filter activated: D[1/s]>40
step1: Bingham: Y=280.17+1.0144*X ;B=0.99323; S=9.73
step1: Bingham yieldstress[Pa]=280.1724
step1: Bingham viscosity[Pas]=1.0144
step2: Bingham: Y=282.65+0.99866*X ;B=0.99251; S=10.1
step2: Bingham yieldstress[Pa]=282.6542
step2: Bingham viscosity[Pas]=0.9987
End of report

multiple data sources

11:45 01/08/13
Manual Report Analysis/Regression

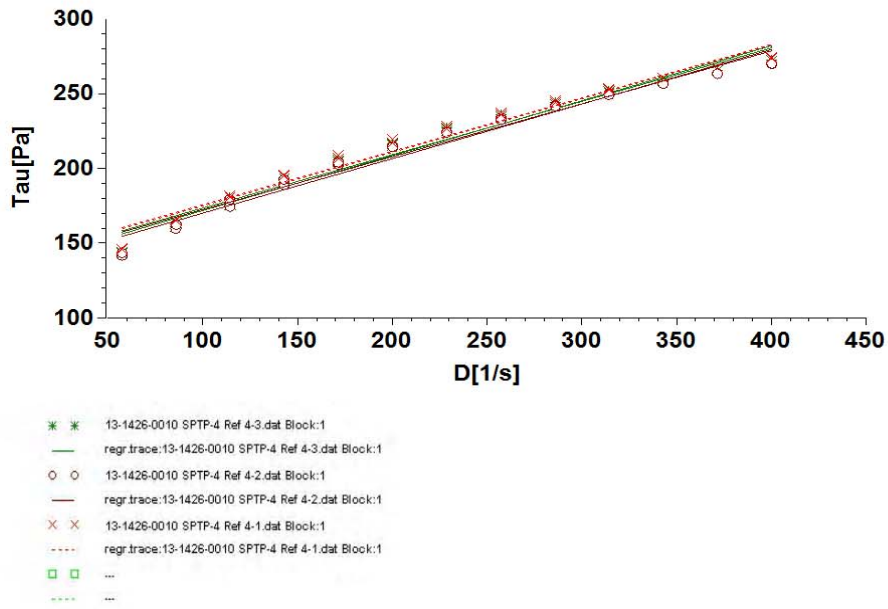


Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 3-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=199.43+0.62472*X ;B=0.9851; S=8.93
step1: Bingham yieldstress[Pa]=199.4283
step1: Bingham viscosity[Pas]=0.6247
step2: Bingham: Y=193.21+0.62813*X ;B=0.98719; S=8.32
step2: Bingham yieldstress[Pa]=193.2052
step2: Bingham viscosity[Pas]=0.6281

filter activated: D[1/s]>40
step1: Bingham: Y=192.28+0.66161*X ;B=0.98609; S=9.13
step1: Bingham yieldstress[Pa]=192.2763
step1: Bingham viscosity[Pas]=0.6616
step2: Bingham: Y=195.33+0.6446*X ;B=0.98721; S=8.53
step2: Bingham yieldstress[Pa]=195.3254
step2: Bingham viscosity[Pas]=0.6446

filter activated: D[1/s]>40
step1: Bingham: Y=197.58+0.63941*X ;B=0.98285; S=9.81
step1: Bingham yieldstress[Pa]=197.5775
step1: Bingham viscosity[Pas]=0.6394
step2: Bingham: Y=194.18+0.64173*X ;B=0.98825; S=8.13
step2: Bingham yieldstress[Pa]=194.1806
step2: Bingham viscosity[Pas]=0.6417
End of report

13:33 01/08/13
Manual Report Analysis/Regression



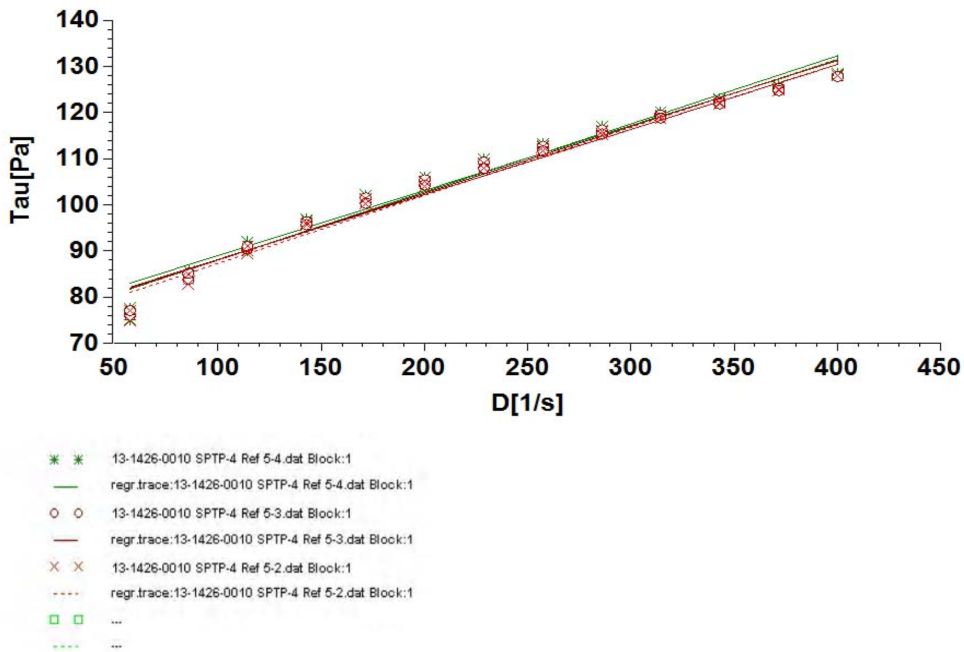
Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 4-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=135.15+0.3671*X ;B=0.9722; S=7.21
step1: Bingham yieldstress[Pa]=135.1464
step1: Bingham viscosity[Pas]=0.3671
step2: Bingham: Y=137.76+0.35695*X ;B=0.97466; S=6.69
step2: Bingham yieldstress[Pa]=137.7607
step2: Bingham viscosity[Pas]=0.357

filter activated: D[1/s]>40
step1: Bingham: Y=133.62+0.3648*X ;B=0.97299; S=7.06
step1: Bingham yieldstress[Pa]=133.6241
step1: Bingham viscosity[Pas]=0.3648
step2: Bingham: Y=137.19+0.35336*X ;B=0.97368; S=6.75
step2: Bingham yieldstress[Pa]=137.1868
step2: Bingham viscosity[Pas]=0.3534

filter activated: D[1/s]>40
step1: Bingham: Y=139.98+0.35737*X ;B=0.97075; S=7.21
step1: Bingham yieldstress[Pa]=139.9822
step1: Bingham viscosity[Pas]=0.3574
step2: Bingham: Y=139.1+0.35838*X ;B=0.97624; S=6.5
step2: Bingham yieldstress[Pa]=139.0976
step2: Bingham viscosity[Pas]=0.3584
End of report

multiple data sources

14:03 01/08/13
Manual Report Analysis/Regression

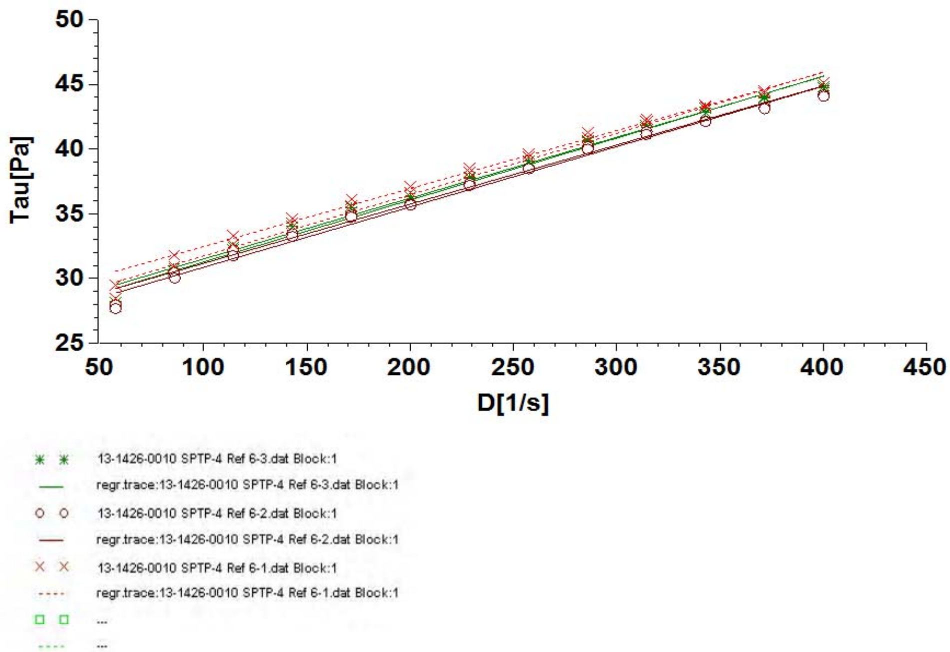


Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 5-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=73.24+0.14747*X ;B=0.96645; S=3.19
step1: Bingham yieldstress[Pa]=73.2401
step1: Bingham viscosity[Pas]=0.1475
step2: Bingham: Y=74.914+0.14068*X ;B=0.97949; S=2.37
step2: Bingham yieldstress[Pa]=74.9144
step2: Bingham viscosity[Pas]=0.1407

filter activated: D[1/s]>40
step1: Bingham: Y=73.588+0.14446*X ;B=0.97122; S=2.89
step1: Bingham yieldstress[Pa]=73.5876
step1: Bingham viscosity[Pas]=0.1445
step2: Bingham: Y=74.059+0.14067*X ;B=0.98201; S=2.21
step2: Bingham yieldstress[Pa]=74.059
step2: Bingham viscosity[Pas]=0.1407

filter activated: D[1/s]>40
step1: Bingham: Y=72.518+0.14737*X ;B=0.96901; S=3.06
step1: Bingham yieldstress[Pa]=72.5182
step1: Bingham viscosity[Pas]=0.1474
step2: Bingham: Y=73.848+0.14135*X ;B=0.9829; S=2.17
step2: Bingham yieldstress[Pa]=73.8479
step2: Bingham viscosity[Pas]=0.1413
End of report

14:27 01/08/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 SPTP-4 Ref 6-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=26.804+0.047061*X ;B=0.98971; S=0.558
step1: Bingham yieldstress[Pa]=26.8036
step1: Bingham viscosity[Pas]=0.0471
step2: Bingham: Y=26.489+0.047895*X ;B=0.98941; S=0.576
step2: Bingham yieldstress[Pa]=26.4894
step2: Bingham viscosity[Pas]=0.0479

filter activated: D[1/s]>40
step1: Bingham: Y=26.6+0.045744*X ;B=0.99004; S=0.533
step1: Bingham yieldstress[Pa]=26.6005
step1: Bingham viscosity[Pas]=0.0457
step2: Bingham: Y=26.195+0.04668*X ;B=0.99013; S=0.542
step2: Bingham yieldstress[Pa]=26.1948
step2: Bingham viscosity[Pas]=0.0467

filter activated: D[1/s]>40
step1: Bingham: Y=27.979+0.044877*X ;B=0.99165; S=0.479
step1: Bingham yieldstress[Pa]=27.979
step1: Bingham viscosity[Pas]=0.0449
step2: Bingham: Y=26.998+0.047422*X ;B=0.99025; S=0.547
step2: Bingham yieldstress[Pa]=26.9976
step2: Bingham viscosity[Pas]=0.0474
End of report

Golder Associates

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mine
Project Number:	13-1426-0010
Date:	8/6/2013
Technologist	CJC/CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**8/7/2013**
Data Review	**1st Review**	**Complete**	**CA**	**8/7/2013**
	2nd Review	**Complete**	**am**	**8/8/2013**

Sample ID:	13-1426-0010 SPTP-5
Sample Description:	coarse, dark grey sample
Water:	13-1426-0010 water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.85

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	0.5918	0.6150	0.6285	0.612
2	0.4819	0.5010	0.4837	0.489
3	0.2600	0.2660	0.2597	0.262
4	0.1113	0.1104	0.1111	0.111
5	0.0448	0.0460	0.0450	0.045
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
0.6790	0.7053	0.7036	0.696
0.5385	0.5522	0.5535	0.548
0.2905	0.2915	0.2885	0.290
0.1220	0.1206	0.1235	0.122
0.0526	0.0530	0.0510	0.052

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	124.9850	123.4832	122.8009	124
2	101.0324	96.8088	101.4938	100
3	52.3391	50.2659	51.8040	51
4	25.1340	25.2925	26.3825	26
5	11.8365	11.3505	11.2746	11
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
74.8482	70.1088	69.9602	72
58.8195	58.3922	51.5851	56
31.9418	32.8002	31.4545	32
16.9323	16.8358	16.5970	17
7.7889	7.7898	7.9095	8

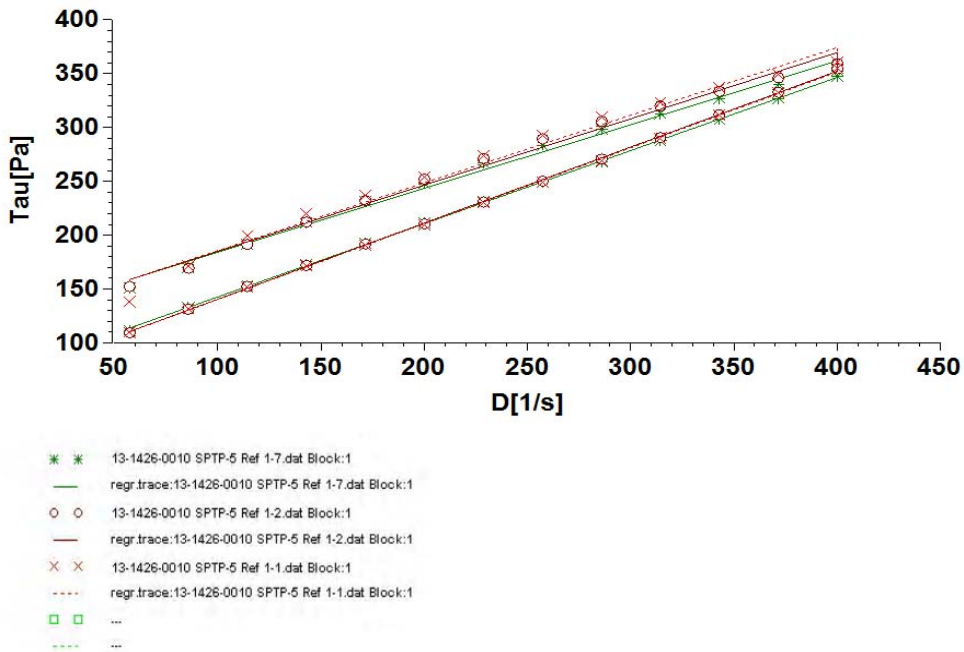
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	x6	6.01	27.98	23.01	77.38%	0.55
2	32	30.50	63.22	55.35	75.95%	0.53
3	17	30.59	74.70	63.39	74.36%	0.50
4	66	30.69	75.15	62.83	72.29%	0.48
5	Z6	31.55	72.50	60.02	69.52%	0.44
6						
7						

Additional Notes:

multiple data sources page 1

13:22 06/08/13
Manual Report Analysis/Regression



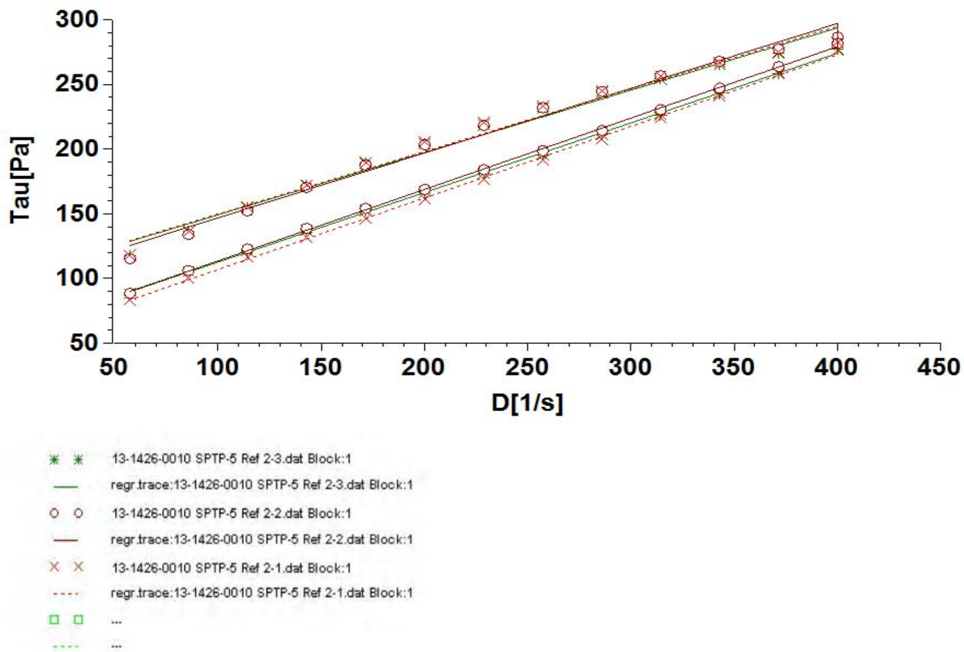
Analysis-results
Analysis data source: 13-1426-0010 SPTP-5 Ref 1-7.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=124.98+0.59184*X ;B=0.99311; S=5.73
step1: Bingham yieldstress[Pa]=124.985
step1: Bingham viscosity[Pas]=0.5918
step2: Bingham: Y=74.848+0.67896*X ;B=0.99984; S=0.988
step2: Bingham yieldstress[Pa]=74.8482
step2: Bingham viscosity[Pas]=0.679

filter activated: D[1/s]>40
step1: Bingham: Y=123.48+0.615*X ;B=0.99214; S=6.36
step1: Bingham yieldstress[Pa]=123.4832
step1: Bingham viscosity[Pas]=0.615
step2: Bingham: Y=70.109+0.70531*X ;B=0.99981; S=1.13
step2: Bingham yieldstress[Pa]=70.1088
step2: Bingham viscosity[Pas]=0.7053

filter activated: D[1/s]>40
step1: Bingham: Y=122.8+0.62851*X ;B=0.98325; S=9.53
step1: Bingham yieldstress[Pa]=122.8009
step1: Bingham viscosity[Pas]=0.6285
step2: Bingham: Y=69.96+0.70358*X ;B=0.99963; S=1.58
step2: Bingham yieldstress[Pa]=69.9602
step2: Bingham viscosity[Pas]=0.7036
End of report

multiple data sources page 1

14:02 06/08/13
Manual Report Analysis/Regression



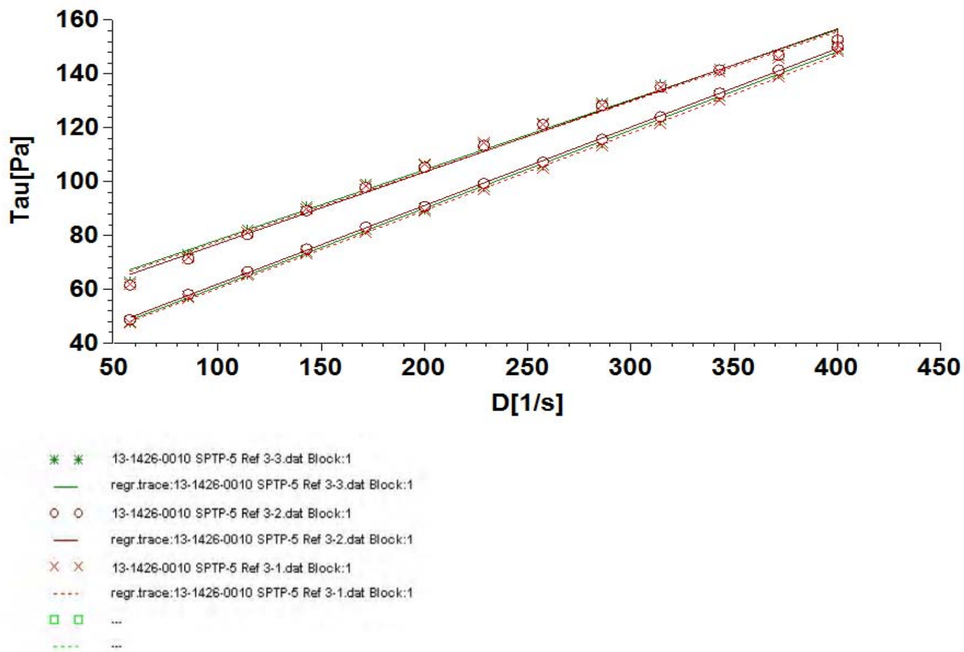
Analysis-results
Analysis data source: 13-1426-0010 SPTP-5 Ref 2-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=101.03+0.48193*X ;B=0.98496; S=6.92
step1: Bingham yieldstress[Pa]=101.0324
step1: Bingham viscosity[Pas]=0.4819
step2: Bingham: Y=58.819+0.53846*X ;B=0.99944; S=1.48
step2: Bingham yieldstress[Pa]=58.8195
step2: Bingham viscosity[Pas]=0.5385

filter activated: D[1/s]>40
step1: Bingham: Y=96.809+0.501*X ;B=0.98764; S=6.51
step1: Bingham yieldstress[Pa]=96.8088
step1: Bingham viscosity[Pas]=0.501
step2: Bingham: Y=58.392+0.55216*X ;B=0.99957; S=1.33
step2: Bingham yieldstress[Pa]=58.3922
step2: Bingham viscosity[Pas]=0.5522

filter activated: D[1/s]>40
step1: Bingham: Y=101.49+0.48369*X ;B=0.98294; S=7.41
step1: Bingham yieldstress[Pa]=101.4938
step1: Bingham viscosity[Pas]=0.4837
step2: Bingham: Y=51.585+0.55349*X ;B=0.99928; S=1.72
step2: Bingham yieldstress[Pa]=51.5851
step2: Bingham viscosity[Pas]=0.5535
End of report

multiple data sources

14:23 06/08/13
Manual Report Analysis/Regression



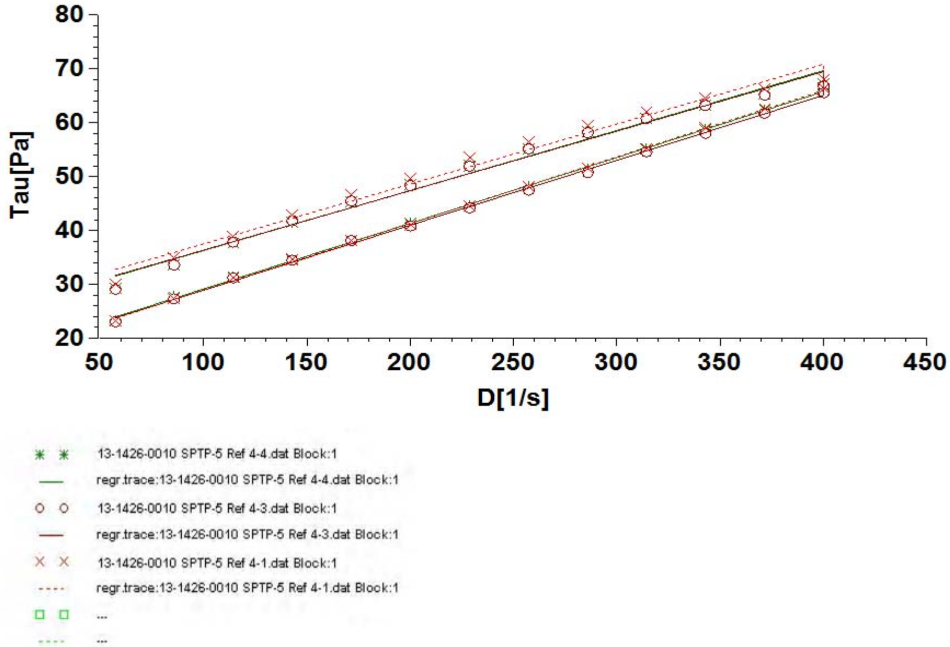
Analysis-results
Analysis data source: 13-1426-0010 SPTP-5 Ref 3-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=52.339+0.26*X ;B=0.99255; S=2.62
step1: Bingham yieldstress[Pa]=52.3391
step1: Bingham viscosity[Pas]=0.26
step2: Bingham: Y=31.942+0.29053*X ;B=0.99976; S=0.523
step2: Bingham yieldstress[Pa]=31.9418
step2: Bingham viscosity[Pas]=0.2905

filter activated: D[1/s]>40
step1: Bingham: Y=50.266+0.266*X ;B=0.99372; S=2.46
step1: Bingham yieldstress[Pa]=50.2659
step1: Bingham viscosity[Pas]=0.266
step2: Bingham: Y=32.8+0.29146*X ;B=0.9998; S=0.483
step2: Bingham yieldstress[Pa]=32.8002
step2: Bingham viscosity[Pas]=0.2915

filter activated: D[1/s]>40
step1: Bingham: Y=51.804+0.2597*X ;B=0.99047; S=2.96
step1: Bingham yieldstress[Pa]=51.804
step1: Bingham viscosity[Pas]=0.2597
step2: Bingham: Y=31.454+0.28853*X ;B=0.99959; S=0.678
step2: Bingham yieldstress[Pa]=31.4545
step2: Bingham viscosity[Pas]=0.2885
End of report

multiple data sources

14:47 06/08/13
Manual Report Analysis/Regression

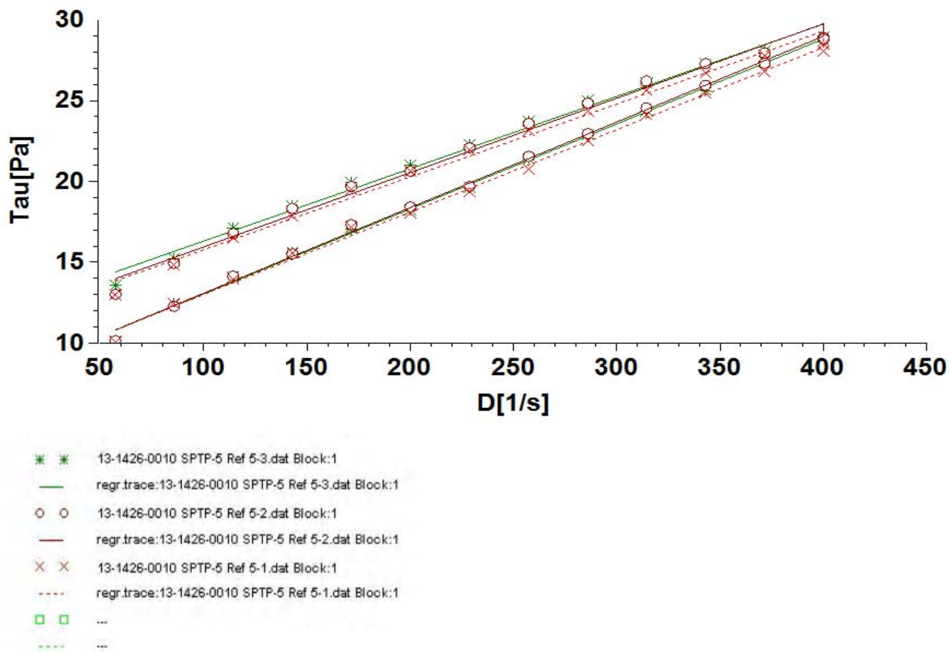


Analysis-results
Analysis data source: 13-1426-0010 SPTP-5 Ref 4-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=25.134+0.1113*X ;B=0.98797; S=1.43
step1: Bingham yieldstress[Pa]=25.134
step1: Bingham viscosity[Pas]=0.1113
step2: Bingham: Y=16.932+0.12201*X ;B=0.99945; S=0.333
step2: Bingham yieldstress[Pa]=16.9323
step2: Bingham viscosity[Pas]=0.122

filter activated: D[1/s]>40
step1: Bingham: Y=25.293+0.11041*X ;B=0.98622; S=1.52
step1: Bingham yieldstress[Pa]=25.2925
step1: Bingham viscosity[Pas]=0.1104
step2: Bingham: Y=16.836+0.1206*X ;B=0.99906; S=0.431
step2: Bingham yieldstress[Pa]=16.8358
step2: Bingham viscosity[Pas]=0.1206

filter activated: D[1/s]>40
step1: Bingham: Y=26.382+0.1111*X ;B=0.98488; S=1.6
step1: Bingham yieldstress[Pa]=26.3825
step1: Bingham viscosity[Pas]=0.1111
step2: Bingham: Y=16.597+0.12351*X ;B=0.99937; S=0.362
step2: Bingham yieldstress[Pa]=16.597
step2: Bingham viscosity[Pas]=0.1235
End of report

15:06 06/08/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 SPTP-5 Ref 5-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=11.836+0.044765*X ;B=0.99227; S=0.459
step1: Bingham yieldstress[Pa]=11.8365
step1: Bingham viscosity[Pas]=0.0448
step2: Bingham: Y=7.7889+0.052587*X ;B=0.99802; S=0.272
step2: Bingham yieldstress[Pa]=7.7889
step2: Bingham viscosity[Pas]=0.0526

filter activated: D[1/s]>40
step1: Bingham: Y=11.35+0.046011*X ;B=0.99069; S=0.518
step1: Bingham yieldstress[Pa]=11.3505
step1: Bingham viscosity[Pas]=0.046
step2: Bingham: Y=7.7898+0.052991*X ;B=0.99787; S=0.284
step2: Bingham yieldstress[Pa]=7.7898
step2: Bingham viscosity[Pas]=0.053

filter activated: D[1/s]>40
step1: Bingham: Y=11.275+0.045046*X ;B=0.99272; S=0.448
step1: Bingham yieldstress[Pa]=11.2746
step1: Bingham viscosity[Pas]=0.045
step2: Bingham: Y=7.9095+0.050988*X ;B=0.99677; S=0.337
step2: Bingham yieldstress[Pa]=7.9095
step2: Bingham viscosity[Pas]=0.051
End of report

Golder Associates

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1321-0010
Date:	8/13/2013
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**8/14/2013**
Data Review	**1st Review**	**Complete**	**CA**	**8/14/2013**
	2nd Review	**Complete**	**ML**	**9/3/2013**

Sample ID:	13-1321-0010 CPTP 01
Sample Description:	coarse, dark grey material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.85

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
7"	0.6870	0.6941	0.7015	0.694
10"	0.5546	0.5576	0.5341	0.549

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
0.7428	0.7385	0.7468	0.743
0.5559	0.5831	0.5818	0.574

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
7"	113.9555	107.0076	110.2436	110
10"	67.4374	79.0940	90.4616	79

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
83.1941	81.2063	86.0897	83
66.5746	65.0049	60.6024	64

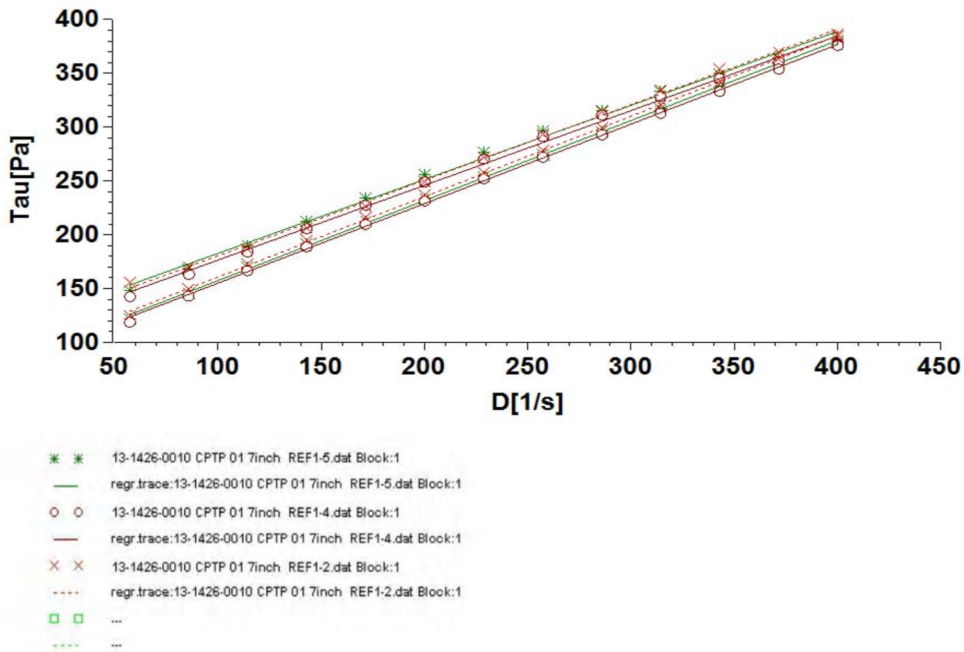
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
7"	57	6.75	45.04	36.81	78.51%	0.56
10"	69	6.82	48.00	38.67	77.34%	0.54

Additional Notes:

multiple data sources

10:06 13/08/13
Manual Report Analysis/Regression



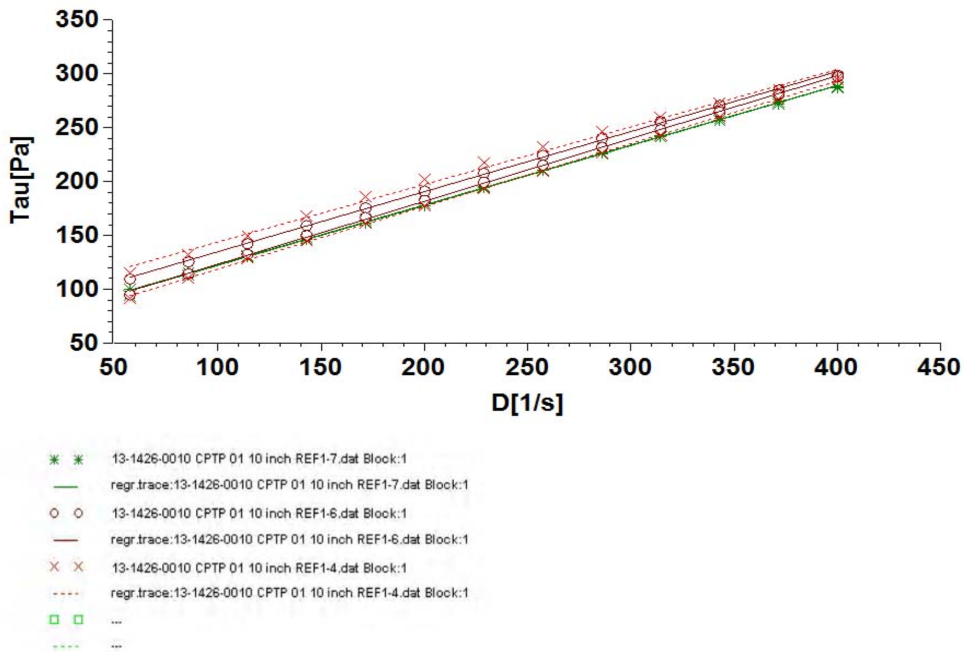
Analysis-results
Analysis data source: 13-1426-0010 CPTP 01 7inch REF1-5.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=113.96+0.68701*X ;B=0.99624; S=4.9
step1: Bingham yieldstress[Pa]=113.9555
step1: Bingham viscosity[Pas]=0.687
step2: Bingham: Y=83.194+0.74276*X ;B=0.99955; S=1.84
step2: Bingham yieldstress[Pa]=83.1941
step2: Bingham viscosity[Pas]=0.7428

filter activated: D[1/s]>40
step1: Bingham: Y=107.01+0.69412*X ;B=0.99693; S=4.47
step1: Bingham yieldstress[Pa]=107.0076
step1: Bingham viscosity[Pas]=0.6941
step2: Bingham: Y=81.206+0.73846*X ;B=0.99942; S=2.07
step2: Bingham yieldstress[Pa]=81.2063
step2: Bingham viscosity[Pas]=0.7385

filter activated: D[1/s]>40
step1: Bingham: Y=110.24+0.70148*X ;B=0.99795; S=3.69
step1: Bingham yieldstress[Pa]=110.2436
step1: Bingham viscosity[Pas]=0.7015
step2: Bingham: Y=86.09+0.74684*X ;B=0.99963; S=1.66
step2: Bingham yieldstress[Pa]=86.0897
step2: Bingham viscosity[Pas]=0.7468
End of report

multiple data sources

12:55 13/08/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 CPTP 01 10 inch REF1-7.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=67.437+0.55463*X ;B=0.99984; S=0.817
step1: Bingham yieldstress[Pa]=67.4374
step1: Bingham viscosity[Pas]=0.5546
step2: Bingham: Y=66.575+0.55593*X ;B=0.99906; S=1.98
step2: Bingham yieldstress[Pa]=66.5746
step2: Bingham viscosity[Pas]=0.5559

filter activated: D[1/s]>40
step1: Bingham: Y=79.094+0.55759*X ;B=0.99941; S=1.58
step1: Bingham yieldstress[Pa]=79.094
step1: Bingham viscosity[Pas]=0.5576
step2: Bingham: Y=65.005+0.58311*X ;B=0.9996; S=1.36
step2: Bingham yieldstress[Pa]=65.0049
step2: Bingham viscosity[Pas]=0.5831

filter activated: D[1/s]>40
step1: Bingham: Y=90.462+0.53406*X ;B=0.99473; S=4.52
step1: Bingham yieldstress[Pa]=90.4616
step1: Bingham viscosity[Pas]=0.5341
step2: Bingham: Y=60.602+0.58181*X ;B=0.99979; S=0.982
step2: Bingham yieldstress[Pa]=60.6024
step2: Bingham viscosity[Pas]=0.5818
End of report

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	8/14/2013
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**8/15/2013**
Data Review	**1st Review**	**Complete**	**CA**	**8/15/2013**
	2nd Review	**Complete**	**ML**	**9/3/2013**

Sample ID:	13-1426-0010 CPTP 02
Sample Description:	coarse, dark grey material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.86

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
7.25"	0.8956	0.8908	0.8464	0.878
10"	0.7681	0.7641	0.7657	0.766

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
0.9894	1.0377	1.0564	1.028
0.8977	0.8807	0.8971	0.892

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
7.25"	184.5833	190.8189	218.8424	198
10"	165.7810	157.1368	171.9295	165

Ramp Down

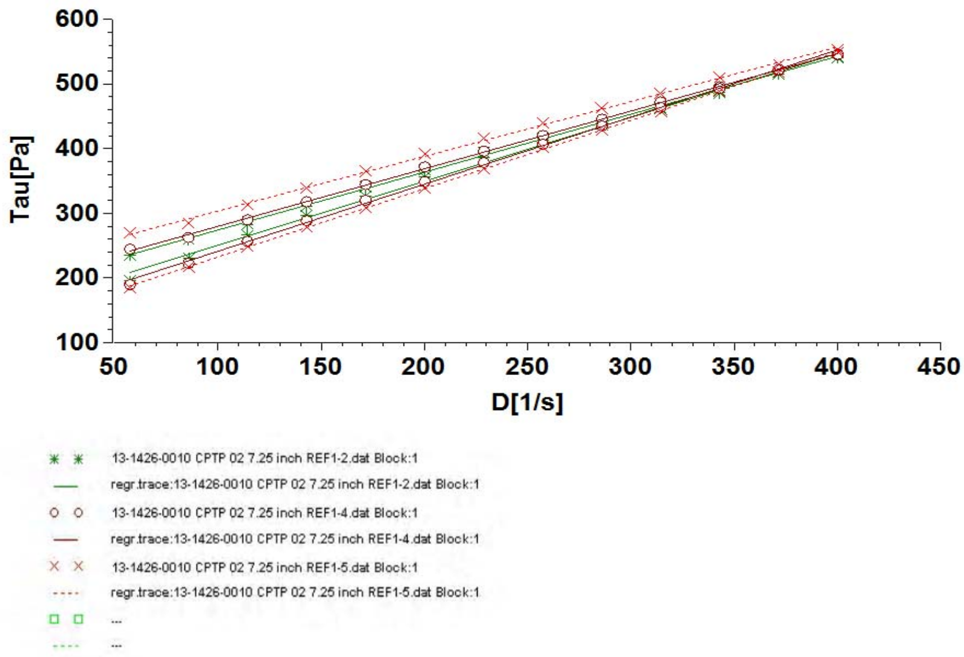
Trial 1	Trial 2	Trial 3	AVG
151.5568	137.5879	126.8997	139
97.6788	105.7071	105.9426	103

WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
7.25"	X3	6.25	35.17	28.91	78.35%	0.56
10"	4	30.49	73.00	63.37	77.35%	0.54

Additional Notes:

10:58 14/08/13
Manual Report Analysis/Regression

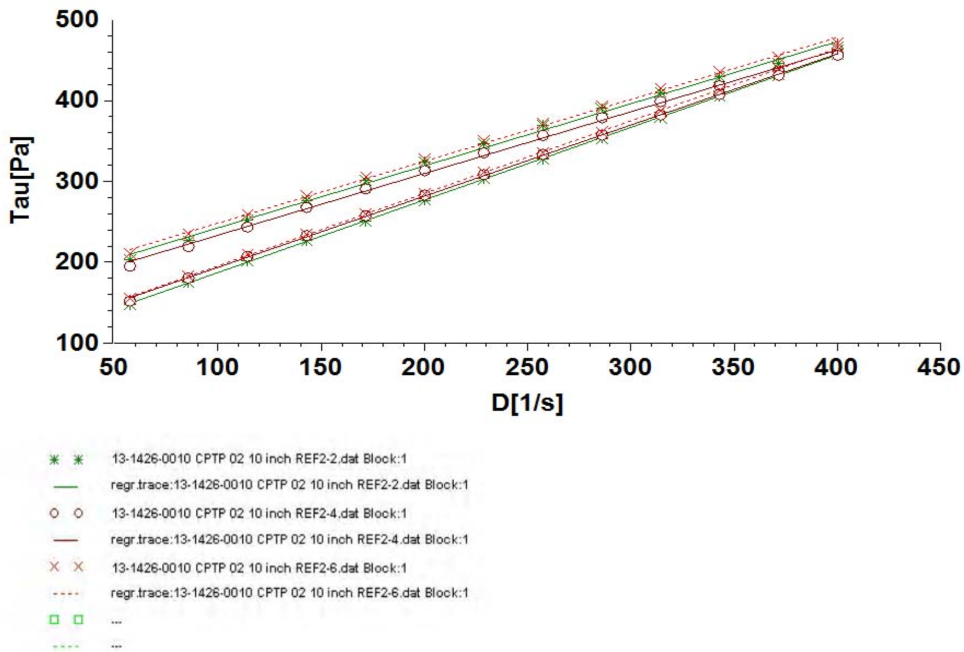


Analysis-results
Analysis data source: 13-1426-0010 CPTP 02 7.25 inch REF1-2.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=184.58+0.89561*X ;B=0.99943; S=2.49
step1: Bingham yieldstress[Pa]=184.5833
step1: Bingham viscosity[Pas]=0.8956
step2: Bingham: Y=151.56+0.98944*X ;B=0.9967; S=6.62
step2: Bingham yieldstress[Pa]=151.5568
step2: Bingham viscosity[Pas]=0.9894

filter activated: D[1/s]>40
step1: Bingham: Y=190.82+0.89085*X ;B=0.99956; S=2.17
step1: Bingham yieldstress[Pa]=190.8189
step1: Bingham viscosity[Pas]=0.8908
step2: Bingham: Y=137.59+1.0377*X ;B=0.99885; S=4.09
step2: Bingham yieldstress[Pa]=137.5879
step2: Bingham viscosity[Pas]=1.0377

filter activated: D[1/s]>40
step1: Bingham: Y=218.84+0.84635*X ;B=0.9989; S=3.27
step1: Bingham yieldstress[Pa]=218.8424
step1: Bingham viscosity[Pas]=0.8464
step2: Bingham: Y=126.9+1.0564*X ;B=0.99986; S=1.47
step2: Bingham yieldstress[Pa]=126.8997
step2: Bingham viscosity[Pas]=1.0564
End of report

11:38 14/08/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 CPTP 02 10 inch REF2-2.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=165.78+0.76814*X ;B=0.99648; S=5.3
step1: Bingham yieldstress[Pa]=165.781
step1: Bingham viscosity[Pas]=0.7681
step2: Bingham: Y=97.679+0.89771*X ;B=0.99994; S=0.809
step2: Bingham yieldstress[Pa]=97.6788
step2: Bingham viscosity[Pas]=0.8977

filter activated: D[1/s]>40
step1: Bingham: Y=157.14+0.76413*X ;B=0.99835; S=3.61
step1: Bingham yieldstress[Pa]=157.1368
step1: Bingham viscosity[Pas]=0.7641
step2: Bingham: Y=105.71+0.8807*X ;B=0.99973; S=1.67
step2: Bingham yieldstress[Pa]=105.7071
step2: Bingham viscosity[Pas]=0.8807

filter activated: D[1/s]>40
step1: Bingham: Y=171.93+0.76568*X ;B=0.99833; S=3.64
step1: Bingham yieldstress[Pa]=171.9295
step1: Bingham viscosity[Pas]=0.7657
step2: Bingham: Y=105.94+0.89711*X ;B=0.99992; S=0.931
step2: Bingham yieldstress[Pa]=105.9426
step2: Bingham viscosity[Pas]=0.8971
End of report

APPENDIX C

Photos

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 1

13-1426-0010 STPT – 1 TP1 as received

Observations:

-till + some clay

-no clumps of clay after mixing, easy to mix

-material sticks to itself once water is added and sample is homogenized

-bleeds water as soon as you stop mixing

Photograph 2

13-1426-0010 STPT – 1 TP1 as received

-sample shown halfway down the pail

-larger clay clumps

Golder Associates

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 3 13-1426-0010 STPT – 1 TP1 homogenized	
Photograph 4 13-1426-0010 STPT – 2 TP2 as received Observations: -till + some clay -no clumps of clay after mixing, easy to mix -material sticks to itself once water is added and sample is homogenized -bleeds water as soon as you stop mixing	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 5 13-1426-0010 STPT – 2 TP2 as received -sample shown halfway down the pail	
Photograph 6 13-1426-0010 STPT – 2 TP2 homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 7

13-1426-0010 STPT – 3 as received

Observations:

-till + some clay

-no clumps of clay after mixing, easy to mix

-material sticks to itself once water is added and sample is homogenized

-bleeds water as soon as you stop mixing

Photograph 8

13-1426-0010 STPT – 3 as received

-sample shown halfway down the pail

-medium size clay clumps

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 9

13-1426-0010 STPT – 3 homogenized

Photograph 10

13-1426-0010 STPT – 4 as received

Observations:
-some clay clumps
-water on top of sample when received
-sample harder to mix compared to others since sample was more compact in pail
-more time needed to homogenize sample
-no clumps after sample was mixed
-bleeds water as soon as

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 11

13-1426-0010 STPT – 4 as received -sample shown halfway down the pail

Photograph 12

13-1426-0010 STPT – 4 homogenized

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 13 13-1426-0010 STPT – 5 as received Observations: -some clay clumps -no clumps of clay after mixing, easy to mix -material sticks to itself once water is added and sample is homogenized -bleeds water as soon as you stop mixing	
Photograph 14 13-1426-0010 STPT – 5 as received -sample shown halfway down the pail	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 15

13-1426-0010 STPT – 5 homogenized

Photograph 16

13-1426-0010 STPT – 6 as received

Observations:
-some clay clumps
-no clumps of clay after mixing, easy to mix
-material sticks to itself once water is added and sample is homogenized
-bleeds water as soon as you stop mixing

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 17 13-1426-0010 STPT – 6 as received -sample shown halfway down the pail -larger clumps of clay	
Photograph 18 13-1426-0010 STPT – 6 homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 19 13-1426-0010 CPTP 01 as received Observations: -mostly till, only a few clay clumps -no clumps of clay after mixing, easy to mix -material sticks to itself once water is added and sample is homogenized -bleeds water as soon as you stop mixing	
Photograph 20 13-1426-0010 CPTP 01 as received -sample shown halfway down the pail	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 21 13-1426-0010 CPTP 02 as received Observations: -mostly till, only a few clay clumps -no clumps of clay after mixing, easy to mix -material sticks to itself once water is added and sample is homogenized -bleeds water as soon as you stop mixing	
Photograph 22 13-1426-0010 CPTP 02 as received -sample shown halfway down the pail	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 23

13-1426-0010 CPTP 02 homogenized

Photograph 24

13-1426-0010 SPTP 1-2-3 as received

Observations:

- mostly till with some small to large clay chunks
- larger clay chunks easy to break up as long as material is above a 7" – 8" slump
- after thoroughly homogenizing material small clay balls are present throughout the entire sample
- clay balls can be easily broken up between fingers and after sitting undisturbed for 48 hrs all clay balls were broken up and not visible after re-homogenzing the sample

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 25

13-1426-0010 SPTP

4-5-6 as received

Observations:
- much higher clay content than SPTP 1-2-3 sample
- more effort and time needed to homogenize sample
- after thoroughly homogenizing larger clay chunks, some an inch in diameter were still present and could not be broken up and mixed into sample
- clay chunks after mixing could not be broken between fingers, only squished and slightly displaced
- however like SPTP 1-2-3 sample these clay chunks broke up after sitting undisturbed for 48 hrs and were not visible after re-homogenizing sample

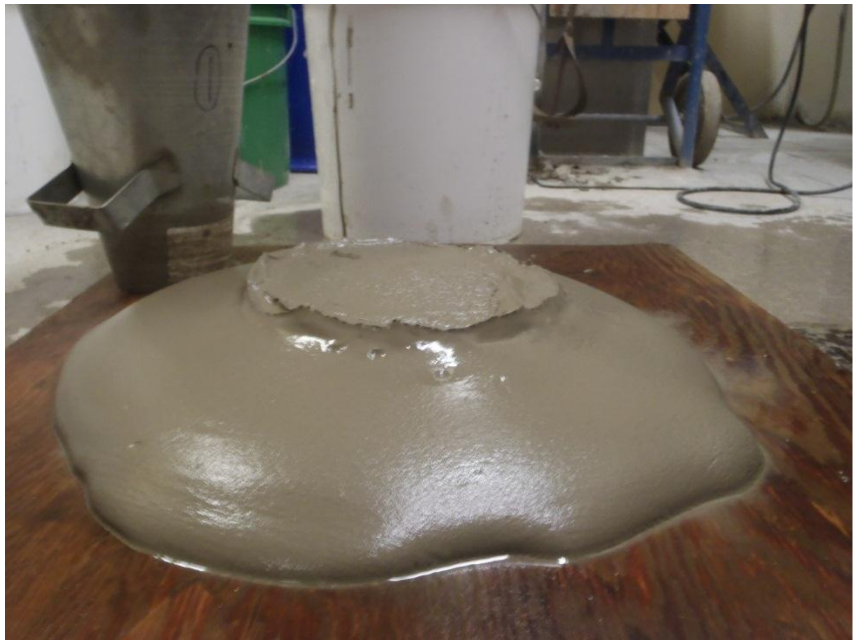
Photograph 26

13-1426-0010 SPTP

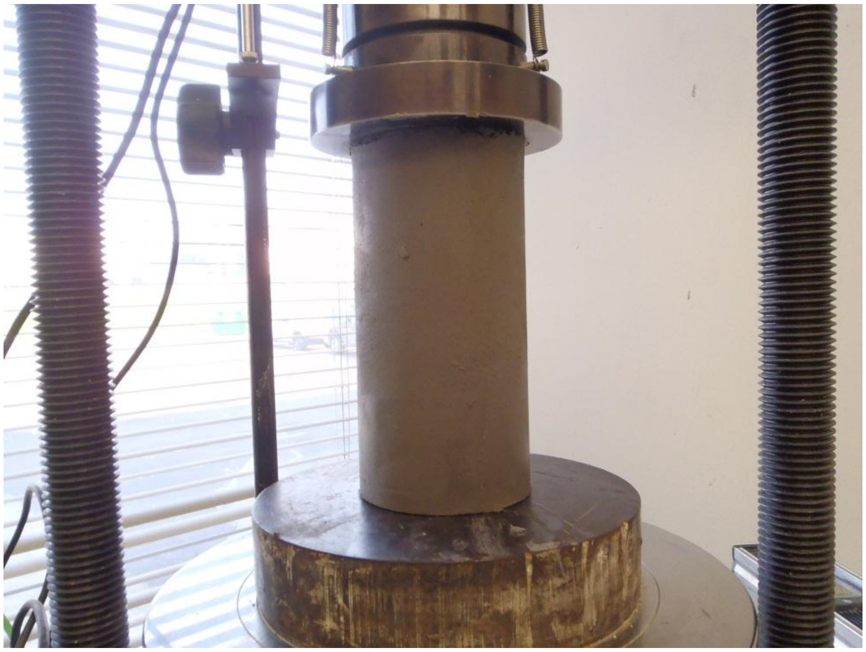
-4 - 178mm slump

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

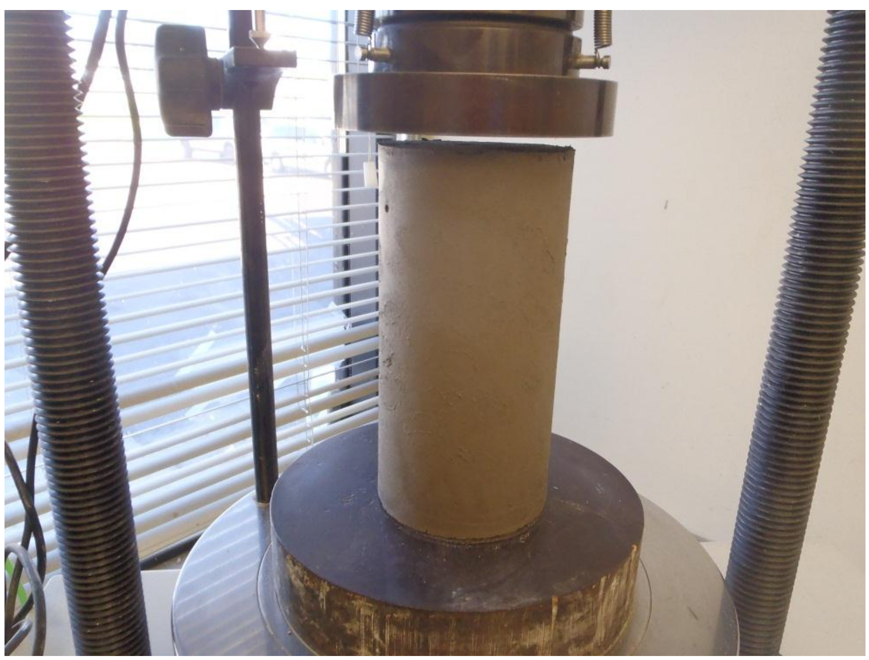
Photograph 27 13-1426-0010 SPTP -4 - 254mm slump	
Photograph 28 13-1426-0010 SPTP -5 - 178mm slump	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	
Photograph 29 13-1426-0010 SPTP -5 - 254mm slump	
Photograph 30 13-1426-0010 Mix 1 – 7 day UCS	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 31 13-1426-0010 Mix 1 – 7 day UCS	
Photograph 32 13-1426-0010 Mix 2 – 7 day UCS	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 33 13-1426-0010 Mix 2 – 7 day UCS	
Photograph 34 13-1426-0010 Mix 3 – 7 day UCS	

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 35 13-1426-0010 Mix 3 – 7 day UCS	
Photograph 36 13-1426-0010 Mix 4 – 7 day UCS	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 37 13-1426-0010 Mix 4 – 7 day UCS	
Photograph 38 13-1426-0010 Mix 5 – 7 day UCS	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 39

13-1426-0010

Mix 5 – 7 day UCS

Photograph 40

13-1426-0010

Mix 6 – 7 day UCS

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 41
13-1426-0010
Mix 6 – 7 day UCS

Photograph 42
13-1426-0010
Mix 7 – 7 day UCS

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 43 13-1426-0010 Mix 7 – 7 day UCS	
Photograph 44 13-1426-0010 Mix 8 – 7 day UCS	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 45

13-1426-0010
Mix 8 – 7 day UCS

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

Golder Associates

TECHNICAL MEMORANDUM

DATE January 24, 2014 **REFERENCE No.** 1314260010-061-TM-Rev0-1000

TO Brad Thompson
PWGCS

CC Dave Colbourne

FROM Jared Beloin and David Caughill **EMAIL** jbeloin@golder.com; dcaughill@golder.com

FIELD INVESTIGATION FOR PASTE PRODUCTION PLANNING AT GIANT MINE, YELLOWKNIFE, NORTHWEST TERRITORIES – OCTOBER 2013

Public Works and Government Services Canada (PWGSC) requested Golder Associates Ltd. (Golder) to undertake a field investigation program to provide information to support future paste production at the Giant Mine Site, NWT. This technical memorandum was prepared to provide a factual field investigation record of the activities undertaken and observations recorded during the field program. The paste evaluation and testing component of this field program is provided under separate cover.

The reader is referred to the Study Limitations section which follows the text and forms an integral part of this technical memorandum.

1.0 INTRODUCTION

Golder completed a field investigation program between October 19, 2013 and October 31, 2013 to provide information on the upper portion of the tailings within the South and Central Ponds. The program included observations on consistency and composition of the tailings and collection of samples, to be used for laboratory testing to evaluate the suitability of the tailings to produce paste. This program, combined with previous investigation programs is intended to provide information to support the planning and design of paste production programs in 2014 and 2015. The overall objective is to use paste produced with the tailings as underground backfill in key stopes at the Giant Mine Site. It is expected that tailings from upper portions of the South Pond, the Central Pond and possibly the North Pond will be used to supply tailings for paste production in 2014 and 2015.

Field supervision of the test pitting program was provided by an Engineer-in-Training from Golder Associates who located the test pits in the field, supervised and logged their excavation. Field support was provided by members of Golder's Paste Group.

2.0 FIELD PROGRAM

A total of 26 test pits were excavated on the South Pond and a total 23 test pits were excavated on the Central Pond between October 19 and 30, 2013. Due to ongoing paste production, the test pitting program was carried out when equipment was available, primarily from October 19 to 23, 2013 then finished on October 29 and 30, 2013. The test pits were excavated by track mounted excavators supplied and operated by RTL Construction (RTL). Test pits excavated from October 19, to October 23, 2013 were excavated with a Komatsu PC400 LC excavator. Test pits excavated on October 29 and 30, 2013 were excavated with a Deere 270D LC.

The test pit locations are shown in Figure 1. The depths of the test pits ranged from 2.0 m to 6.5 m. The target depth for the test pits was generally 4.0 m or deeper. Some test pits encountered native ground/rock, permafrost or soft conditions which limited the depth to less than 4.0 m. Golder field representatives located the test pits in the field, observed and logged their excavation, and directed their backfilling. Observations made during excavation of the test pits included soil visual description, ground water conditions and sloughing conditions. Samples were collected from selected test pits for subsequent laboratory testing.

The visual description of the tailings was determined based on field assessment techniques which were limited to visual inspection and handling with gloved hands.

In general the tailings encountered during the current investigation in the South and Central Ponds can be classified as silty sand, sandy silt or clayey silt, as described below:

- silty sand, fine grained, grey to brown, no cementation, non-cohesive, dry to moist, very loose to loose. This unit often contains lenses of blocky/friable sandy silt up to about 0.5 m thick.
- sandy silt, various shades of brown and grey 1 to 10 mm thick interlaminations, very weakly cemented, blocky/friable, dry to moist, soft. This unit often contained lenses of silty sand up to about 0.5 m thick.
- clayey silt, low plasticity, some sand to sandy, light grey to brown, cohesive, wet of plastic limit, very soft. This unit retained its water (no seepage/free water observed at time of excavation).

With few variations the material encountered during this investigation can be classified in one of these three categories. For the purposes of this investigation the classification took into consideration the behavior of the material from the standpoint of paste production. The material described as silty sand is generally loose material that crumbles easily with light finger pressure. The material descried as sandy silt is generally blocky or friable and requires moderate to strong finger pressure to crumble. The material described as clayey silt is plastic in nature and can be moulded or squeezed rather than crumbled with light to moderate finger pressure.

Observations during the 2013 paste production activities were that each type of material required different processing in order to be used for paste production (using Reimer trucks in this case). Silty sand was generally suitable to be used as excavated, except to possibly screen for debris within the tailings. Sandy silt required screening or mechanical conditioning, to break up the lumps in the tailings. Without conditioning, the tailings tended to cause blockages in the paste production (mixing process) operation. Clayey silt material, due to the plasticity, would need to be blended with coarser material, in order to not cause blockages in the paste piping system.

All test pits were backfilled immediately after completion with selected material left in small piles from select test pits, in order to collect samples for paste production testing at a later date.

Based on field observations made during tailings excavation at the north end of the South Pond for the 2013 paste production trial, it should be noted that water conditions in the tailings can change due to the excavation activity itself. For example repeated passes by heavy equipment made over the same spot can have a "pumping" effect, apparently bringing water closer to the surface than it was during the initial investigation.

2.1 South Pond Test Pits

The approximate locations of the test pits excavated in South Pond are shown in Figure 1. Data and observations pertaining to these test pits are provided in Table 1 and in the Record of Test Pit sheets (Attachment 1). The observations below only apply to the upper portions of the ponds, to the depth of the test pits.

In general coarser material (silty sand) was observed near the former discharge points along the west and south edges of the pond. Finer grained material (clayey silt) was observed in greater quantities closer to the center and along the eastern edge of the pond. More clayey silt was encountered and the surface of the pond became softer towards the open water in the bay in the north east corner of the pond. Test pits SP-TP-38 and SP-TP-41 represent the limit of approach for the excavator during the field program, moving closer to the north east bay was considered unsafe as the track mounted excavator began sinking into the ground.

Moisture conditions in South Pond typically varied from dry to moist at shallower depths to moist at deeper depths in the coarser material. Generally wetter conditions were noted in the finer grained material in the center and eastern edges of the pond, though no seepage or free water was observed at the time of excavation. Test pits SP-TP-50, SP-TP-51 and SP-TP-52 in the center of the pond near the paste trial area showed wetter conditions than most others. It is suspected that this may be due to the heavy equipment traffic from the paste trial pumping the water up.

Sloughing off the side walls of the test pits was noted in many of the test pits containing slayey silt. Notably while excavating test pit SP-TP-41 the test pit collapsed at a depth of 3.0 m.

2.2 Central Pond Test Pits

The approximate locations of the test pits excavated in Central Pond are shown in Figure 1. Data and observations pertaining to these test pits are provided in Table 1 and in the Record of Test Pit sheets (Attachment 1). The observations below only apply to the upper portions of the ponds, to the depth of the test pits.

In general the material in Central Pond was observed to be coarser than that in South Pond at the depths excavated to during this investigation, with most of the material consisting of dry to moist silty sand to sandy silt. Wetter clayey silt material was observed starting at depths ranging from 1.75 to 2.5 m in test pits CP-TP-09, CP-TP-10, CP-TP-11, CP-TP-12 and CP-TP-14 located along the south and south east edges of the pond. Coarser material was observed in the central and northern parts of the pond. Clayey silt was also observed in test pits CP-TP-18, CP-TP-20 and CP-TP-23 starting at depths ranging from 3.75 to 4.0 m.

Moisture conditions observed in Central Pond were typically drier than those observed in South Pond at the depths excavated to in the current test pit program. No seepage was observed in any of the test pits.

Frozen tailings (suspected permafrost) were encountered within the tailings in test pits CP-TP-21 and CP-TP-22 at depths of 3.5 m and 3.0 m respectively. The frozen material contained ice lenses 1 to 2 mm thick. The excavators were unable to dig through the frozen layers.

Table 1: Central and South Pond Test Pit Summary October 2013

Location	Test Pit ID	Depth (m)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Visual Description/Comments/Notes
Central Pond	CP-TP-09	0-1.25				Silty Sand
		1.25-2.5	23	70	7	Sandy Silt
		2.5-4.5				Clayey Silt. Sloughing in Clayey Silt
	CP-TP-10	0-1.25				Silty Sand
		1.25-1.75				Sandy Silt
		1.75-4.5	4	87	9	Clayey Silt. Sloughing in Clayey Silt.
	CP-TP-11	0-1.0				Silty Sand
		1.0-4.0	28	66	6	Sandy Silt (moist to wet). Sloughing in sandy Silt layer, rock (suspected bedrock) at 4.0 m.
	CP-TP-12	0-3.5				Sandy Silt (dry to moist. Clayey Silt lens from 2.0 to 2.5 m.
	CP-TP-13	0-2.0				Sandy Silt
		2.0-5.0				Silty Sand. Clayey Silt lens from 4.0 to 4.5 m.
	CP-TP-14	0-2.5	42	54	4	Sandy Silt
		2.5-4.5	2	89	9	Clayey Silt
	CP-TP-15	0-4.0	64	33	3	Silty Sand, containing lenses/laminations of blocky and clayey material
		4.0-5.5				Sandy Silt
	CP-TP-16	0-4.5	48	48	4	Silty Sand
	CP-TP-17	0-1.0				Sandy Silt
		1.0-4.5				Silty Sand. Dry to moist, containing wet clayey lenses at 3.0 m.
	CP-TP-18	0-3.75	32	63	5	Sandy Silt
		3.75-5.0				Clayey Silt
	CP-TP-19	0-4.0				Sand and Silt, laminated
		4.0-4.5	35	61	4	Sandy Silt
	CP-TP-20	0-4.0				Sandy Silt with sand lenses. Clayey lenses at 2.5 m.
		4.0-4.5	12	81	7	Clayey Silt. Sloughing off side walls observed.
	CP-TP-21	0-3.75				Silty Sand to Sandy Silt. Frozen from 3.5 to 3.75 m. Unable to excavate through the frozen tailings.
	CP-TP-22	0-4.0				Sandy Silt. Frozen, containing ice with 1 to 2 mm ice lenses from 3.0 to 4.0 m. Unable to excavate further.
	CP-TP-23	0-4.0				Sandy Silt
		4.0-5.0				Clayey Silt. Sloughing off side walls observed.
	CP-TP-24	0-2.5				Sandy Silt. Rock below 2.5 m. Topsoil and tree roots encountered from 2.25 to 2.5 m.
	CP-TP-25	0-3.5				Silty Sand with Silt lenses. Rock below 3.5 m. Soft clayey lenses at 2.25 m.
	CP-TP-26	0-2.25				Sandy Silt
		2.25-3.0	12	80	8	Clayey Silt. Rock (suspected bedrock) below 3.0 m. Roots encountered from 2.5 to 3.0 m.

Location	Test Pit ID	Depth (m)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Visual Description/Comments/Notes
	CP-TP-27	0-4.25				Silty Sand. Containing Sandy Silt lenses up to 0.5 m thick. Clayey Silt lenses below 3.5 m.
	CP-TP-28	0-5.0				Silty Sand. Containing Sandy Silt lenses up to 0.5 m thick. Clayey Silt lens from 3.0 to 3.5 m.
	CP-TP-29	0-2.0				Silty Sand containing Sandy Silt lenses.
		2.0-5.0				Sandy Silt. Clayey Silt lenses from 2.5 to 5.0 m.
	CP-TP-30	0-1.0				Silt and Sand
		1.0-4.0				Silty Sand
		4.0-5.5				Sandy Silt. Clayey Silt lenses from 4.0 to 5.5 m.
	CP-TP-31	0-5.0				Silty Sand
		5.0-6.5				Sandy Silt. Wet Clayey Silt lenses at 4.75 m.
South Pond	SP-TP-26	0-0.75				Sandy Silt to Silty Sand
		0.75-2.75				Silty Sand
		2.75-3.75				Clayey Silt
		3.75-4.25				Silty Sand
	SP-TP-27	0-1.5	24	70	6	Sandy Silt
		1.5-4.0				Silty Sand
	SP-TP-28	0-1.0				Sandy Silt
		1.0-4.0				Silty Sand containing Sandy Silt lenses
	SP-TP-29	0-0.5				Sandy Silt
		0.5-3.75				Silty Sand. Clayey Silt lens from 1.75 to 2.5 m
		3.75-4.0				Clayey Silt
	SP-TP-30	0-4.0				Silty Sand. Sandy Silt lenses from 2.5 to 4.0 m.
	SP-TP-31	0-2.0				Sandy Silt to Silty Sand. Rock (suspected bedrock) below 2.0 m.
	SP-TP-32	0-4.0				Silty Sand. Moist to wet silt lenses from 3.5 to 4.0 m.
	SP-TP-33	0-1.25				Sandy Silt
		1.25-2.25				Clayey Silt
		2.25-4.0				Silty Sand
	SP-TP-34	0-3.0				Sandy Silt. Wet Clayey Silt lens at 1.75 m
		3.0-4.0				Clayey Silt.
	SP-TP-35	0-1.25	38	57	5	Sandy Silt
		1.25-2.0				Silty Sand
		2.0-4.0				Clayey Silt
	SP-TP-36	0-3.0				Silty Sand
		3.0-4.0	0	90	10	Clayey Silt
	SP-TP-37	0-0.75				Silty Sand
		0.75-4.0				Clayey Silt
	SP-TP-38	0-2.5				Sandy Silt to Silty Sand containing Clayey Silt lenses.
		2.5-4.0	0	88	12	Clayey Silt. Sloughing off side walls noted.
	SP-TP-39	0-2.25				Sandy Silt to Silty Sand
		2.25-3.75				Clayey Silt. Rock (suspected bedrock) below 3.75 m. Roots and topsoil encountered from 3.5 to 3.75 m

Location	Test Pit ID	Depth (m)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Visual Description/Comments/Notes
	SP-TP-40	0-0.5				Sandy Silt
		0.5-3.0				Clayey Silt. Rock (suspected bedrock) below 3.0 m.
	SP-TP-41	0-3.0	0	89	11	Clayey Silt. Possible Silty Clay from 2.0 to 3.0 m. Side walls collapsed.
	SP-TP-44	0-2.75				Silty Sand. Rock (suspected bedrock) below 2.75 m. Tree roots and boulders encountered from 2.5 to 2.75 m.
	SP-TP-45	0-1.0				Sandy Silt
		1.0-3.0				Silty Sand. Rock below 3.0 m (suspected bedrock). A PVC pipe was encountered in this test pit.
	SP-TP-46	0-1.75				Silty Sand containing Sandy Silt lenses.
		1.75-2.75				Clayey Silt. Sloughing noted in Clayey Silt layer.
		2.75-4.0				Silty Sand
	SP-TP-47	0-1.0				Clayey Silt
		1.0-2.0				Sandy Silt
		2.0-4.0				Silty Sand
	SP-TP-48	0-0.5				Clayey Silt
		0.5-3.0				Silty Sand containing Sandy Silt lenses. Rock below 3.0 m (suspected bedrock).
	SP-TP-49	0-3.5				Silty Sand containing Sandy Silt lenses
		3.5-4.25				Sandy Silt
	SP-TP-50	0-2.0				Sandy Silt containing Silty Sand.
		2.0-4.0				Silty Sand containing Sandy Silt lenses. Moist to wet from 0 to 4.0 m.
	SP-TP-51	0-1.0				Sandy Silt
		1.0-3.25				Silty Sand containing Sandy Silt
		3.25-4.0				Sandy Silt containing some clay. Moist to wet from 1.5 to 4.0 m
	SP-TP-52	0-3.5	10	83	7	Sandy Silt. Clayey lenses from 1.5 to 3.5 m. Moist to wet from 0 to 3.5 m.
		3.5-4.0				Silty Sand. Moist from 3.5 to 4.0m.
	SP-TP-53	0-1.25				Sandy Silt
		1.25-2.5				Silty Sand
		2.5-4.0				Clayey Silt

3.0 CLOSURE

We trust that the information provided in this technical memorandum meets your present needs. Should you have any questions or require additional information, please feel free to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Jared Beloin, EIT
Geotechnical Engineer-in-Training

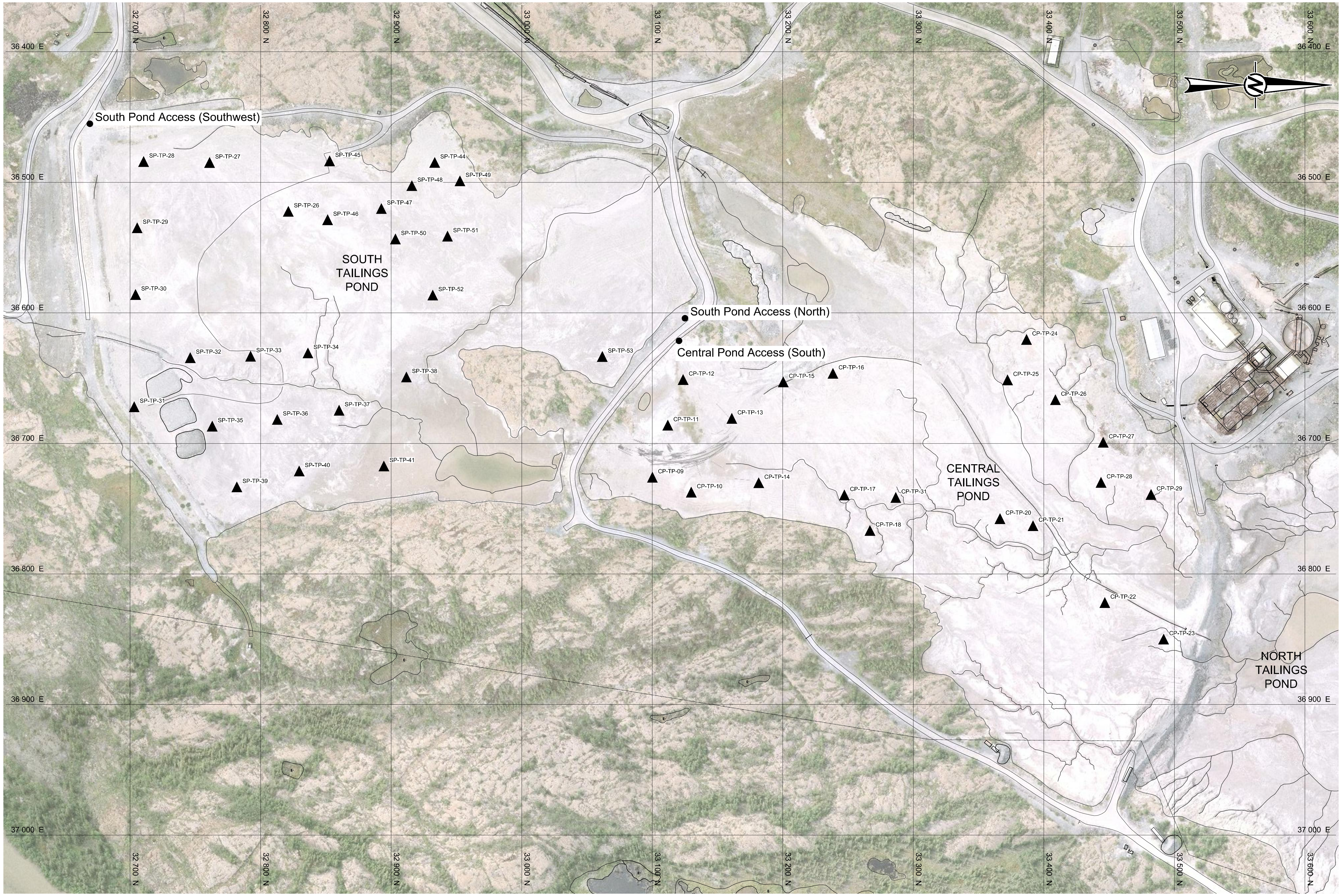
ORIGINAL SIGNED AND SEALED

Dave Caughill, M.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

JJB/DC/rs/km/ja

Attachments: Figure 1
Attachment 1: Record of Test Pits

o:\final\2013\1426\13-1426-0010\1314260010-061-tm-rev0-1000\1314260010-061-tm-rev0-1000-giant mine october test pitting 24jan_14.docx



LEGEND

▲ TEST PIT LOCATION (GOLDER 2013)

● ACCESS POINT

PLAN VIEW

SCALE A

NOTES

ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS THE GMRP COORDINATE SYSTEM.

REFERENCES

AERIAL PHOTO DATED 2009, PROVIDED BY PUBLIC WORKS GOVERNMENT SERVICES CANADA

0 60 120 180

SCALE A 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

Revision/Revisión	Description/Description	Date/Date
0	ISSUED WITH DOC. #061 REV0	2014-01-24
A	ISSUED WITH DOC. #061 REVB	2013-12-03

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuvé par: CJ

Designed by/Concept par: JB

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

TEST PIT LOCATION PLAN
OTOBER 2013 TEST PIT PROGRAM

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010 DOC. #061	01 OF 1	0

PWGSC – A1 – 841X594

13-1426-0010-1000-1608_0

ATTACHMENT 1
Record of Test Pits

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-09

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 29, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, containing silt lenses/laminations, light brown, dry to moist.		0.00							
1		(ML) SILT, sandy, laminated grey and brown, dry to moist.		1.25							
2		(ML) CLAYEY SILT, some sand, containing sandy lenses, grey, moist to wet, very soft.		2.50							
3											
4											
		End of TEST PIT.		4.50							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed off side walls during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

DATA ENTRY: JJB

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

RECORD OF TEST PIT: CP-TP-10

PROJECT No.: 13-1426-0010

LOCATION: See Location Plan

EXCAVATION DATE: October 29, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, containing silt lenses/laminations, light brown, dry to moist.		0.00							
1		(ML) SILT, sandy, laminated grey and brown, dry to moist.		1.25							
2		(ML) CLAYEY SILT, some sand to sandy, containing sand lenses, laminated, moist to wet, very soft to soft.		1.75							
3											
4											
		End of TEST PIT.		4.50							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed off side walls during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

RECORD OF TEST PIT: CP-TP-11

PROJECT No.: 13-1426-0010

LOCATION: See Location Plan

EXCAVATION DATE: October 29, 2013

SHEET 1 OF 1

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, brown to grey, dry, loose to compact.		0.00							
1		(ML) SILT, sandy, some clay, containing clayey lenses, containing sandy lenses, dark to light grey, moist to wet.		1.00							
2											
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Suspected bedrock at 4.0 m.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) Sloughing observed off side walls during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

DATA ENTRY: JJB

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-12

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, laminated light grey and brown, blocky, dry to moist.		0.00							
2		... 0.5 m thick clayey silt lens									
		End of TEST PIT.		3.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-13

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, laminated light grey and brown, blocky, dry to moist.		0.00							
1											
2		(SM) SAND, fine grained, silty, light grey, containing silt lenses, dry to moist.		2.00							
3											
4		(ML) CLAYEY SILT, grey, moist to wet.		4.00							
		(SM) SAND, fine grained, silty, light grey, containing silt lenses, moist.		4.50							
5		End of TEST PIT.		5.00							
		NOTES: 1) Test Pit backfilled on completion. 2) No seeping water observed during excavation. 3) No sloughing observed during excavation.									
6											
7											

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-14

LOCATION: See Location Plan

EXCAVATION DATE: October 29, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(ML) SILT, sandy, containing sand lenses, greyish brown, dry to moist		0.00							
2		... clayey lenses									
		(ML) CLAYEY SILT, sandy, containing sand lenses, moist to wet, very soft to soft.		2.50							
		End of TEST PIT.		4.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-15

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator RTL Construction	(SM) SAND, fine grained, silty, containing silt lenses/laminations and clayey laminations, moist.		0.00							
4		(ML) SILT, sandy, grey, some clay, moist to wet		4.00							
		End of TEST PIT.		5.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

RECORD OF TEST PIT: CP-TP-16

PROJECT No.: 13-1426-0010

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator RTL Construction	(SM) SAND, fine grained, silty, light brown, dry to moist.		0.00							
4.5		End of TEST PIT.		4.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE 1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-17

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, some sand to sandy, laminated brown and grey, containing sand lenses, dry to moist.		0.00							
1		(SM) SAND, fine grained, silty, containing silt lenses, light brown, dry to moist, loose to compact.		1.00							
3		... wet clayey lenses									
		End of TEST PIT.		4.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE
1 : 35

Golder Associates

LOGGED: JJB
CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-18

LOCATION: See Location Plan

EXCAVATION DATE: October 29, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, grey to brown, dry to moist, loose to compact.		0.00							
1											
2											
3											
		(ML) CLAYEY SILT, sandy, containing sand lenses, moist to wet, very soft to soft.		3.75							
4											
5		End of TEST PIT.		5.00							
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-19

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, laminated brown and grey, dry, loose to compact.		0.00							
4		(ML) SILT, sandy, clayey, grey, moist to wet, soft to firm.		4.00							
		End of TEST PIT.		4.50							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-20

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, light grey to brown, containing sand lenses, dry to moist, soft/loose.		0.00							
1											
2		... clayey lenses									
3											
4		(ML) CLAYEY SILT, some sand, grey, moist to wet, very soft to soft.		4.00							
		End of TEST PIT.		4.50							
5											
6											
7											

NOTES:

1) Test pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed off side walls of test pit during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-21

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(SM/ML) SAND and SILT, fine grained, containing sand lenses, laminated brown and light grey, loose/soft, dry to moist.		0.00							
		(ML) SILT, sandy, light brown, laminated, platey, dry, hard. (suspected permafrost)		3.50							
		End of TEST PIT.		3.75							

NOTES:

1) Refusal due to suspected permafrost.
2) Test pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-22

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC; RTL Construction	(ML) SILT, sandy, laminated grey and brown, blocky/friable, dry to moist.		0.00							
2–3		... sandy/clayey lenses									
3		... suspected permafrost below about 3.0 m.									
4		End of TEST PIT.		4.00							

NOTES:

1) Refusal due to suspected permafrost.
2) Test pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-23

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC RTL Construction	(ML) SILT, sandy, blocky, laminated brown and grey, dry to moist, soft to firm.		0.00							
3		... clayey silt lenses									
4		(ML) CLAYEY SILT, some sand to sandy, dark brown to grey, moist to wet, very soft to soft.		4.00							
5		End of TEST PIT.		5.00							

NOTES:

1) Test pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed off side walls of test pit during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-24

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(ML) SILT, sandy, containing clayey lenses, containing sand lenses laminated grey and brown, dry to moist.		0.00							
		... Topsoil encountered									
		End of TEST PIT.		2.50							

Depth scale marks: 0, 1, 2, 3, 4, 5, 6, 7

NOTES:

1) Refusal due to suspected bedrock.
2) Test pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-25

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, silty, containing silt lenses, laminated grey and brown, friable, dry, loose to compact.		0.00							
2		... soft clayey silt lens									
		End of TEST PIT.		3.50							

NOTES:

1) Refusal due to suspected bedrock.
2) Test pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-26

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m / SHEAR STRENGTH Cu, kPa	HYDRAULIC CONDUCTIVITY, k, cm/s / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(ML) SILT, sandy, laminated brown and grey, friable, dry to moist.		0.00							
2.25		(ML) CLAYEY SILT, sandy, grey, moist to wet, very soft to soft. ... topsoil encountered		2.25							
3		End of TEST PIT.		3.00							

NOTES:

1) Refusal due to suspected bedrock.
2) Test pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE 1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

DATA ENTRY: JJB

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

DATA ENTRY: JJB

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-27

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC RTL Construction	(SM) SAND, fine grained, silty, contains friable silt lenses, dry to moist, loose to compact.		0.00							
1											
2											
3		... clayey silt lenses									
4											
		End of TEST PIT.		4.25							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

DATA ENTRY: JJB

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-28

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, containing blocky laminated silt lenses, light grey to brown, dry to moist.		0.00							
3		... 0.5 m thick clayeys silt lens									
5		End of TEST PIT.		5.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-29

LOCATION: See Location Plan

EXCAVATION DATE: October 30, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Deere 270D LC / RTL Construction	(SM) SAND, fine grained, silty, containing blocky silt lenses, light grey to brown, dry to moist.		0.00							
2		(ML) SILT, sandy, some clay, containing clayey lenses, containing sandy lenses, light brown to grey, moist with wet lenses.		2.00							
5		End of TEST PIT.		5.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-30

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES – NUMBER	SAMPLES – TYPE	SAMPLES – BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML/SM) SILT and SAND, light brown and grey, laminations, dry.		0.00							
1		(SM) SAND, silty, fine grained, light brown to grey, dry to moist		1.00							
2											
3											
4		(ML/SM) Sandy SILT and silty SAND interlayers, containing clayey silt lenses.		4.00							
5											
		End of TEST PIT.		5.50							
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-31

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator RTL Construction	(SM) SAND, silty, fine grained, containing blocky silt layers and clayey silt lenses, dry to moist.		0.00							
1											
2											
3											
4											
		... wet clayey silt lenses									
5		(ML) SILT, sandy, light grey to brown, moist.		5.00							
6											
		End of TEST PIT.		6.50							
		NOTES:									
7		1) Test Pit backfilled on completion.									

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: CP-TP-31

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
7		2) No seeping water observed during excavation. 3) No sloughing observed during excavation.									
8											
9											
10											
11											
12											
13											
14											

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-26

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(SM/ML) Sandy SILT to silty SAND, laminated brown and grey, dry to moist.		0.00							
1		(SM) SAND, silty, containing wet clayey silt lenses, light grey, dry to moist, loose to compact.		0.75							
2											
3		(ML) CLAYEY SILT, light brown to grey, w>PL, very soft to soft.		2.75							
		(SM) SAND, fine grained, silty, light grey, moist.		3.75							
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE
1 : 35

Golder Associates

LOGGED: JJB
CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-27

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(ML) SILT, sandy, containing clayey laminations, laminated brown and grey, dry.		0.00							
1											
		(SM) SAND, fine grained, silty, light to dark grey, dry to moist.		1.50							
2											
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-28

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) SILT, sandy, some clay, laminated brown and grey, dry to moist.		0.00							
1		(SM) SAND, fine grained, silty, containing silt lenses, light grey, dry to moist.		1.00							
2											
		... fewer silt lenses									
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-29

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, laminated light brown and grey, dry.		0.00							
		(SM) SAND, fine grained, silty, light grey, dry to moist.		0.50							
1		... silt lenses									
		(ML) CLAYEY SILT, laminated brown and grey, moist to wet, very soft to soft, sand laminations.		1.75							
2											
		(SM) SAND, fine grained, silty, light grey, dry to moist.		2.50							
3											
		(ML) CLAYEY SILT, laminated brown and grey, moist to wet, very soft to soft, sand laminations.		3.75							
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.
4) Boulders/cobbles on surface.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-30

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	SAND, fine grained, silty, light brown to grey, dry, loose to compact.		0.00							
1											
2		... dry, friable sandy silt lenses									
3		... dry, black, friable sandy silt lenses									
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE
1 : 35

Golder Associates

LOGGED: JJB
CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-31

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML/SM) Sandy SILT to Silty SAND, laminated grey and brown, dry to moist.		0.00							
1											
		... boulders encountered									
2		End of TEST PIT.		2.00							
		NOTES: 1) Refusal due to suspected bedrock. 2) Test Pit backfilled on completion. 3) No seeping water observed during excavation. 4) No sloughing observed during excavation.									
3											
4											
5											
6											
7											

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-32

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ├─○W─┤ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(SM) SAND, fine grained, silty, containing silt laminations, light grey, dry to moist.		0.00							
1											
2											
3		... moist to wet silt lenses									
4		End of TEST PIT.		4.00							
		NOTES: 1) Test Pit backfilled on completion. 2) No seeping water observed during excavation. 3) No sloughing observed during excavation.									
5											
6											
7											

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-33

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DATA ENTRY: JJB

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface								
0	Komatsu PC400 LC Excavator, RTL Construction	(ML) SILT, sandy, containing clayey silt and sand inter-laminations, laminated brown and light grey, dry to moist.	0.00							
1		(ML) CLAYEY SILT, brown, wet, very soft to soft.	1.25							
2		(SM) SAND, fine grained, silty, contains wet silt lenses, laminated, dry to moist.	2.25							
4		End of TEST PIT.	4.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-34

LOCATION: See Location Plan

EXCAVATION DATE: October 22, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(ML) SILT, sandy, containing sand lenses, light grey, dry to moist.		0.00							
		... wet clayey silt lens									
3		(ML) CLAYEY SILT, light grey, wet, very soft to soft.		3.00							
4		End of TEST PIT.		4.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

DATA ENTRY: JJB

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-35

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(ML) SILT, sandy, containing clayey laminations, blocky, laminated light and dark brown, yellow staining, dry to moist. ... sand interlayers		0.00							
1		(SM) SAND, silty, light grey, dry.		1.25							
2		(ML) CLAYEY SILT, light to dark grey, moist to wet, very soft to soft.		2.00							
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

TESTPIT 13-1426-0010 TEST PIT RECORDS 13JAN2014.GPJ GLDR_CAN.GDT 01/23/14

DEPTH SCALE 1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-36

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(SM) SAND, fine grained, silty, containing laminated sandy silt lenses, light brown to grey, dry to moist		0.00							
3		(ML) CLAYEY SILT, laminated brown and grey, wet, very soft to soft.		3.00							
4		End of TEST PIT.		4.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

Depth scale marks: 0, 1, 2, 3, 4, 5, 6, 7

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-37

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(SM) SAND, silty, light grey, dry to moist.		0.00							
1		(ML) CLAYEY SILT, containing sandy silt and silty sand lenses, laminated brown and grey with yellow staining, moist to wet, very soft to soft.		0.75							
4		End of TEST PIT.		4.00							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing recorded during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-38

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 23, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(SM/ML) Sandy SILT to silty SAND, containing clayey silt lenses, light grey, dry to moist.		0.00							
1											
2											
		(ML) CLAYEY SILT, containing sand lenses, light grey, moist to wet, very soft to soft.		2.50							
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed off side walls of excavation during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-39

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, clayey laminations, dry to moist.		0.00							
		(SM) SAND, silty, fine grained, grey to brown, loose to compact.		0.50							
1		SILT/SAND inter-layers/laminations,light brown to grey, soft/loose, moist.		1.25							
2		(ML) CLAYEY SILT, grey, black silt lenses, wet, very soft to soft.		2.25							
3		... encountered boulders, topsoil, roots									
		End of TEST PIT.		3.75							
4											
5											
6											
7											

NOTES:

1) Refusal due to suspected bedrock.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) Sloughing observed off side walls during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-40

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) SILT, sandy, laminated grey and brown, dry to moist.		0.00							
		(ML) CLAYEY SILT, laminated light grey and brown, very soft to soft.		0.50							
1											
		... brown									
2											
		... encountered boulders, topsoil									
3		End of TEST PIT.		3.00							
4											
5											
6											
7											

NOTES:

1) Refusal due to suspected bedrock.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) Sloughing observed off side walls during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-41

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) CLAYEY SILT, containing sand lenses, laminated brown and grey, very soft to soft.		0.00							
2		(ML/MH) SILTY CLAY to CLAYEY SILT, brown, w>PL, very soft to soft.		2.00							
3		End of TEST PIT.		3.00							

NOTES:

1) Excavation side walls collapsed at 3.0 m.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-44

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(SM) SAND, fine grained, silty, light grey to brown, moist.		0.00							
1		... dark grey silt lenses									
2		... encountered boulders, tree roots									
		End of TEST PIT.		2.75							
3											
4											
5											
6											
7											

NOTES:

1) Refusal due to suspected bedrock.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-45

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) SILT, sandy, laminated brown and grey, dry to moist, wet clayey lenses.		0.00							
1		(SM) SAND, fine grained, silty, containing friable/blocky silt lenses and clayey silt lenses, light brown, moist.		1.00							
2											
		End of TEST PIT.		2.75							
3											
4											
5											
6											
7											

NOTES:

1) Refusal due to suspected bedrock.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-46

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(SM) SAND, fine grained, silty, containing friable/blocky silt lenses, light grey to brown, dry to moist.		0.00							
1											
		(ML) CLAYEY SILT, laminated light grey and brown, wet, soft to very soft.		1.75							
2											
		(SM) SAND, fine grained, silty, containing friable/blocky silt lenses, light grey to brown, dry to moist.		2.75							
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) Sloughing observed in clayey silt layer during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-47

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ● rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator; RTL Construction	(ML) CLAYEY SILT, laminated reddish brown and grey, moist to wet, very soft to soft.		0.00							
1		(ML) SILT, sandy, laminated light grey and brown, moist.		1.00							
2		(SM) SAND, fine grained, silty, containing blocky/friable silt lenses, dry to moist.		2.00							
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-48

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) CLAYEY SILT, laminated reddish brown and grey, moist to wet, very soft to soft.		0.00							
		(SM) SAND, silty, containing silt lenses, moist, loose to compact.		0.50							
2		... wet, black clayey silt lenses									
3		End of TEST PIT.		3.00							

NOTES:

1) Refusal due to suspected bedrock.
2) Test Pit backfilled on completion.
3) No seeping water observed during excavation.
4) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-49

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(SM) SAND, fine grained, silty, containing suspected silt lenses, brown to grey, moist, loose to compact.		0.00							
3.50		(ML) SILT, sandy, laminated grey and brown, wet.		3.50							
4.25		End of TEST PIT.		4.25							

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-50

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) SILT, sandy, containing sand lenses, grey to brown, moist to wet.		0.00							
1											
		... yellow staining									
2		(SM) SAND, silty, containing silt lenses, light brown, moist to wet.		2.00							
3											
		(ML) SILT, sandy, light grey, moist to wet.		3.50							
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-51

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator, RTL Construction	(ML) SILT, sandy, laminated brown and grey, dry to moist.		0.00							
1		(SM) SAND, fine grained, silty, containing silt lenses, grey, moist, loose to compact		1.00							
2											
3		(ML) SILT, sandy, some clay, grey, moist to wet.		3.25							
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-52

SHEET 1 OF 1

LOCATION: See Location Plan

EXCAVATION DATE: October 19, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) SILT, sandy, laminated light brown and grey, moist to wet.		0.00							
1											
		(ML) SILT, sandy, some clay, containing clayey silt lenses, laminated light and dark grey, moist to wet, soft to firm.		1.50							
2											
3											
		(SM) SAND, fine grained, silty, grey, moist.		3.50							
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

PROJECT No.: 13-1426-0010

RECORD OF TEST PIT: SP-TP-53

LOCATION: See Location Plan

EXCAVATION DATE: October 20, 2013

DATUM:

DEPTH SCALE METRES	EXCAVATION METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Komatsu PC400 LC Excavator / RTL Construction	(ML) SILT, sandy, laminated light brown and grey, blocky, dry.		0.00							
1		(SM) SAND, fine grained, silty, containing silt lenses, dry to moist.		1.25							
2		(ML) CLAYEY SILT, mottled light brown and grey with yellow staining, moist to wet, very soft to soft.		2.50							
3											
4		End of TEST PIT.		4.00							
5											
6											
7											

NOTES:

1) Test Pit backfilled on completion.
2) No seeping water observed during excavation.
3) No sloughing observed during excavation.

DEPTH SCALE

1 : 35

Golder Associates

LOGGED: JJB

CHECKED: DC

January 29, 2014

LABORATORY REPORT FOR

Giant Mine Backfill Testing - South and Central Pond

Submitted to:
Public Works and Government Services Canada
(PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6

Attention: Brad Thompson

REPORT

Reference Number: 1314260010-102-R-Rev0-5000

Distribution:

1 Electronic Copy - Public Works and Government Services Canada

1 Hardcopy - Golder Associates Ltd.

Golder Associates

Study Limitations

This report was prepared for the exclusive use of Public Works and Government Services Canada (PWGSC) on the Giant Mine Project. The report, which specifically includes all tables, figures and appendices, is based on measurements and observations made and data and information collected during the laboratory studies conducted by Golder Associates Ltd. (Golder) for PWGSC. The test results are based solely on the ambient conditions of the laboratory at the time the measurements and tests were conducted.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

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APPENDICES

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Golder Associates Ltd. (Golder) to carry out laboratory testing on Giant Mine tailings to assess the rheological and strength properties of the South and Central Pond tailings for the purpose of using them as feed material for underground paste backfill.

2.0 SAMPLE RECEIPT AND PREPARATION

2.1 Sample Receipt

Samples received by Golder's Sudbury laboratory are summarized in Table 1. All samples were received in good condition with all seals intact. The total weight of the shipment was 928 kg. The samples were shipped via Manitoulin Transport.

Table 1: Sample Receipt Summary

Date	Amount / Container	Label as Received	Golder Sample ID
November 26, 2013	22.2kg – 20L Pail	Central Tailings Pond, GA13 -TP09	13-1426-0010 CTP - GA13-TP09
	8.7kg – 20L Pail	Central Tailings Pond, GA13 -TP10	13-1426-0010 CTP - GA13-TP10
	16.2kg – 20L Pail	Central Tailings Pond, GA13 -TP11	13-1426-0010 CTP - GA13-TP11
	13.3kg – 20L Pail	Central Tailings Pond, GA13-TP14 (1 of 2)	13-1426-0010 CTP - GA13-TP14-1
	16.4kg – 20L Pail	Central Tailings Pond, GA13-TP14 (2 of 2)	13-1426-0010 CTP - GA13-TP14-2
	15.1kg – 20L Pail	Central Tailings Pond, GA13-TP15	13-1426-0010 CTP - GA13-TP15
	14.1kg – 20L Pail	Central Tailings Pond, GA13-TP16	13-1426-0010 CTP - GA13-TP16
	14.8kg – 20L Pail	Central Tailings Pond, GA13-TP18	13-1426-0010 CTP - GA13-TP18
	13.3kg – 20L Pail	Central Tailings Pond, GA13-TP19	13-1426-0010 CTP - GA13-TP19
	10.2kg – 20L Pail	Central Tailings Pond, GA13-TP20	13-1426-0010 CTP - GA13-TP20
	14.8kg – 20L Pail	Central Tailings Pond, GA13-TP26	13-1426-0010 CTP - GA13-TP26
	19.7kg – 20L Pail	South Tailings Pond, GA13-TP27	13-1426-0010 STP - GA13-TP27
	11.7kg – 20L Pail	South Tailings Pond, GA13-TP35	13-1426-0010 STP - GA13-TP35
	13.8kg – 20L Pail	South Tailings Pond, GA13-TP36	13-1426-0010 STP - GA13-TP36
	18.1kg – 20L Pail	South Tailings Pond, GA13-TP38	13-1426-0010 STP - GA13-TP38
	9.0kg – 20L Pail	South Tailings Pond, GA13-TP41	13-1426-0010 STP - GA13-TP41
	17.0kg – 20L Pail	South Tailings Pond, GA13-TP52	13-1426-0010 STP - GA13-TP52
	1 - 200L Drum	South and Central Tailings Ponds, Bulk Sample - Silty Sand	13-1426-0010 SCTP - BS - Silty Sand
	1 - 200L Drum	South and Central Tailings Ponds, Bulk Sample - Mixed silt, sand, and clay	13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay)
	1 - 200L Drum	South and Central Tailings Ponds, Bulk Sample - Clayey Silt	13-1426-0010 SCTP - BS - Clay - Silt
December 9, 2013	1 – 200L Drum	Crushed Rock	13-1426-0010 SCTP-BS-Clay-Silt (S2)

All samples received by Golder are subjected to material property characterization tests to establish properties and allow for comparison should future testing be required.

2.2 Hazard Assessment

Prior to handling the Giant Mine sample each pails and drums was assessed separately for hazardous gases. The gas analysis results are presented in Table 2.

Table 2: Sample Hazard Assessment

Date	Label as Received	Golder Sample ID	VOC (ppm)	HCN (ppm)	H_2S (ppm)
November 26, 2013	Central Tailings Pond, GA13 -TP09	13-1426-0010 CTP - GA13-TP09	0	0	0
	Central Tailings Pond, GA13 -TP10	13-1426-0010 CTP - GA13-TP10	0	0	0
	Central Tailings Pond, GA13 -TP11	13-1426-0010 CTP - GA13-TP11	0	0	0
	Central Tailings Pond, GA13-TP14 (1 of 2)	13-1426-0010 CTP - GA13-TP14-1	0	0	0
	Central Tailings Pond, GA13-TP14 (2 of 2)	13-1426-0010 CTP - GA13-TP14-2	0	0	0
	Central Tailings Pond, GA13-TP15	13-1426-0010 CTP - GA13-TP15	0	0	0
	Central Tailings Pond, GA13-TP16	13-1426-0010 CTP - GA13-TP16	0	0	0
	Central Tailings Pond, GA13-TP18	13-1426-0010 CTP - GA13-TP18	0	0	0
	Central Tailings Pond, GA13-TP19	13-1426-0010 CTP - GA13-TP19	0	0	0
	Central Tailings Pond, GA13-TP20	13-1426-0010 CTP - GA13-TP20	0	0	0
	Central Tailings Pond, GA13-TP26	13-1426-0010 CTP - GA13-TP26	0	0	0
	South Tailings Pond, GA13-TP27	13-1426-0010 STP - GA13-TP27	0	0	0
	South Tailings Pond, GA13-TP35	13-1426-0010 STP - GA13-TP35	0	0	0
	South Tailings Pond, GA13-TP36	13-1426-0010 STP - GA13-TP36	0	0	0
	South Tailings Pond, GA13-TP38	13-1426-0010 STP - GA13-TP38	0	0	0
	South Tailings Pond, GA13-TP41	13-1426-0010 STP - GA13-TP41	0	0	0
	South Tailings Pond, GA13-TP52	13-1426-0010 STP - GA13-TP52	0	0	0
	South and Central Tailings Ponds, Bulk Sample - Silty Sand	13-1426-0010 SCTP - BS - Silty Sand	0	0	0
	South and Central Tailings Ponds, Bulk Sample - Mixed silt, sand, and clay	13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay)	0	0	0
	South and Central Tailings Ponds, Bulk Sample - Clayey Silt	13-1426-0010 SCTP - BS - Clay - Silt	0	0	0
December 9, 2013	Crushed Rock	13-1426-0010 SCTP-BS-Clay-Silt (S2)	0	0	0

VOC: Volatile Organic Compounds
HCN: Hydrogen Cyanide gas
H_2S: Hydrogen Sulphide gas

Metals analysis using Inductively Coupled Plasma with a Mass Spectrometer detector (ICP-MS) was performed on a composite sample obtained via individual pipe samples from each pail. This testing helps to identify health and safety hazards such as heavy metals which may be present. The sample was sent to an external laboratory for ICP-MS analysis. Figures 1and 2, and Appendix A present the results.

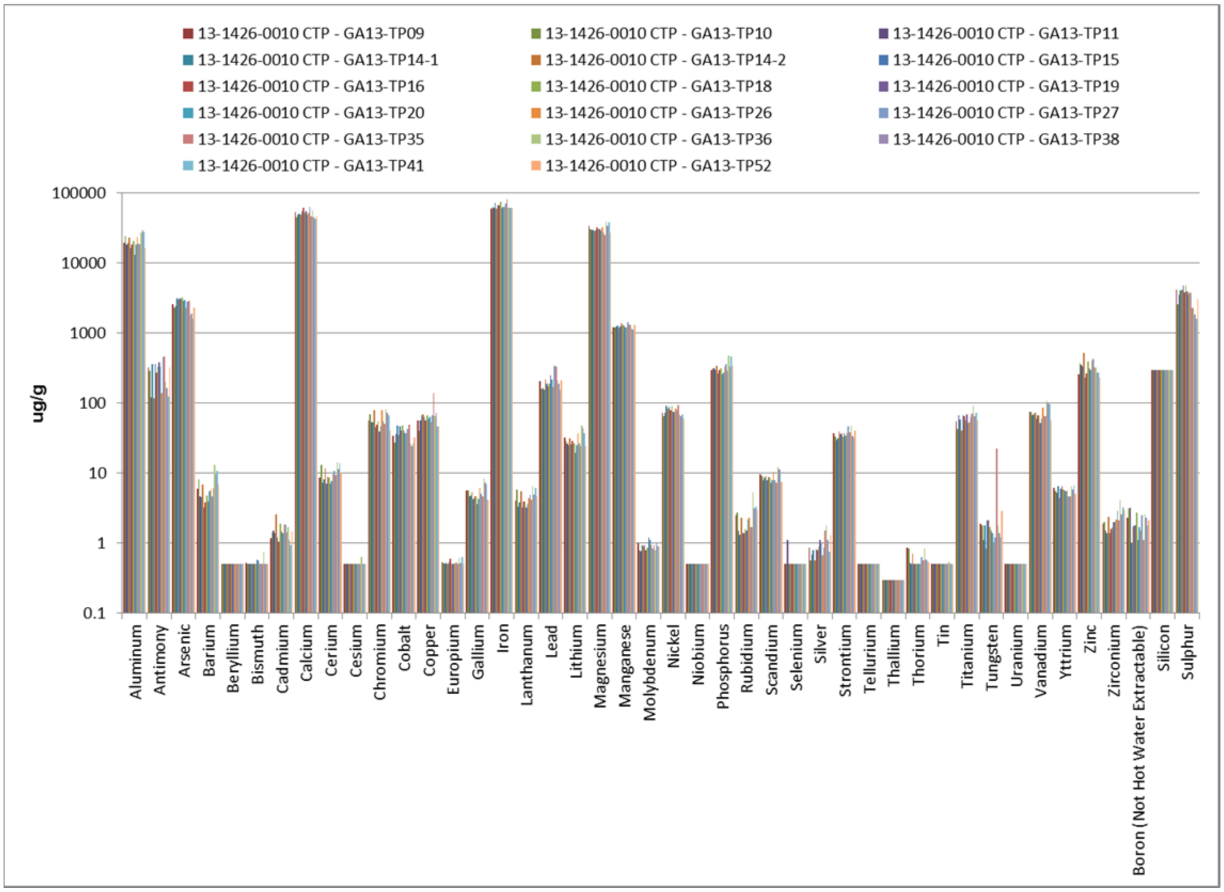

Figure 1: ICP-MS Results

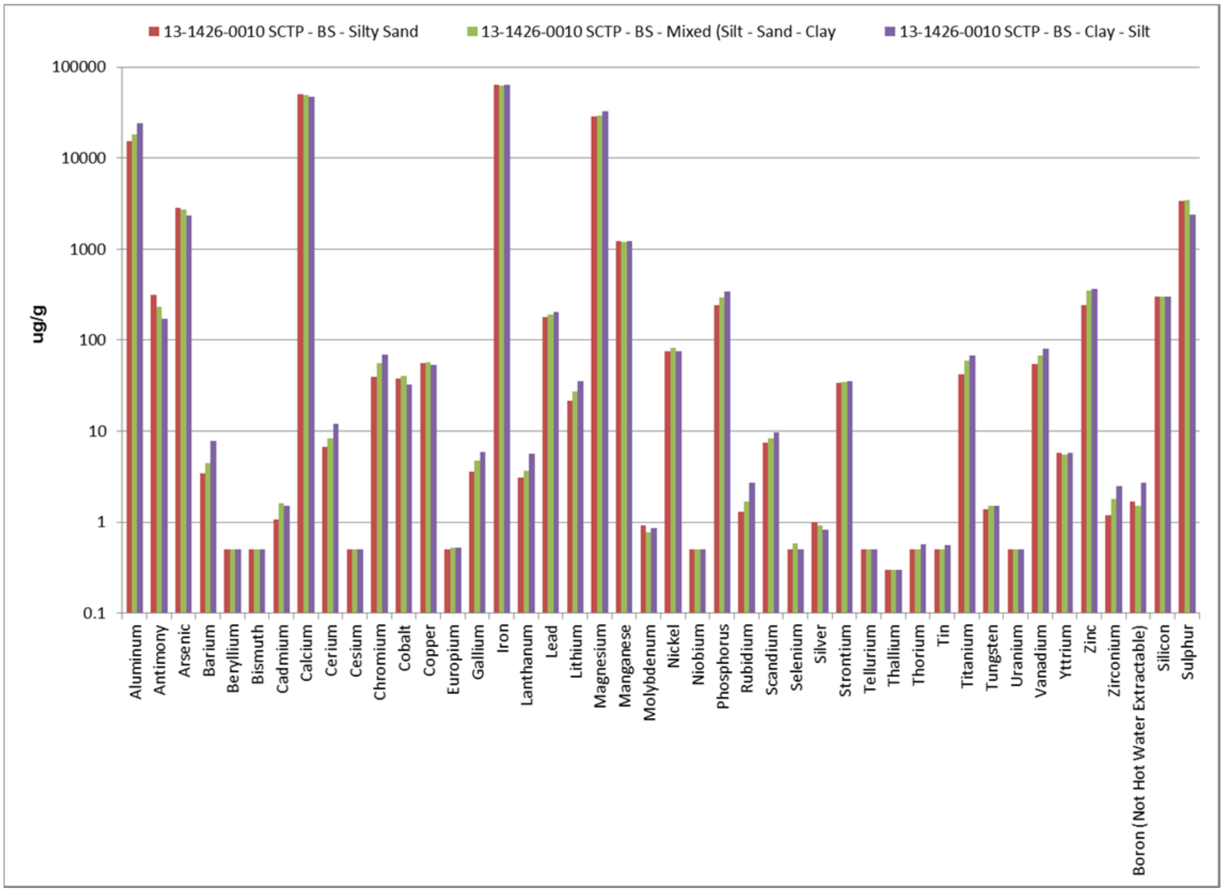

Figure 2: ICP-MS Results - Drums

No hazardous gases were detected in any of the samples. The concentrations of heavy metals and cyanide present in the samples were considered to be acceptable to handle according to Golder's established protocols.

2.3 Sample Preparation

Proper sample preparation technique is a critical first step to ensure proper homogenization of solids, representative sub-sampling and reproducibility of results.

The first step was to mix all of the samples individually with the available 13-1426-0010 Water in order to achieve homogenized samples. Photos are presented in Appendix B.

3.0 MATERIAL CHARACTERIZATION

3.1 pH Analysis

Table 3 presents the pH of each sample and the temperature at which it was measured.

Table 3: pH Analysis

Sample	pH	Temperature (°Celsius)
13-1426-0010 CTP - GA13-TP09	8.5	18
13-1426-0010 CTP - GA13-TP10	8.7	
13-1426-0010 CTP - GA13-TP11	9.1	
13-1426-0010 CTP - GA13-TP14-1	8.7	
13-1426-0010 CTP - GA13-TP14-2	8.7	
13-1426-0010 CTP - GA13-TP15	8.6	
13-1426-0010 CTP - GA13-TP16	8.7	
13-1426-0010 CTP - GA13-TP18	8.6	
13-1426-0010 CTP - GA13-TP19	8.7	
13-1426-0010 CTP - GA13-TP20	8.4	
13-1426-0010 CTP - GA13-TP26	8.5	
13-1426-0010 STP - GA13-TP27	8.5	
13-1426-0010 STP - GA13-TP35	8.6	
13-1426-0010 STP - GA13-TP36	8.8	
13-1426-0010 STP - GA13-TP38	8.8	
13-1426-0010 STP - GA13-TP41	8.9	
13-1426-0010 STP - GA13-TP52	8.9	
13-1426-0010 SCTP - BS - Silty Sand	7.9	19
13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay)	8.0	
13-1426-0010 SCTP - BS - Clay - Silt	8.7	
13-1426-0010 SCTP-BS-Clay-Silt (S2)	8.7	18

3.2 Particle Size Distribution

Particle size distribution (PSD) was determined using mechanical sieving and a Fritsch laser particle size analyzer according to ASTM D4464.

Specific values are presented in Table 4, and on Figures 3 and 4. The gradation parameter DXX, tabulated in microns, refers to the average particle diameter that XX% by weight of material is smaller than.

Table 4: Particle Size Distribution

Sample	D10 (µm)	D30 (µm)	D50 (µm)	D60 (µm)	D80 (µm)
13-1426-0010 CTP - GA13-TP09	3	8	18	27	104
13-1426-0010 CTP - GA13-TP10	2	5	10	14	26
13-1426-0010 CTP - GA13-TP11	3	11	26	39	115
13-1426-0010 CTP - GA13-TP14-1	5	23	55	81	127
13-1426-0010 CTP - GA13-TP14-2	2	6	11	15	28
13-1426-0010 CTP - GA13-TP15	8	54	117	128	149
13-1426-0010 CTP - GA13-TP16	5	26	71	107	135
13-1426-0010 CTP - GA13-TP18	4	14	35	52	116
13-1426-0010 CTP - GA13-TP19	4	18	41	61	120
13-1426-0010 CTP - GA13-TP20	3	8	18	26	52
13-1426-0010 CTP - GA13-TP26	2	7	14	20	43
13-1426-0010 STP - GA13-TP27	3	12	28	39	94
13-1426-0010 STP - GA13-TP35	4	16	44	70	125
13-1426-0010 STP - GA13-TP36	2	5	8	11	19
13-1426-0010 STP - GA13-TP38	2	4	7	9	16
13-1426-0010 STP - GA13-TP41	2	4	8	10	18
13-1426-0010 STP - GA13-TP52	3	7	16	22	44
13-1426-0010 SCTP - BS - Silty Sand	2	6	12	17	36
13-1426-0010 SCTP - BS - Mixed (Silt- Sand - Clay)	3	12	29	44	114
13-1426-0010 SCTP - BS - Clay - Silt	5	24	67	103	136
13-1426-0010 SCTP-BS-Clay-Silt (S2)	6	29	87	119	158

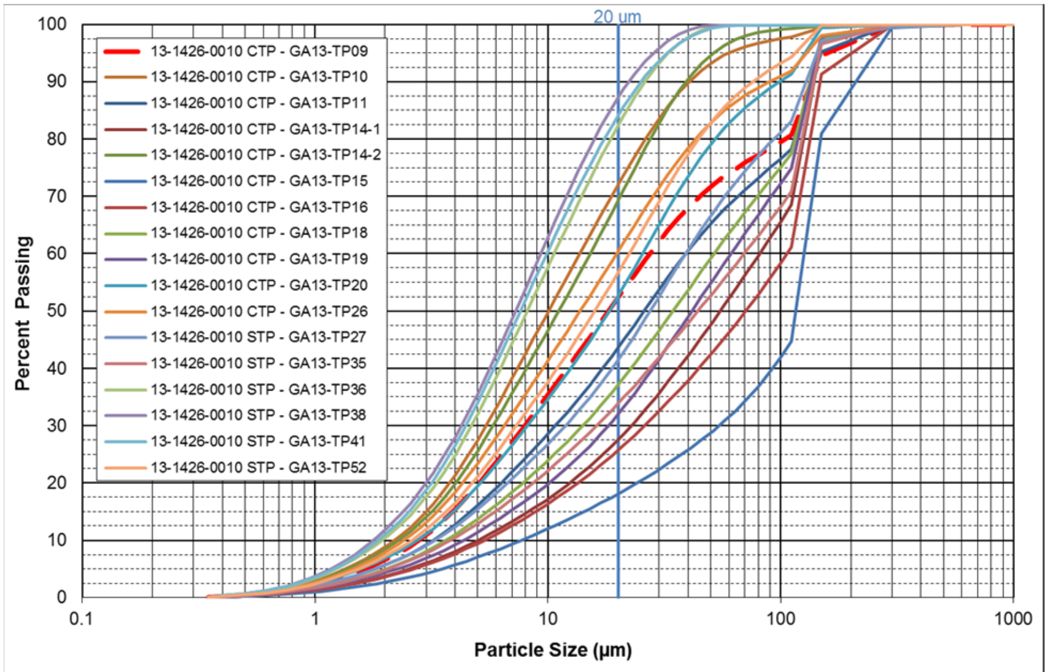

Figure 3: PSD Results

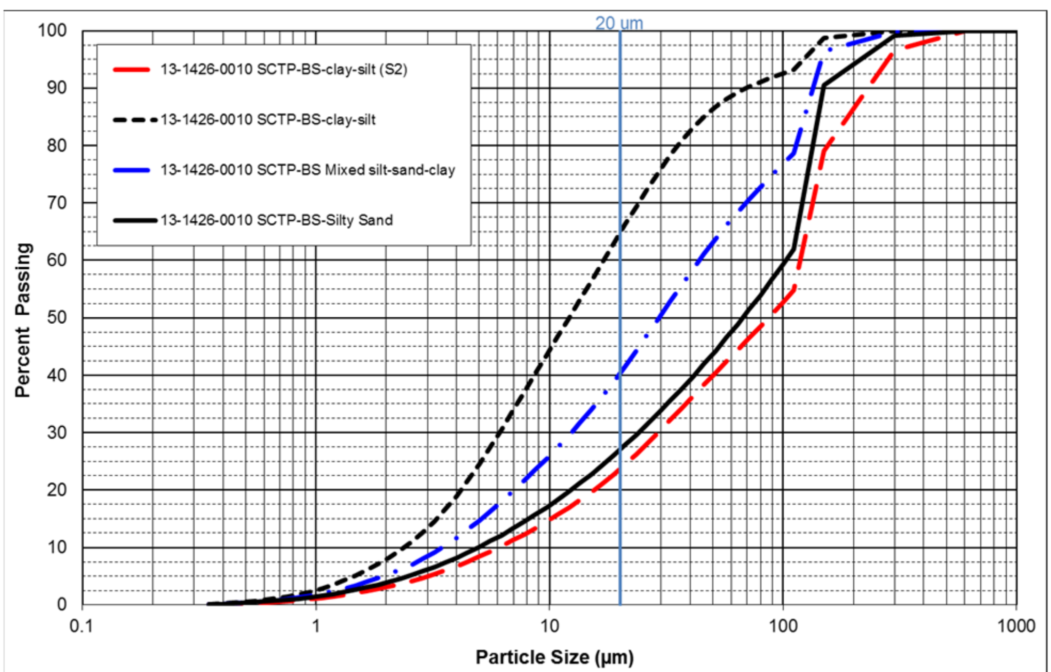

Figure 4: PSD Results

3.3 Specific Gravity

The specific gravity (SG) of the sample was determined using vacuum de-aired water. Each slurry sample was also vacuum de-aired prior to SG measurement. The results are presented in Table 5.

Table 5: Specific Gravity Results

Sample	Trial 1	Trial 2	Average
13-1426-0010 CTP - GA13-TP09	2.78	2.76	2.77
13-1426-0010 CTP - GA13-TP10	2.78	2.77	2.78
13-1426-0010 CTP - GA13-TP11	2.78	2.79	2.78
13-1426-0010 CTP - GA13-TP14-1	2.82	2.83	2.83
13-1426-0010 CTP - GA13-TP14-2	2.80	2.81	2.81
13-1426-0010 CTP - GA13-TP15	2.81	2.84	2.83
13-1426-0010 CTP - GA13-TP16	2.82	2.81	2.82
13-1426-0010 CTP - GA13-TP18	2.80	2.82	2.81
13-1426-0010 CTP - GA13-TP19	2.81	2.82	2.82
13-1426-0010 CTP - GA13-TP20	2.80	2.81	2.80
13-1426-0010 CTP - GA13-TP26	2.78	2.77	2.77
13-1426-0010 STP - GA13-TP27	2.82	2.83	2.83
13-1426-0010 STP - GA13-TP35	2.87	2.89	2.88
13-1426-0010 STP - GA13-TP36	2.75	2.75	2.75
13-1426-0010 STP - GA13-TP38	2.70	2.69	2.69
13-1426-0010 STP - GA13-TP41	2.75	2.77	2.76
13-1426-0010 STP - GA13-TP52	2.82	2.81	2.81
13-1426-0010 SCTP - BS - Silty Sand	2.80	2.83	2.81
13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay)	2.83	2.84	2.84
13-1426-0010 SCTP - BS - Clay - Silt	2.82	2.82	2.82
13-1426-0010 SCTP - BS - Clay - Silt (S2)	2.70	2.71	2.71

The sample 13-1426-0010 SCTP- BS-Clay-Silt (S2) was collected on-site in December and had a similar PSD results to the 13-1426-0010 SCTP-BS-Silty Sand (November) sample. It was intended to collect a sample with a PSD result closer to the 13-1426-0010 SCTP-BS Clay - Silt (November) sample however due to site conditions and the snow covered/frozen tailings the sample turned out to be coarser than anticipated.

4.0 RHEOLOGICAL CHARACTERIZATION

Rheological testing was carried out to evaluate flow and handling properties. These tests provide an indication regarding the material's behaviour in the course of mixing, slump adjustment, pumping, flowing and also while sitting idle. Rheological characterization provides data for the selection of process equipment such as mixers, pumps and pipelines.

The testing was carried out on the finer and coarser tailings samples from the South pond (13-1426-0010 STP-0010-GA13-TP38 and 13-1426-0010 STP-GA13-TP27) and Central pond (13-1426-0010 CTP-GA13-TP15 and 13-1426-0010 CTP-GA13-TP14-2), we also completed rheological testing on the three (3) bulk samples from various location labeled 13-1426-0010 SCTP-BS-Mixed (Silt-Sand-Clay) , 13-1426-0010 SCTP-BS-Silty Sand and 13-1426-0010 SCTP-BS-Clay-Silt.

4.1 Slump vs. Solids Content

To gauge sensitivity to water additions, small increments of water were added to the bulk sample. After each addition, slump and solids content was determined. This generates a relationship between slump and solids content which is typically used to determine the degree of process control required to maintain slump control of the final product. The results are presented on Figure 5.

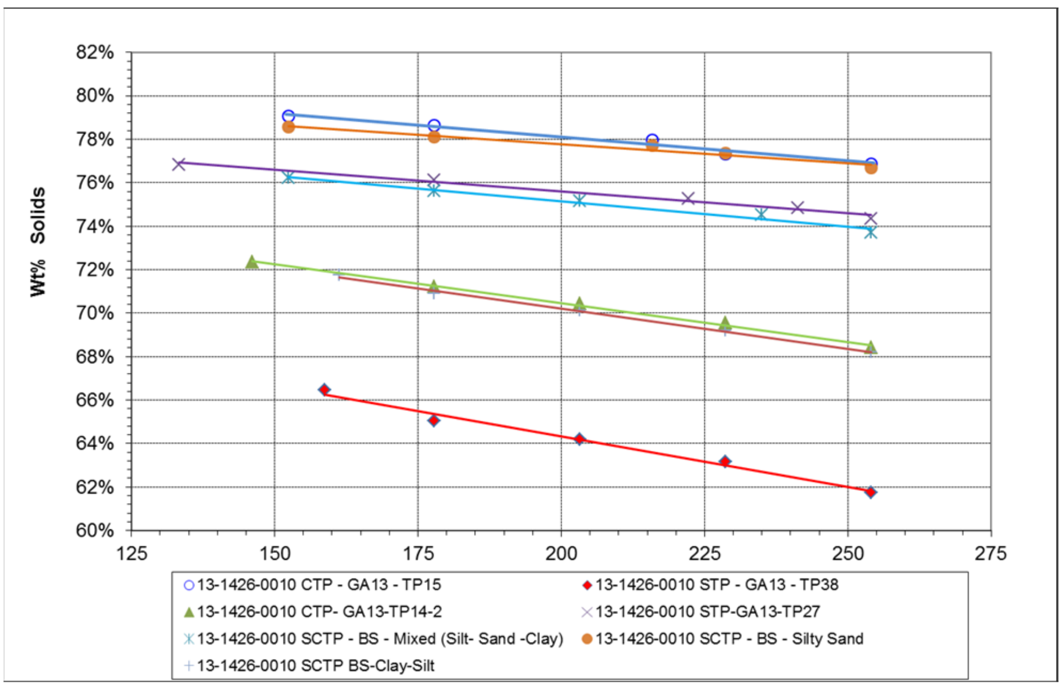

Figure 5: Solids Content vs. Slump

4.2 Static Yield Stress Testing

Yield stress is defined as the minimum force required to initiate flow. Static yield stress was determined by using a very slow moving (0.2 RPM) vane spindle attached to a torque spring. The spindle was immersed in the sample and measurements were taken at various solids contents. There are different test methods to determine yield stress, one termed 'static' and the other 'dynamic'. Figure 6 presents the static yield stress testing results.

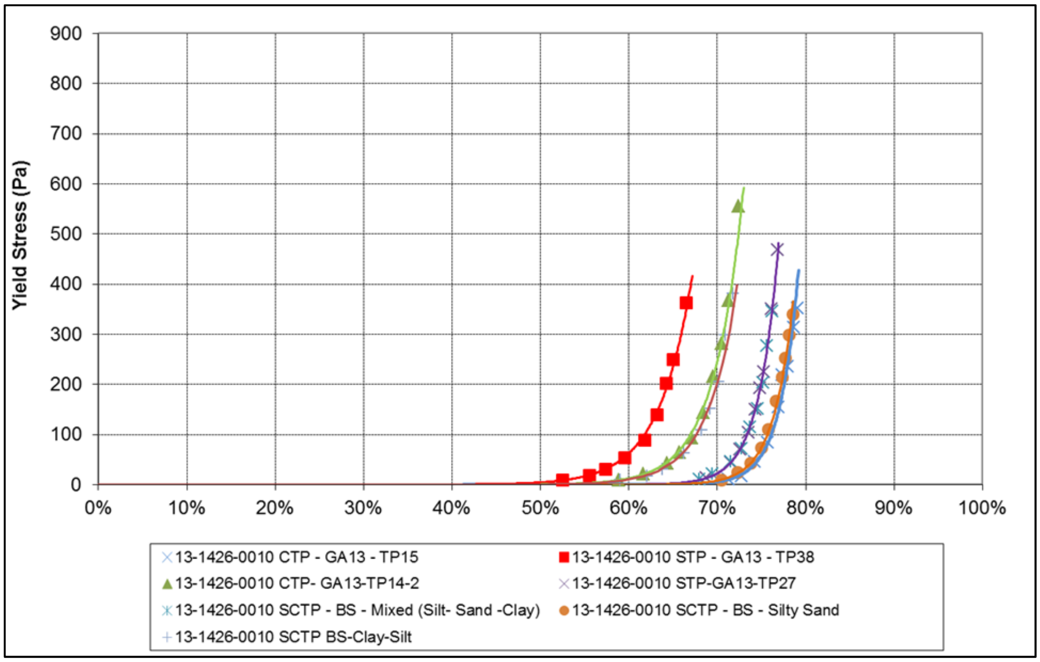

Figure 6: Static Yield Stress vs. wt% Solids

4.3 Water Bleed and Yield Stress vs. Time

Moisture retention testing was carried out to assess the water bleed properties of the paste while sitting idle in test beakers. Two slump consistencies were tested at four time intervals. At each time interval the water bleed and yield stress were measured. Figures 7 to 13 present the results.

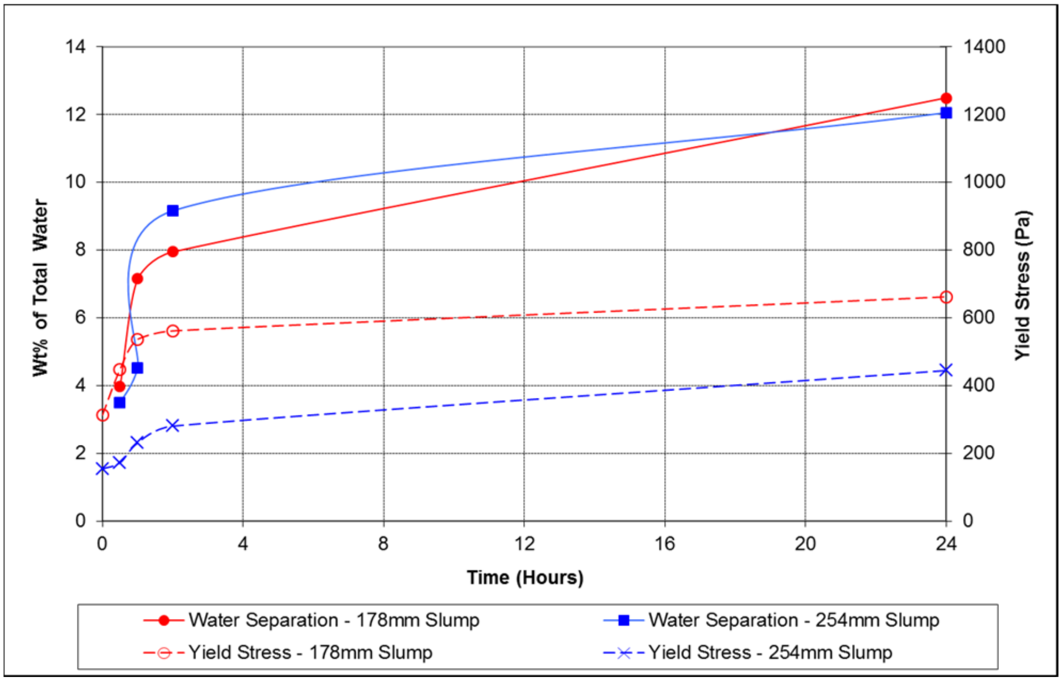

Figure 7: Water Bleed and Yield Stress vs. Time – 13-1426-0010 CTP-GA13-TP15

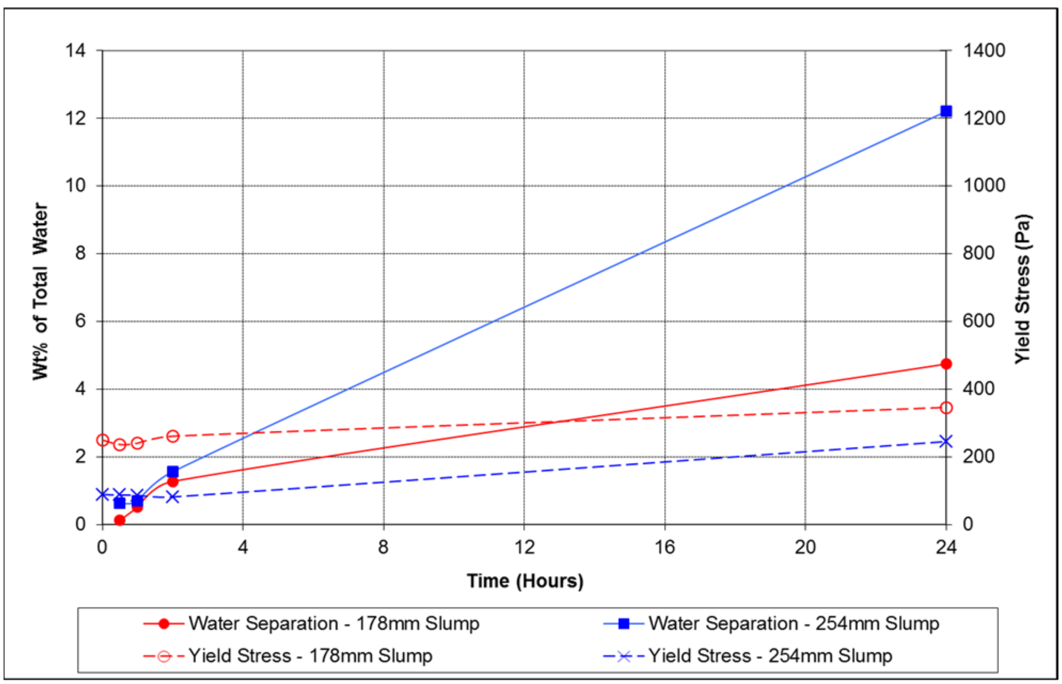

Figure 8: Water Bleed and Yield Stress vs. Time – 13-1426-0010 STP-GA13-TP38

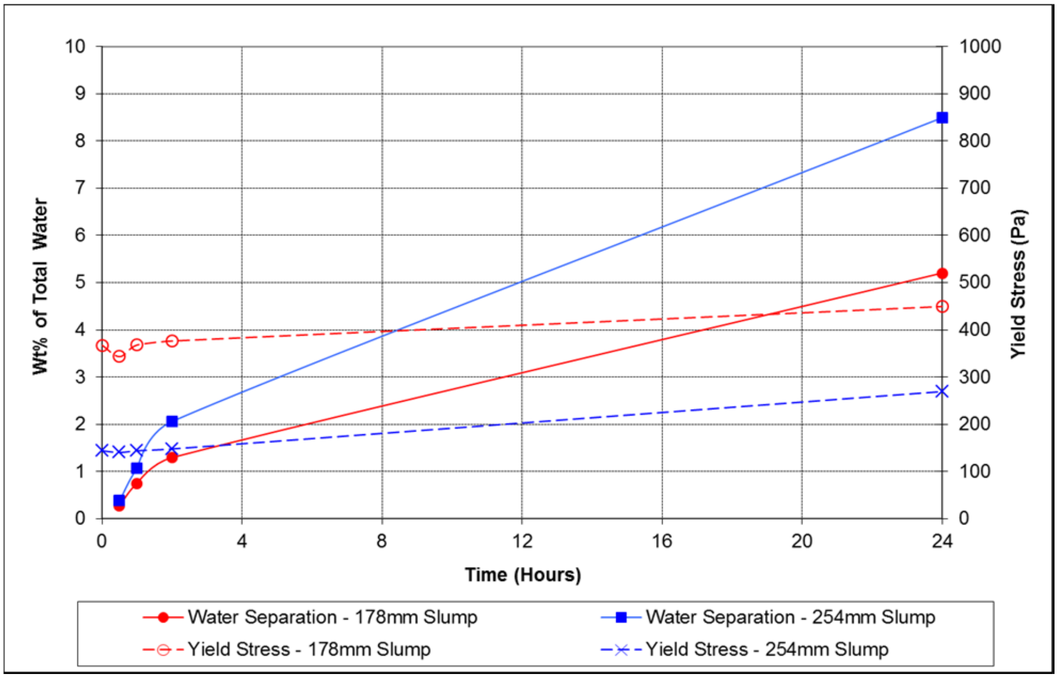

Figure 9: Water Bleed and Yield Stress vs. Time – 13-1426-0010 CTP-GA13-TP14-2

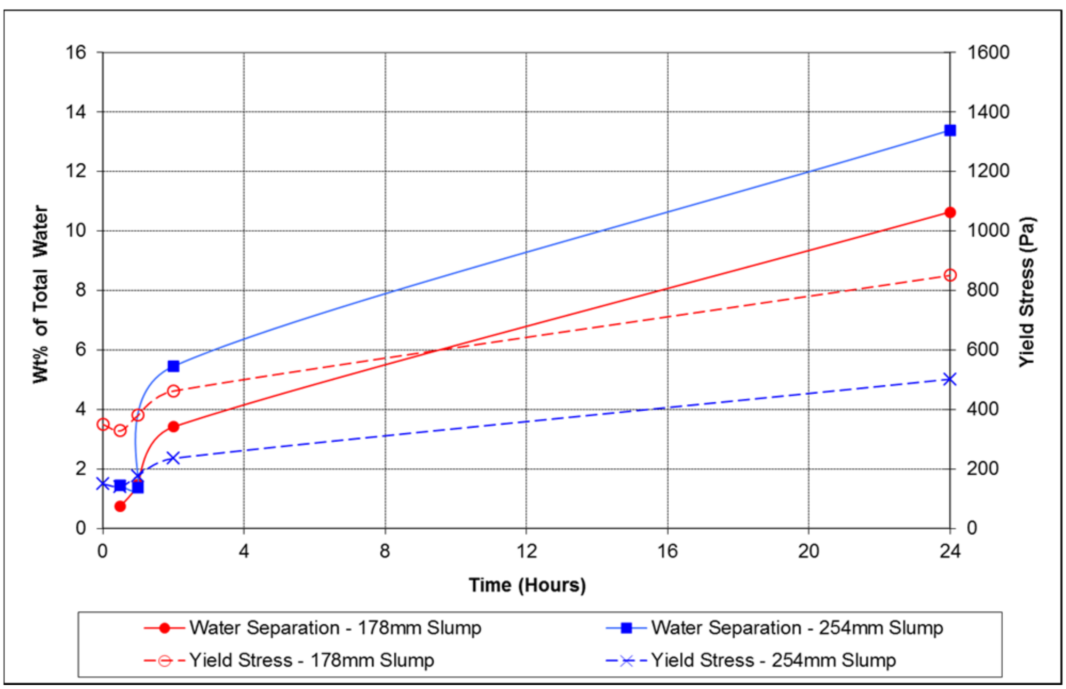

Figure 10: Water Bleed and Yield Stress vs. Time – 13-1426-0010 STP-GA13-TP27

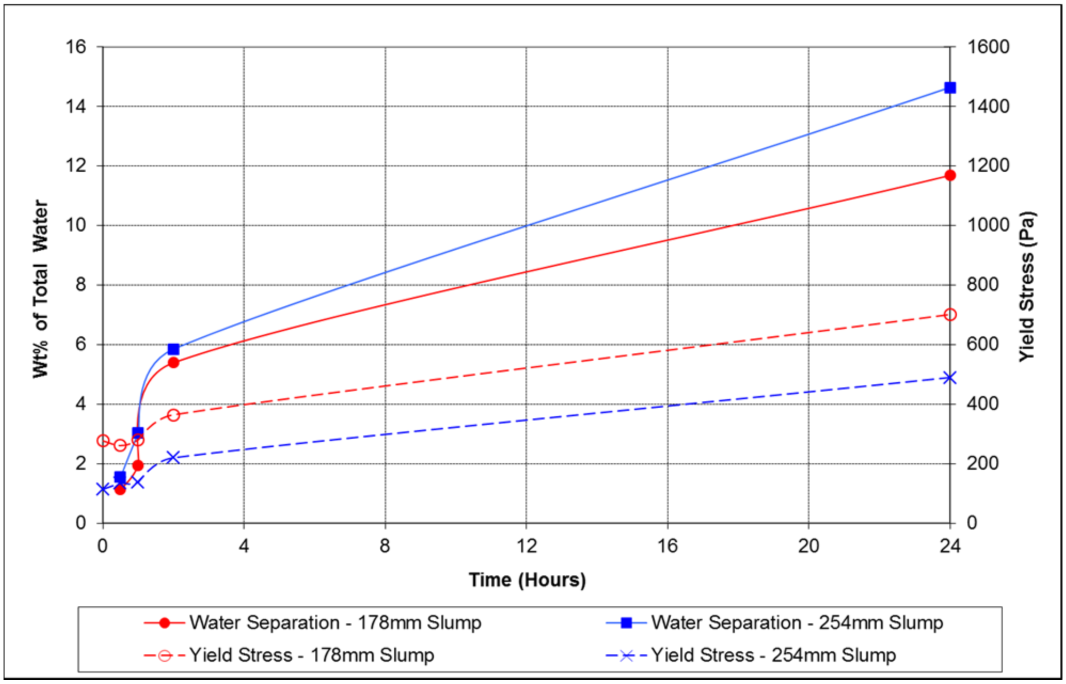

Figure 11: Water Bleed and Yield Stress vs. Time – 13-1426-0010 SCTP - BS - Mixed (Silt - Sand - Clay)

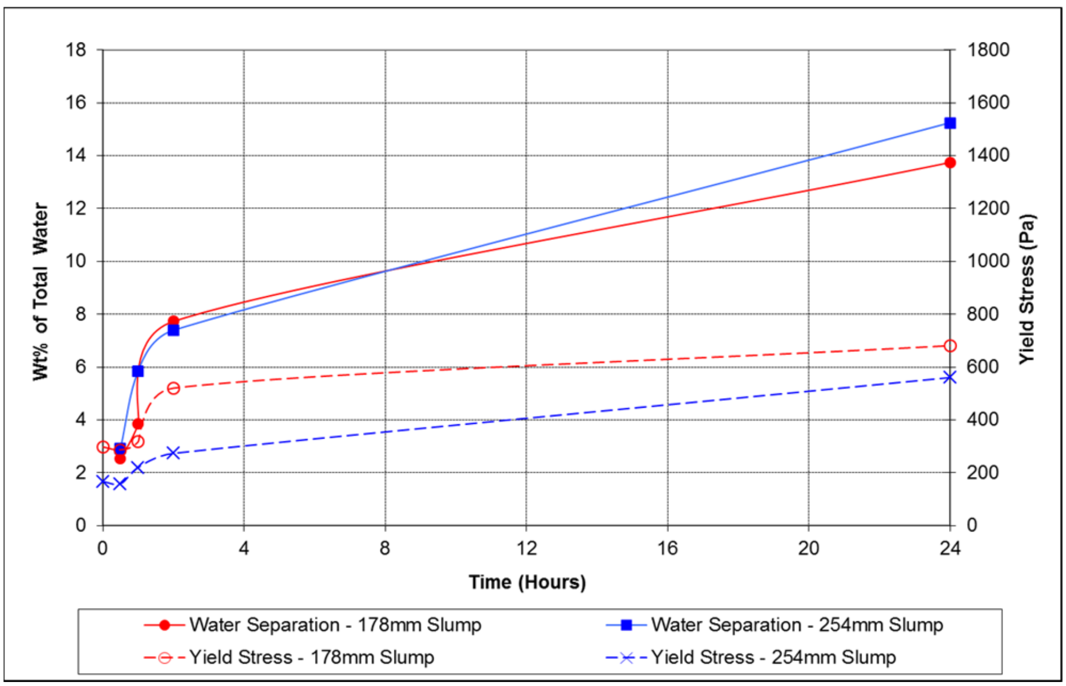

Figure 12: Water Bleed and Yield Stress vs. Time – 13-1426-0010 SCTP - BS - Silty Sand

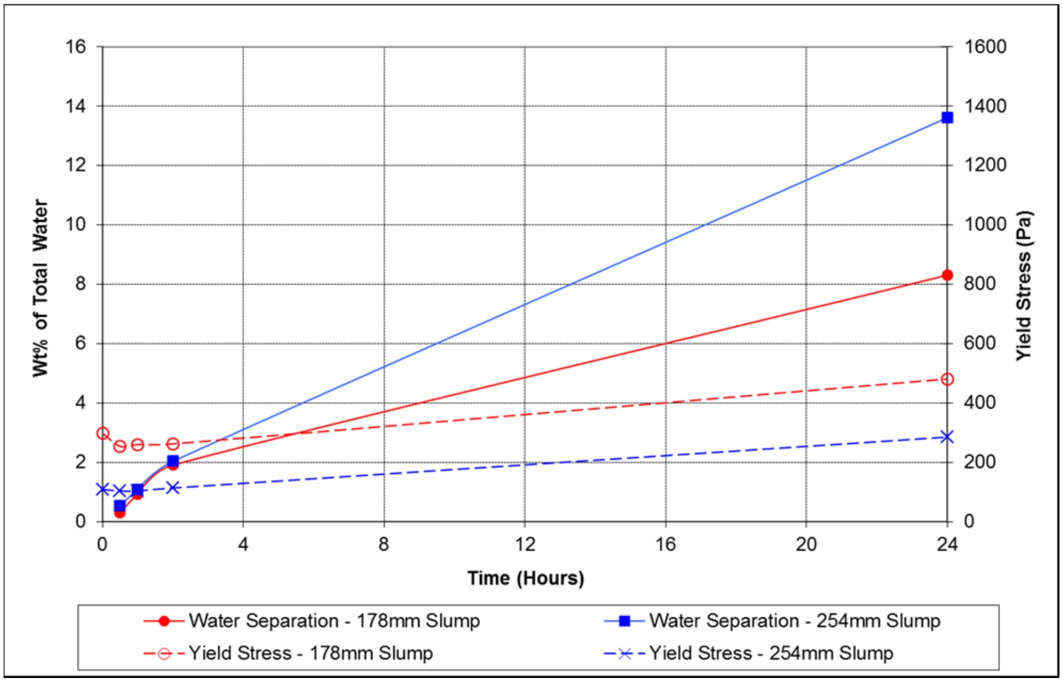

Figure 13: Water Bleed and Yield Stress vs. Time – 13-1426-0010 SCTP - BS - Clay – Silt

4.4 Plug Yield Stress

Plug yield stress analysis was performed to determine if consolidation has occurred throughout a cross-section of idle paste material, as may be present in a pipeline's cross-section. Two slump consistencies of material were allowed to sit idle for two hours, and a specially designed vane spindle was immersed at three depths to measure yield stress. Figures 14 to 20 present the results.

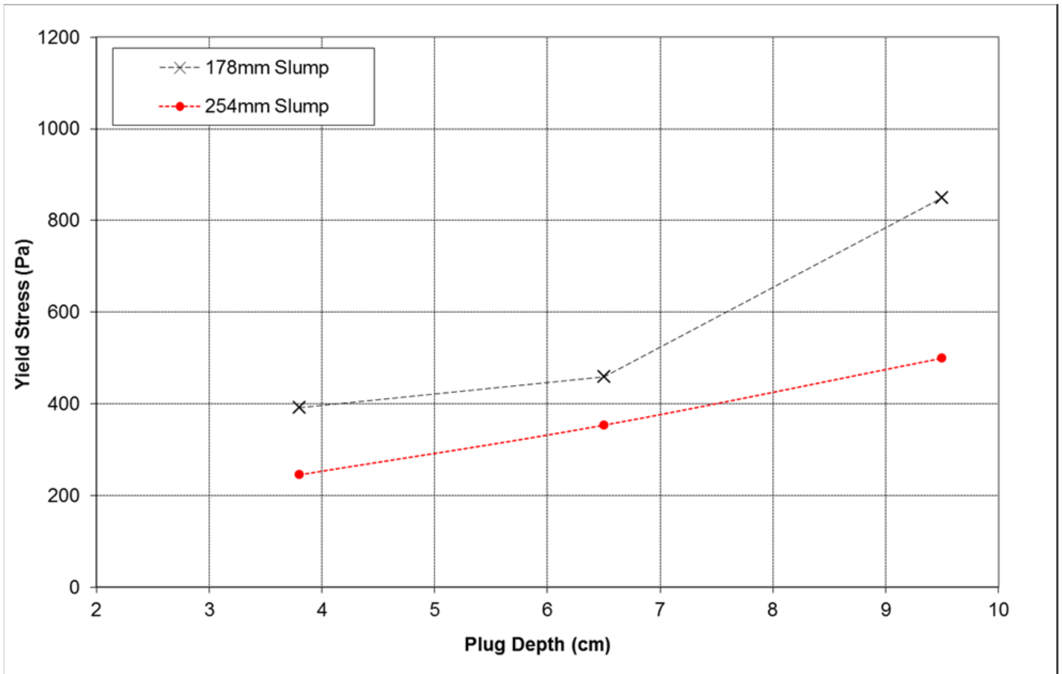

Figure 14: Plug Yield Stress Results -13-1426-0010 CTP-GA13-TP15

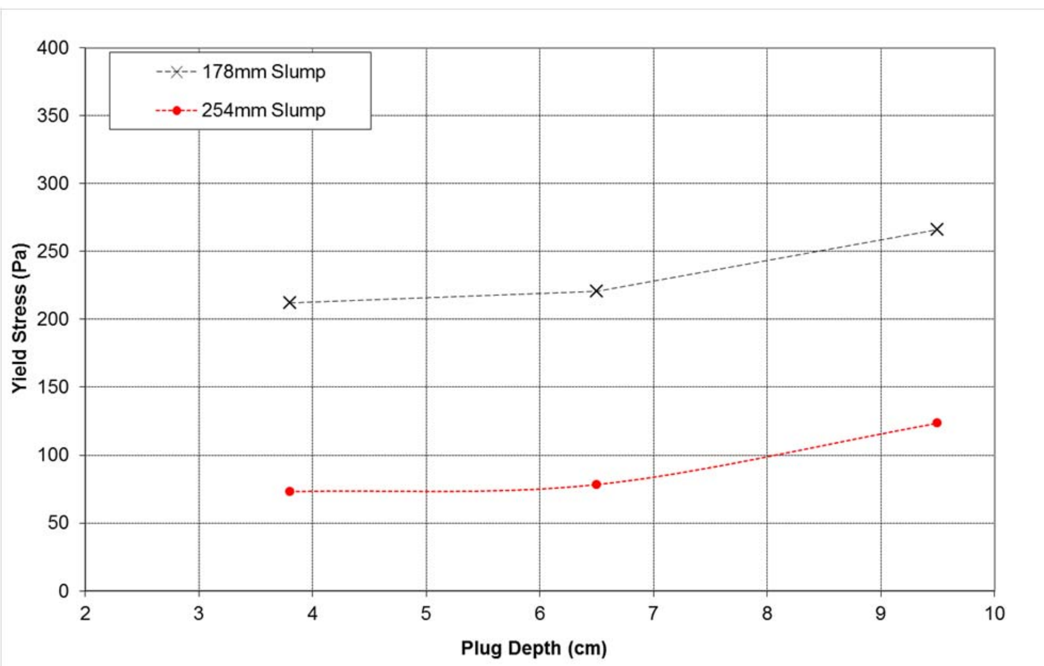

Figure 15: Plug Yield Stress Results -13-1426-0010 STP-GA13-TP38

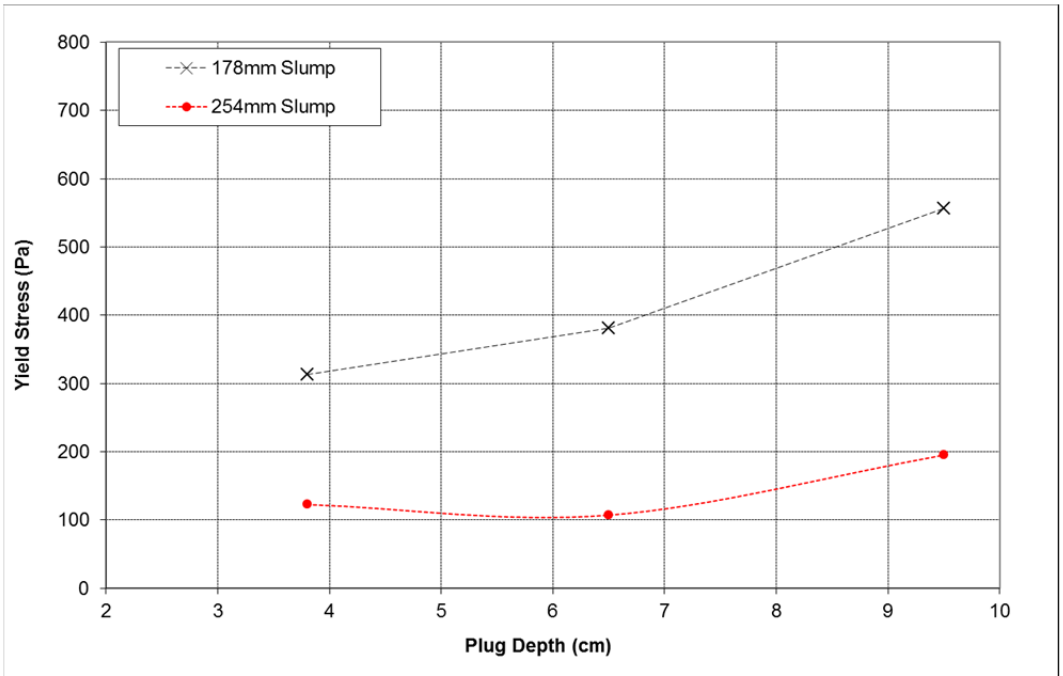

Figure 16: Plug Yield Stress Results -13-1426-0010 CTP-GA13-TP14-2

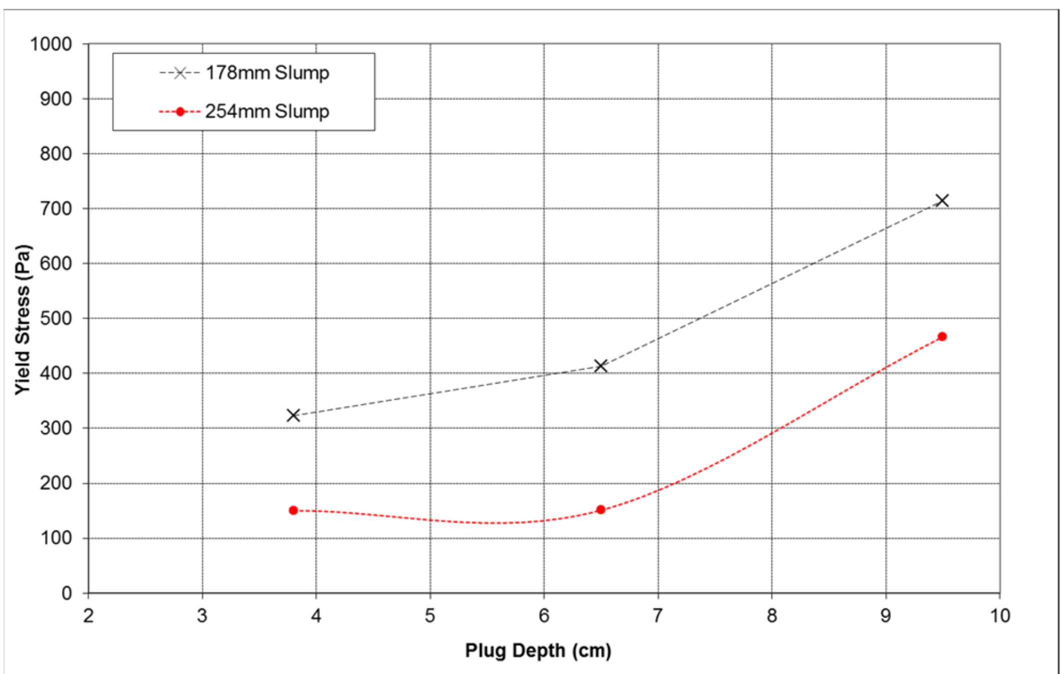

Figure 17: Plug Yield Stress Results -13-1426-0010 STP-GA13-TP27

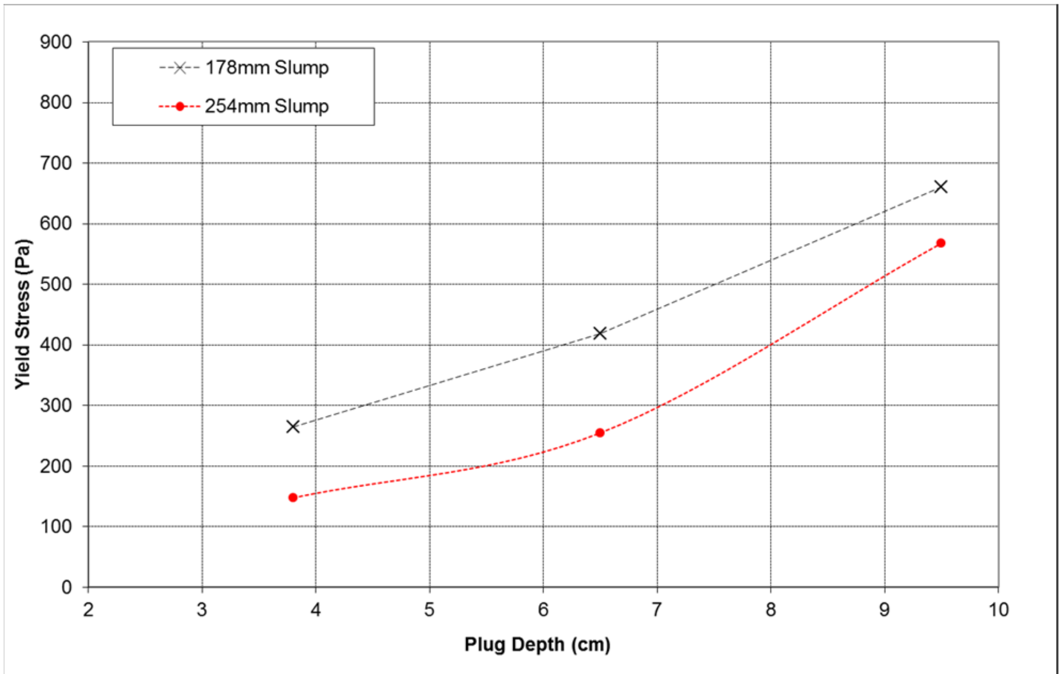

Figure 18: Plug Yield Stress Results -13-1426-0010 - BS - Mixed (Silt - Sand - Clay)

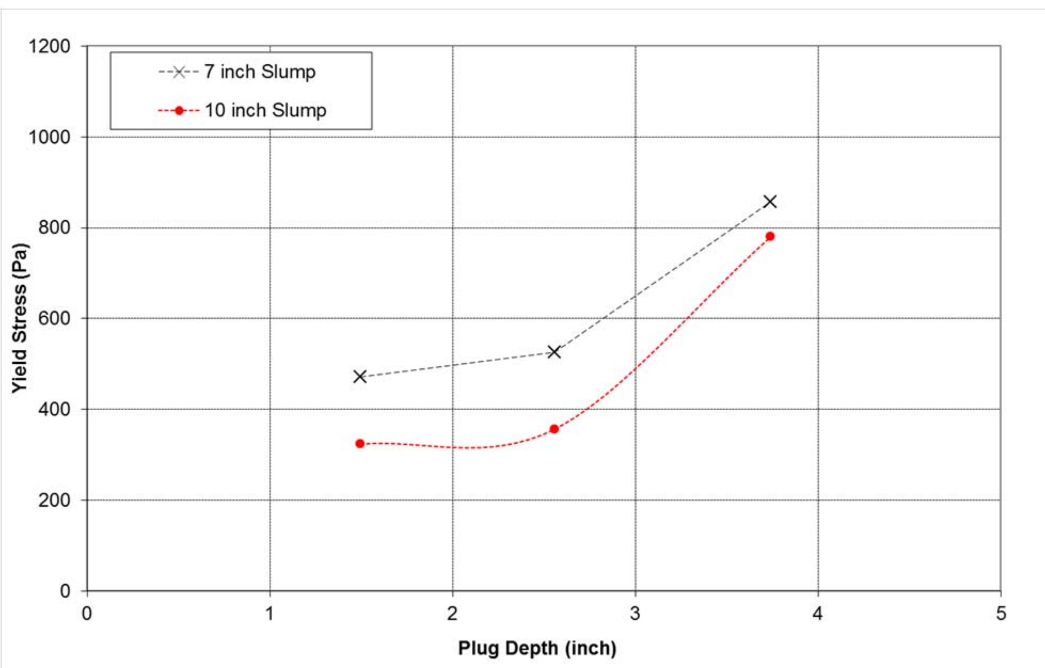

Figure 19: Plug Yield Stress Results -13-1426-0010 - BS - Silty Sand

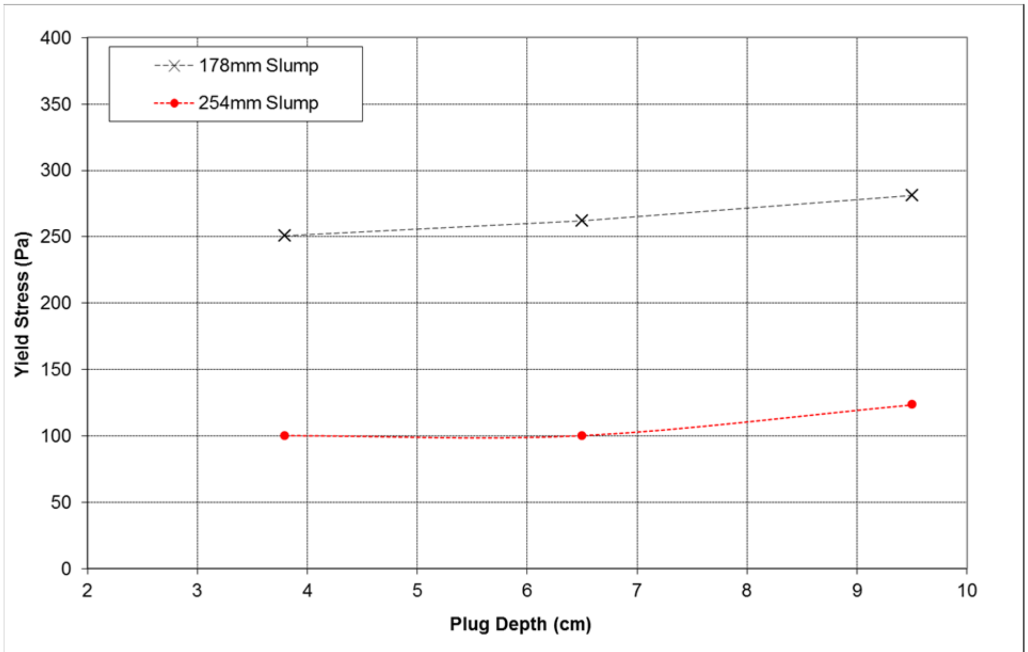

Figure 20: Plug Yield Stress Results -13-1426-0010 - BS - Clay – Silt

4.5 Viscosity and Dynamic Yield Stress Determination

Viscosity testing provides bench scale flow properties and fluid characterization. Dynamic viscosity and yield stress data is essential for mixer, pump and pipeline design. In order to compare or duplicate viscosity results of non-Newtonian fluids, it is important to test according to the same conditions. Test conditions and parameters such as cycle time and instrument sensor configuration are critical to producing usable data from bench scale viscometers.

The yield stress determined through this testing is referred to as dynamic yield stress since it is extrapolated from dynamic shear stress data to zero shear. The instrument sensor or bob rotated inside the cup which contained the sample and torque measurements were recorded at several incremental speeds or shear rates.

The rheograms are presented in Appendix C and summarized test results are presented in Tables 6 to 12 as well as on Figures 21 to 34.

Table 6: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 STP-GA13-TP38

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
66.4	785	673	1.644	1.816
65.2	488	453	1.00	1.066
63.9	337	307	0.528	0.610
61.6	179	167	0.233	0.280
59.1	90	85	0.094	0.113
56.5	47	47	0.050	0.053
52.7	20	20	0.024	0.023

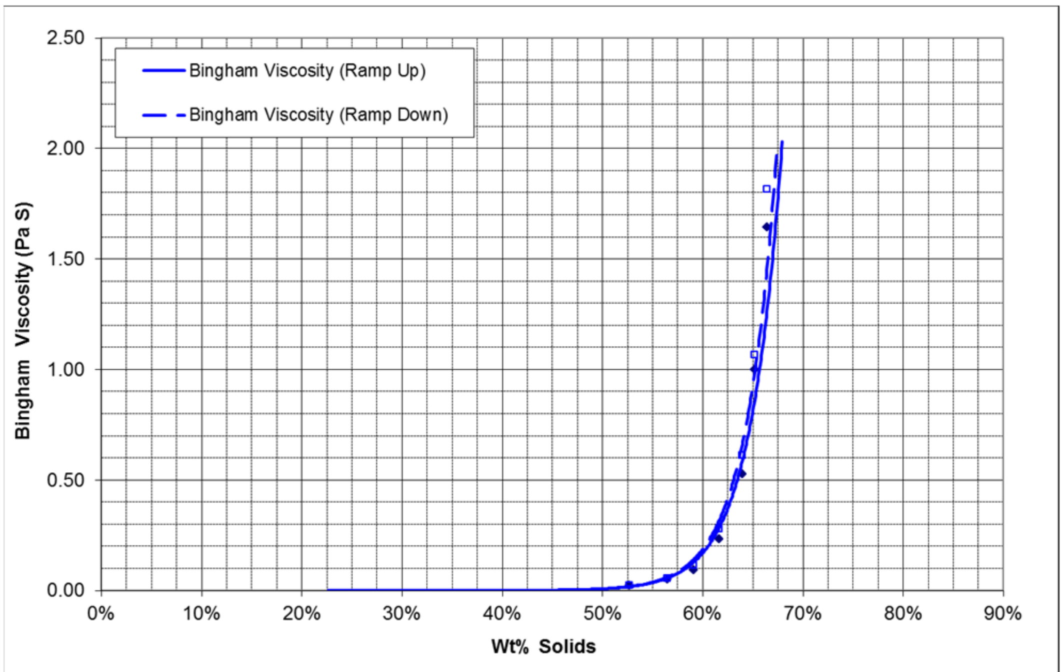

Figure 21: Bingham Viscosity Results – 13-1426-0010 STP – GA13 – TP38

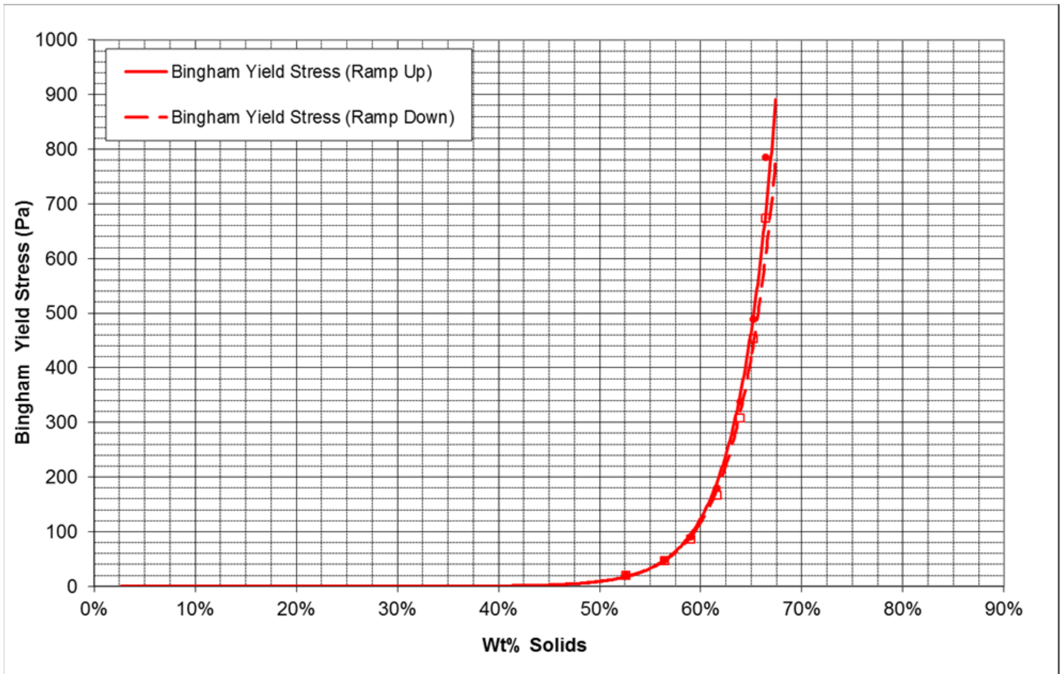

Figure 22: Bingham Yield Stress Results 13-1426-0010 - SPT-GA13-TP38

Table 7: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 CTP-GA13-TP15

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
77.9	58	56	0.488	0.487
76.9	49	39	0.366	0.382
74.4	43	24	0.266	0.306
72.1	19	11	0.111	0.119
68.4	6	3	0.033	0.037

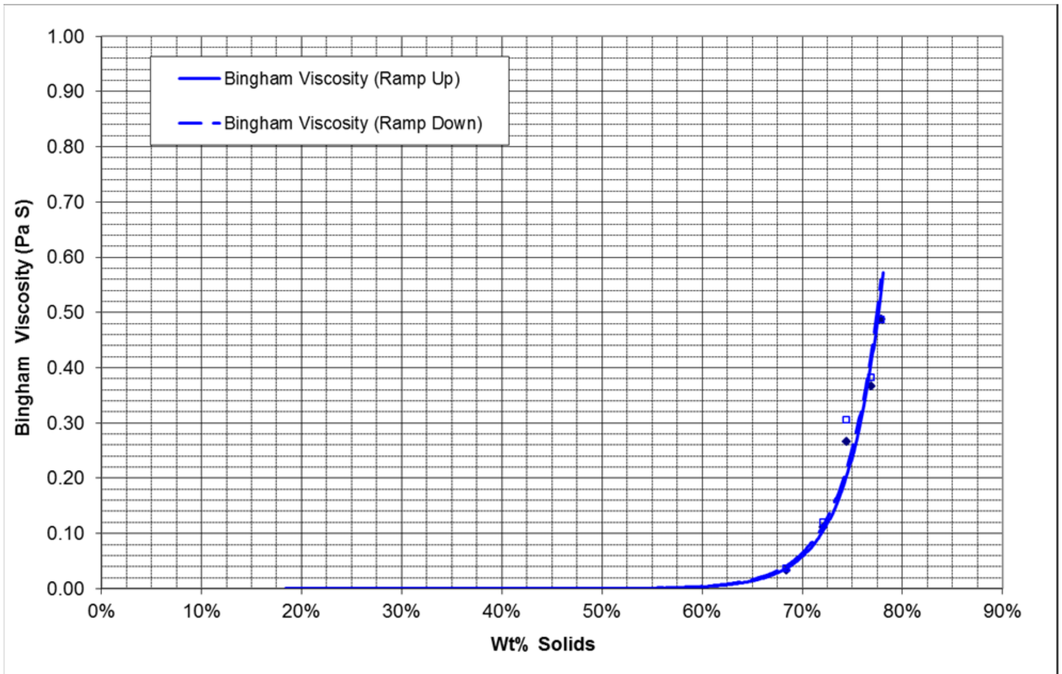

Figure 23: Bingham Viscosity Results – 13-1426-0010 CTP – GA13 – TP15

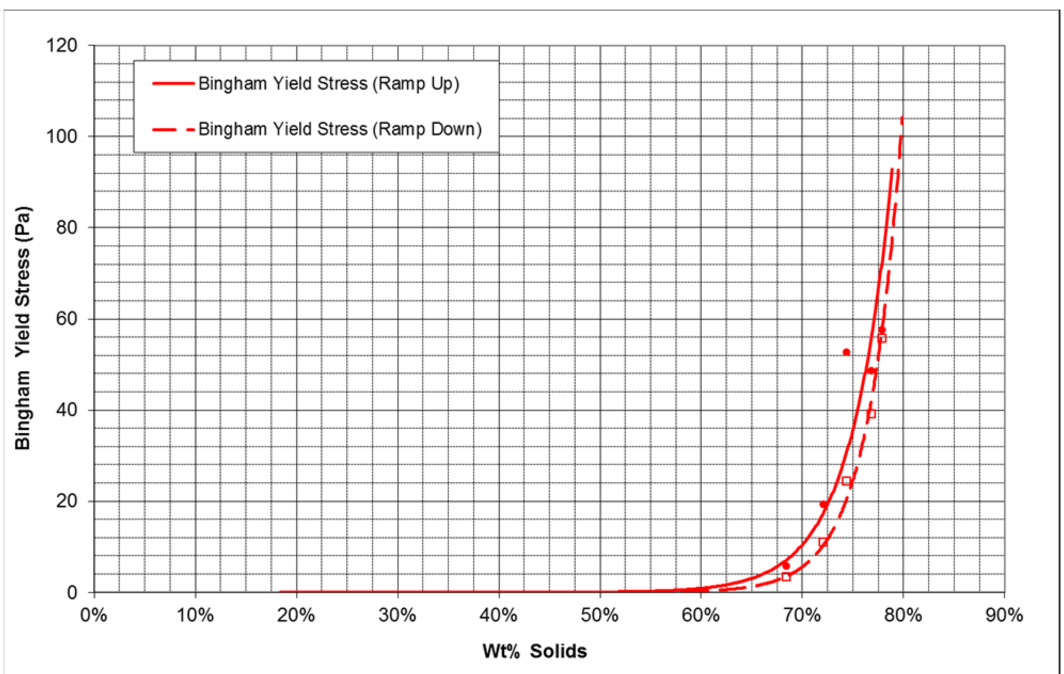

Figure 24: Bingham Yield Stress Results 13-1426-0010 - CPT-GA13-TP15

Table 8: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 CTP-GA13-TP14-2

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
71.5	600	529	1.448	1.617
70.4	417	396	1.041	1.090
69.2	296	288	0.666	0.698
68.1	204	204	0.415	0.433
66.3	124	124	0.198	0.205
63.1	55	54	0.066	0.069
59.9	23	23	0.030	0.031

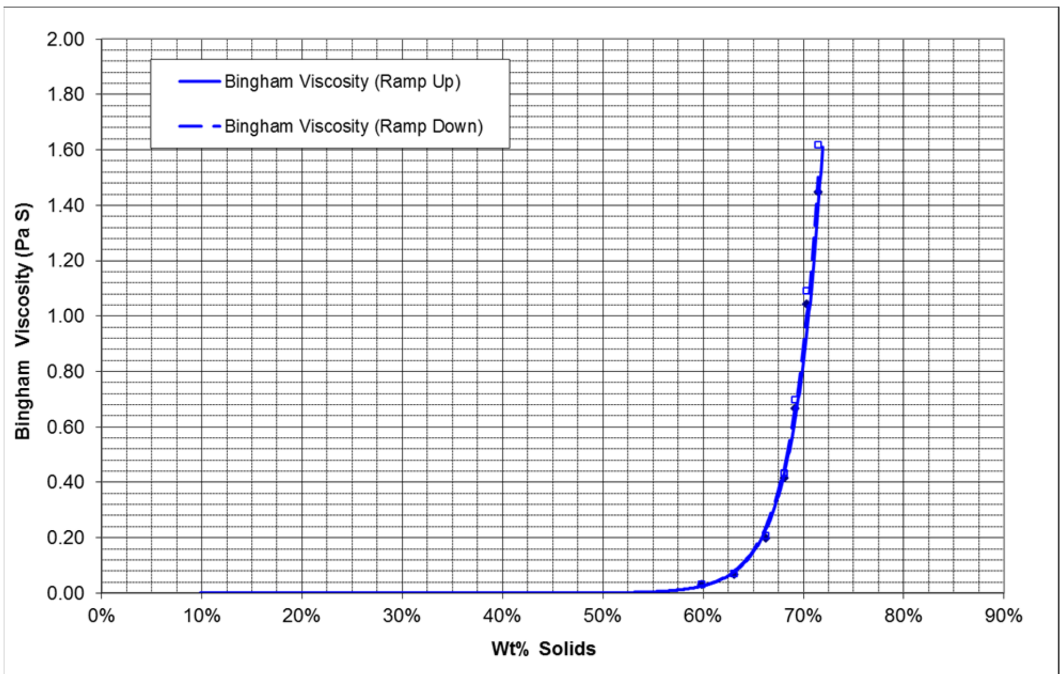

Figure 25: Bingham Viscosity Results – 13-1426-0010 CTP – GA13 – TP14-2

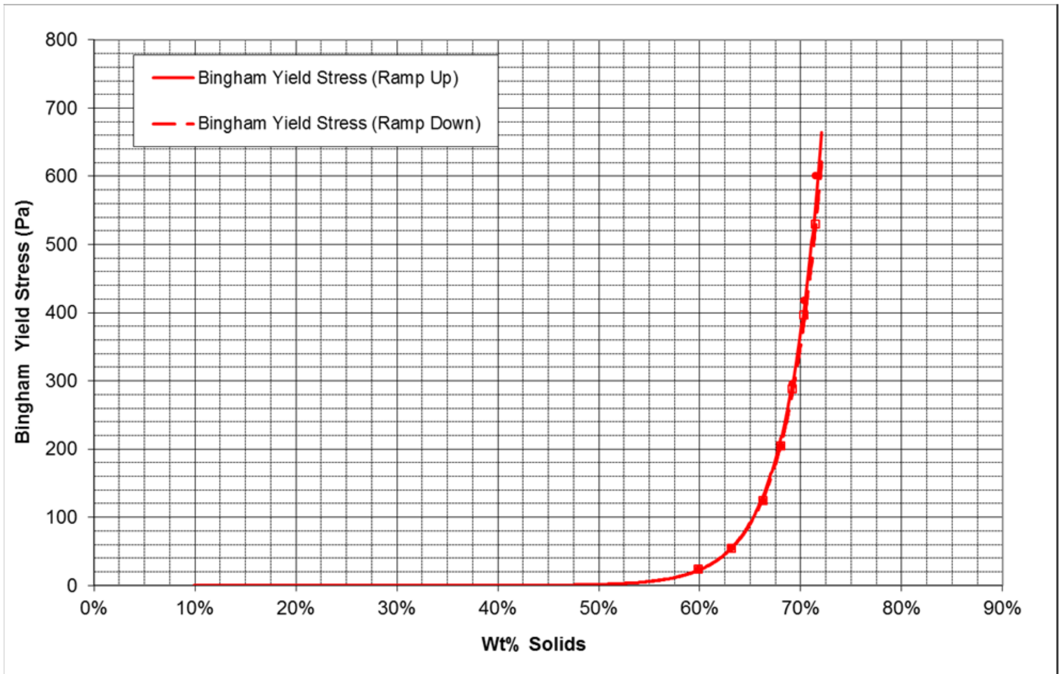

Figure 26: Bingham Yield Stress Results 13-1426-0010 - CPT-GA13-TP14-2

Table 9: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 STP-GA13-TP27

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
76.1	326	249	1.318	1.416
74.7	177	157	0.759	0.774
72.9	101	91	0.315	0.328
71.0	53	50	0.130	0.135
66.1	14	13	0.032	0.034

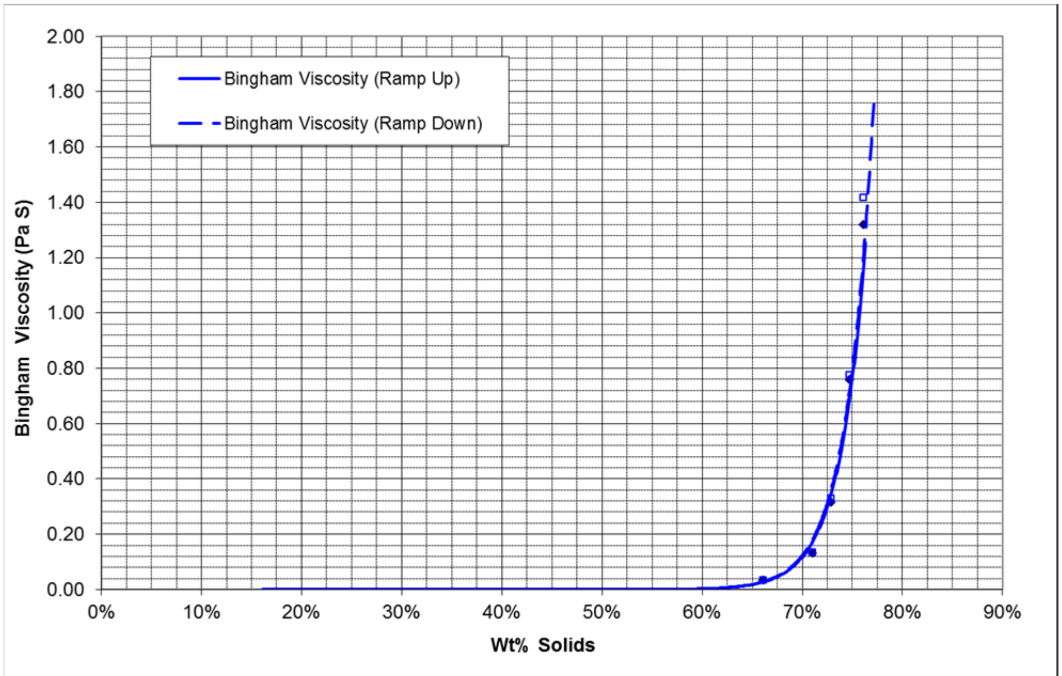

Figure 27: Bingham Viscosity Results – 13-1426-0010 STP – GA13 – TP27

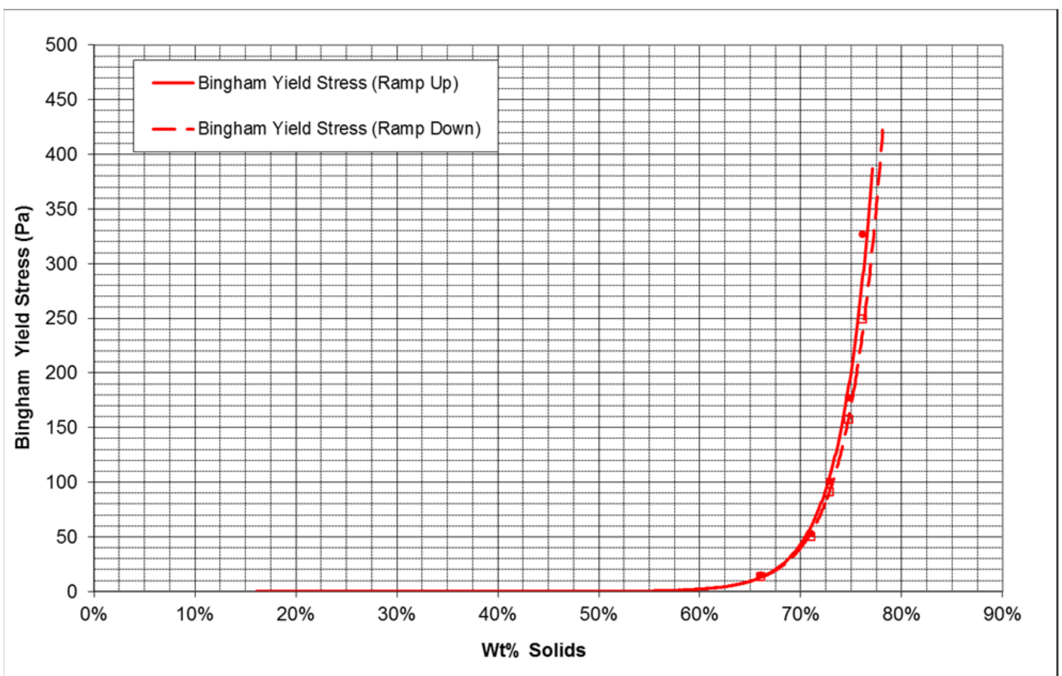

Figure 28: Bingham Yield Stress Results 13-1426-0010 - SPT-GA13-TP27

Table 10: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 SCTP-BS-Mixed (Silt-Sand-Clay)

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
74.4	150	131	0.647	0.668
73.9	119	107	0.483	0.487
72.4	71	67	0.231	0.235
70.9	47	44	0.131	0.134
68.8	25	24	0.064	0.067
65.5	9	9	0.029	0.030

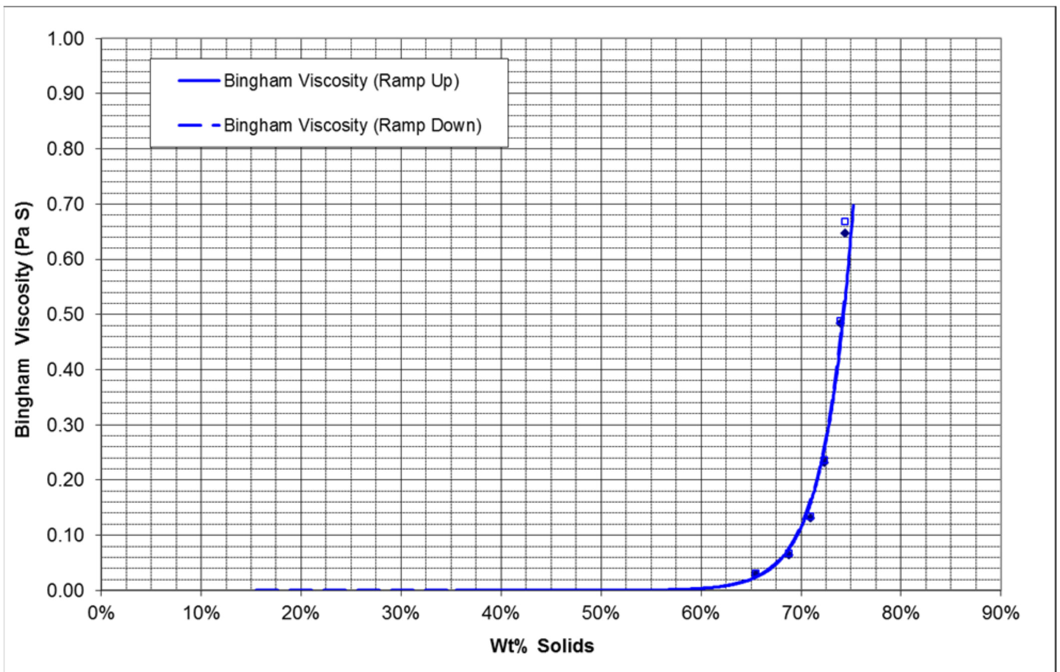

Figure 29: Bingham Viscosity Results –13-1426-0010 SCTP-BS-Mixed (Silt-Sand-Clay)

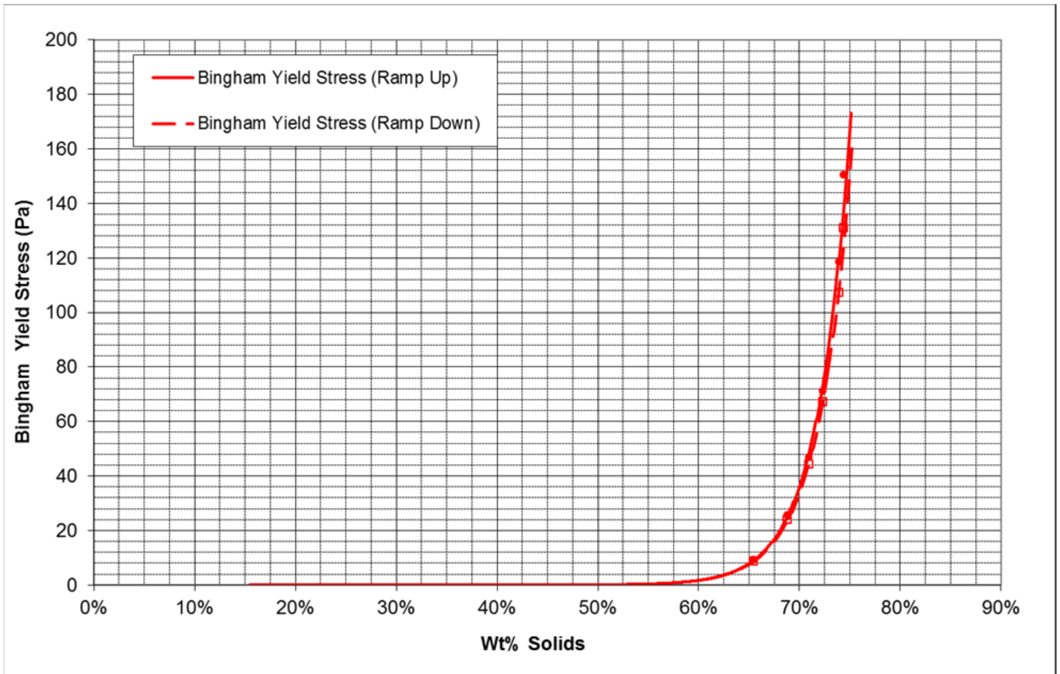

Figure 30: Bingham Yield Stress Results –13-1426-0010 SCTP-BS-Mixed (Silt-Sand-Clay)

Table 11: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 SCTP – BS – Silty Sand

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
76.8	156	86	0.740	0.859
76.4	112	68	0.561	0.628
74.6	55	38	0.272	0.293
73.0	33	22	0.135	0.149
71.3	18	13	0.072	0.080
69.5	10	8	0.045	0.049

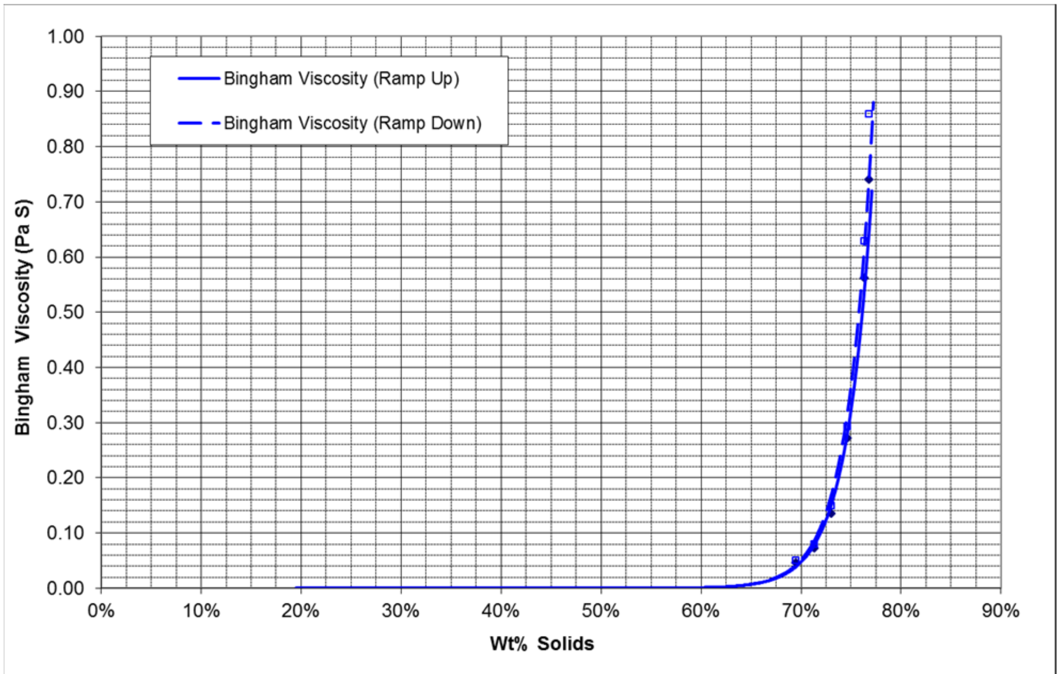

Figure 31: Bingham Viscosity Results –13-1426-0010 SCTP – BS - Silty Sand

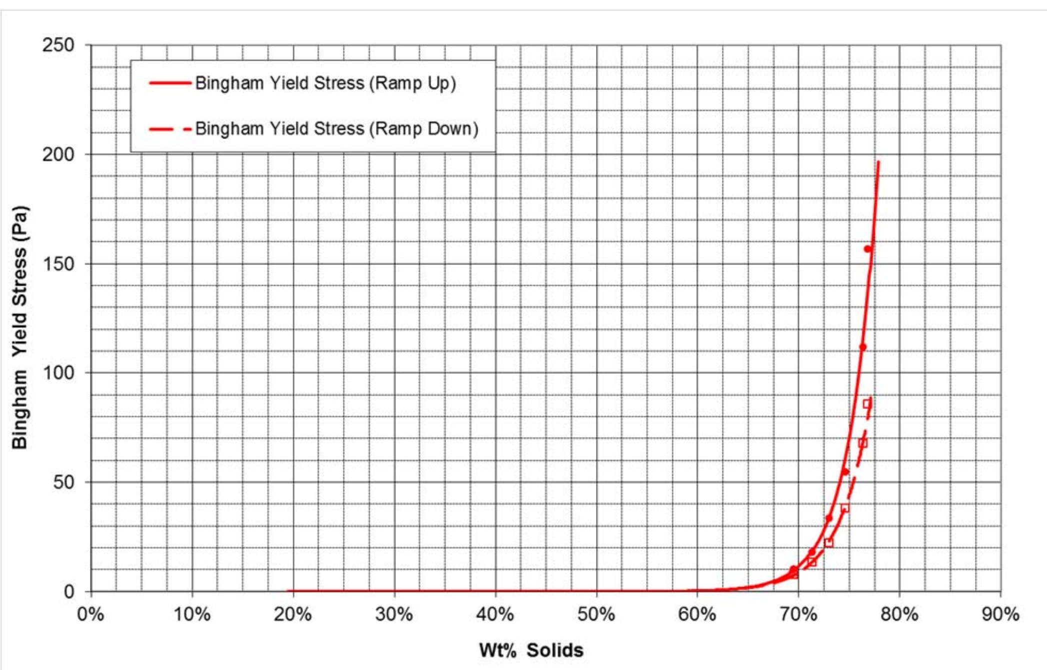

Figure 32: Bingham Yield Stress Results –13-1426-0010 SCTP-BS - Silty Sand

Table 12: Bingham Viscosity and Yield Stress Summary – 13-1426-0010 SCTP – BS – Clay - Silt

Wt% Solids	Bingham Yield Stress (Pa)		Bingham Viscosity (PaS)	
	Ramp Up	Ramp Down	Ramp Up	Ramp Down
71.1	449	388	1.221	1.389
69.8	273	264	0.681	0.714
68.1	179	180	0.380	0.396
65.8	97	94	0.151	0.158
62.5	43	42	0.053	0.055
60.1	25	24	0.033	0.033

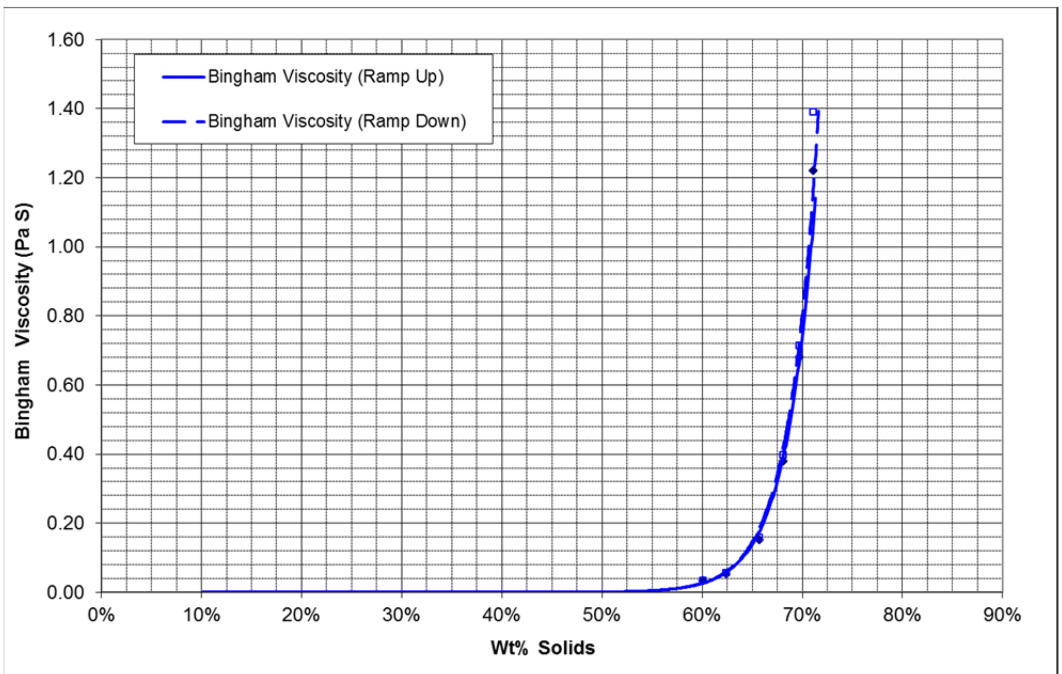

Figure 33: Bingham Viscosity Results –13-1426-0010 SCTP – BS – Clay - Silt

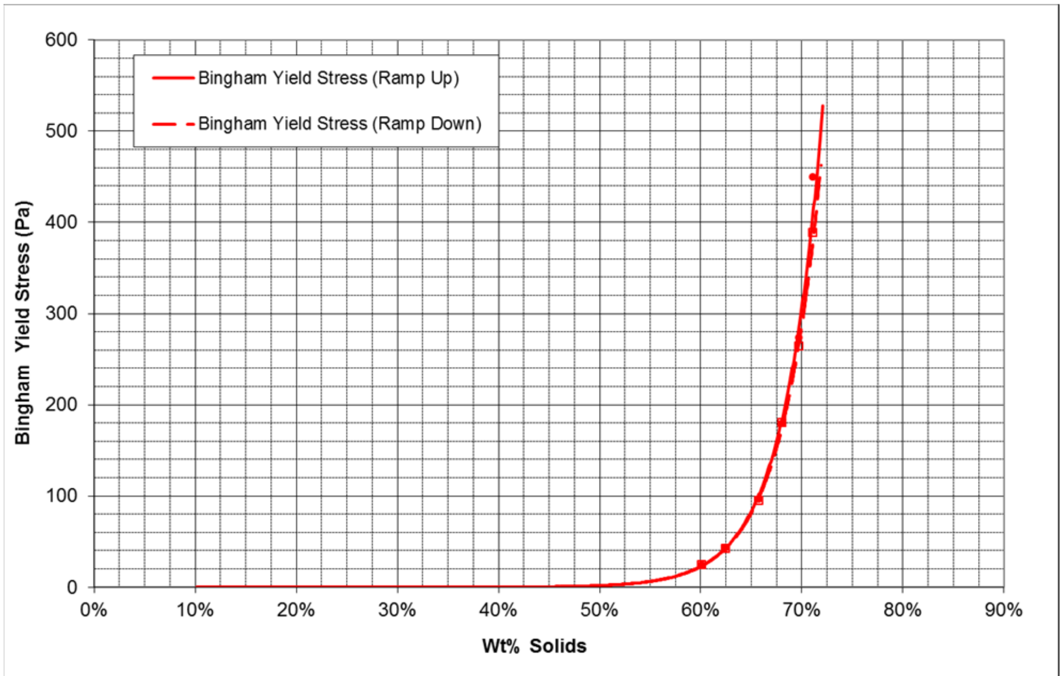

Figure 34: Bingham Yield Stress Results –13-1426-0010 SCTP-BS – Clay - Silt

5.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Mark Labelle
Process Laboratory Manager

ORIGINAL SIGNED

Sue Longo, P.Eng.
Associate / Mechanical Engineer

ML/SL/ds/md

APPENDIX A

ICP-MS Results

TESTMARK Laboratories Ltd.

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Analytical Report

Client:	Mark Labelle	**Work Order Number:**	**199268**
Company:	Golder Associates Ltd - Paste Engineering Lab	**Date Order Received:**	12/2/2013
Address:	1010 Lorne St.	**Regulation:**	Information not provided
	Sudbury, ON, P3A 4S4	**PO #:**	
Phone:	(705) 524-6861	**Project #:**	13-1426-0010
Fax:	(705) 524-9636		
Email:	mlabelle@golder.com		

Analyses were performed on the following samples submitted with your order.

The results relate only to the items tested.

Sample Name	Lab #	Matrix	Type	Comments	Date Collected	Time Collected
13-1426-0010 CTP - GA13-TP09	528822	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP10	528823	Soil	Grab		11/28/2013	13:00
13-1426-0010 CTP - GA13-TP11	528824	Soil	Grab		11/29/2013	13:00
13-1426-0010 CTP - GA13-TP14-1	528825	Soil	Grab		11/30/2013	13:00
13-1426-0010 CTP - GA13-TP14-2	528826	Soil	Grab		12/1/2013	13:00
13-1426-0010 CTP - GA13-TP15	528827	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP16	528828	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP18	528829	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP19	528830	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP20	528831	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP26	528832	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP27	528833	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP35	528834	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP36	528835	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP38	528836	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP41	528837	Soil	Grab		11/27/2013	13:00
13-1426-0010 CTP - GA13-TP52	528838	Soil	Grab		11/27/2013	13:00

The following instrumentation and reference methods were used for your sample(s)

Method Name	Description	Reference
ICPMS Soil	Determination of Metals in Soil by ICP/MS and BCSALM Method **Instrument group:** Perkin Elmer ICPMS	Based on SW846-6020A

This report has been approved by:

Brad Woodward, H.B.Sc.
Inorganic Section Head

TESTMARK Laboratories Ltd.

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199268

Sample Data:

Sample Name: 13-1426-0010 CTP - GA13-TP09 Date: 11/27/2013 Matrix: Soil Lab #: 528822

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	19500	µg/g	20131204.R13na5
Antimony	5	321	µg/g	20131204.R13na5
Arsenic	5	2560	µg/g	20131204.R13na5
Barium	0.5	5.98	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	0.52	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.3	µg/g	20131204.R13na5
Cadmium	0.05	1.17	µg/g	20131204.R13na5
Calcium	30	53500	µg/g	20131204.R13na5
Cerium	0.5	8.62	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	57	µg/g	20131204.R13na5
Cobalt	0.05	34.4	µg/g	20131204.R13na5
Copper	0.5	57.4	µg/g	20131204.R13na5
Europium	0.5	0.54	µg/g	20131204.R13na5
Gallium	0.5	5.7	µg/g	20131204.R13na5
Iron	100	59800	µg/g	20131204.R13na5
Lanthanum	0.5	4	µg/g	20131204.R13na5
Lead	0.5	209	µg/g	20131204.R13na5
Lithium	3	31.9	µg/g	20131204.R13na5
Magnesium	2	34200	µg/g	20131204.R13na5
Manganese	5	1210	µg/g	20131204.R13na5
Mercury	0.05	0.11	µg/g	20131204.R13na5
Molybdenum	0.5	0.98	µg/g	20131204.R13na5
Nickel	0.5	72.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	301	µg/g	20131204.R13na5
Potassium	10	539	µg/g	20131204.R13na5
Rubidium	0.5	2.5	µg/g	20131204.R13na5
Scandium	0.5	9.61	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.85	µg/g	20131204.R13na5
Sodium	10	89	µg/g	20131204.R13na5
Strontium	0.5	37	µg/g	20131204.R13na5
Sulphur	400	4150	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.87	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	55.4	µg/g	20131204.R13na5
Tungsten	0.5	1.9	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	75.5	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP09 Date: 11/27/2013 Matrix: Soil Lab #: 528822

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Yttrium	0.5	6.22	µg/g	20131204.R13na5
Zinc	5	259	µg/g	20131204.R13na5
Zirconium	0.5	1.9	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP10 Date: 11/28/2013 Matrix: Soil Lab #: 528823

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	24800	µg/g	20131204.R13na5
Antimony	5	288	µg/g	20131204.R13na5
Arsenic	5	2320	µg/g	20131204.R13na5
Barium	0.5	8.17	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	3.1	µg/g	20131204.R13na5
Cadmium	0.05	1.42	µg/g	20131204.R13na5
Calcium	30	46000	µg/g	20131204.R13na5
Cerium	0.5	13.1	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	68.2	µg/g	20131204.R13na5
Cobalt	0.05	27.6	µg/g	20131204.R13na5
Copper	0.5	40	µg/g	20131204.R13na5
Europium	0.5	0.52	µg/g	20131204.R13na5
Gallium	0.5	5.68	µg/g	20131204.R13na5
Iron	100	62800	µg/g	20131204.R13na5
Lanthanum	0.5	5.87	µg/g	20131204.R13na5
Lead	0.5	161	µg/g	20131204.R13na5
Lithium	3	29.2	µg/g	20131204.R13na5
Magnesium	2	30600	µg/g	20131204.R13na5
Manganese	5	1210	µg/g	20131204.R13na5
Mercury	0.05	0.15	µg/g	20131204.R13na5
Molybdenum	0.5	0.8	µg/g	20131204.R13na5
Nickel	0.5	65.1	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	318	µg/g	20131204.R13na5
Potassium	10	619	µg/g	20131204.R13na5
Rubidium	0.5	2.7	µg/g	20131204.R13na5
Scandium	0.5	9.05	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.57	µg/g	20131204.R13na5
Sodium	10	86	µg/g	20131204.R13na5
Strontium	0.5	33.4	µg/g	20131204.R13na5
Sulphur	400	2550	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP10 Date: 11/28/2013 Matrix: Soil Lab #: 528823

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Thorium	0.5	0.84	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	42.4	µg/g	20131204.R13na5
Tungsten	0.5	1.8	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	75.1	µg/g	20131204.R13na5
Yttrium	0.5	5.57	µg/g	20131204.R13na5
Zinc	5	372	µg/g	20131204.R13na5
Zirconium	0.5	2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP11 Date: 11/29/2013 Matrix: Soil Lab #: 528824

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18700	µg/g	20131204.R13na5
Antimony	0.5	122	µg/g	20131204.R13na5
Arsenic	5	2450	µg/g	20131204.R13na5
Barium	0.5	4.7	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	3.2	µg/g	20131204.R13na5
Cadmium	0.05	1.53	µg/g	20131204.R13na5
Calcium	30	49800	µg/g	20131204.R13na5
Cerium	0.5	7.19	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	54.1	µg/g	20131204.R13na5
Cobalt	0.05	36	µg/g	20131204.R13na5
Copper	0.5	55.9	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	4.7	µg/g	20131204.R13na5
Iron	100	61100	µg/g	20131204.R13na5
Lanthanum	0.5	3.3	µg/g	20131204.R13na5
Lead	0.5	164	µg/g	20131204.R13na5
Lithium	3	26.4	µg/g	20131204.R13na5
Magnesium	2	29900	µg/g	20131204.R13na5
Manganese	5	1250	µg/g	20131204.R13na5
Mercury	0.05	0.15	µg/g	20131204.R13na5
Molybdenum	0.5	0.76	µg/g	20131204.R13na5
Nickel	0.5	72.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	313	µg/g	20131204.R13na5
Potassium	10	314	µg/g	20131204.R13na5
Rubidium	0.5	1.5	µg/g	20131204.R13na5
Scandium	0.5	7.99	µg/g	20131204.R13na5
Selenium	0.5	1.1	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab   Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP11   Date: 11/29/2013   Matrix: Soil   Lab #: 528824

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Silver	0.5	0.68	µg/g	20131204.R13na5
Sodium	10	49	µg/g	20131204.R13na5
Strontium	0.5	29.5	µg/g	20131204.R13na5
Sulphur	400	3550	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.52	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	67.2	µg/g	20131204.R13na5
Tungsten	0.5	1.1	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	66.9	µg/g	20131204.R13na5
Yttrium	0.5	5.14	µg/g	20131204.R13na5
Zinc	5	349	µg/g	20131204.R13na5
Zirconium	0.5	1.5	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP14-   Date: 11/30/2013   Matrix: Soil   Lab #: 528825

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	19700	µg/g	20131204.R13na5
Antimony	5	361	µg/g	20131204.R13na5
Arsenic	5	3160	µg/g	20131204.R13na5
Barium	0.5	4.5	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	<1	µg/g	20131204.R13na5
Cadmium	0.05	1.4	µg/g	20131204.R13na5
Calcium	30	50300	µg/g	20131204.R13na5
Cerium	0.5	8.17	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	53.2	µg/g	20131204.R13na5
Cobalt	0.05	48.2	µg/g	20131204.R13na5
Copper	0.5	67.1	µg/g	20131204.R13na5
Europium	0.5	0.52	µg/g	20131204.R13na5
Gallium	0.5	4.8	µg/g	20131204.R13na5
Iron	100	73000	µg/g	20131204.R13na5
Lanthanum	0.5	3.8	µg/g	20131204.R13na5
Lead	0.5	155	µg/g	20131204.R13na5
Lithium	3	25.3	µg/g	20131204.R13na5
Magnesium	2	29600	µg/g	20131204.R13na5
Manganese	5	1270	µg/g	20131204.R13na5
Mercury	0.05	0.18	µg/g	20131204.R13na5
Molybdenum	0.5	0.93	µg/g	20131204.R13na5
Nickel	0.5	92.1	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP14- Date: 11/30/2013 Matrix: Soil Lab #: 528825

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Phosphorus	30	294	µg/g	20131204.R13na5
Potassium	10	249	µg/g	20131204.R13na5
Rubidium	0.5	1.3	µg/g	20131204.R13na5
Scandium	0.5	8.71	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.8	µg/g	20131204.R13na5
Sodium	10	52	µg/g	20131204.R13na5
Strontium	0.5	31.8	µg/g	20131204.R13na5
Sulphur	400	4090	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	58.8	µg/g	20131204.R13na5
Tungsten	0.5	1.8	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	68.3	µg/g	20131204.R13na5
Yttrium	0.5	6.43	µg/g	20131204.R13na5
Zinc	5	331	µg/g	20131204.R13na5
Zirconium	0.5	1.4	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP14- Date: 12/1/2013 Matrix: Soil Lab #: 528826

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	22800	µg/g	20131204.R13na5
Antimony	0.5	116	µg/g	20131204.R13na5
Arsenic	5	2970	µg/g	20131204.R13na5
Barium	0.5	6.94	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.7	µg/g	20131204.R13na5
Cadmium	0.05	2.59	µg/g	20131204.R13na5
Calcium	30	49500	µg/g	20131204.R13na5
Cerium	0.5	11.7	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	79.8	µg/g	20131204.R13na5
Cobalt	0.05	34.8	µg/g	20131204.R13na5
Copper	0.5	69.6	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	5.41	µg/g	20131204.R13na5
Iron	100	60900	µg/g	20131204.R13na5
Lanthanum	0.5	5.46	µg/g	20131204.R13na5
Lead	0.5	219	µg/g	20131204.R13na5
Lithium	3	31.2	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP14- Date: 12/1/2013 Matrix: Soil Lab #: 528826

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Magnesium	2	29200	µg/g	20131204.R13na5
Manganese	5	1190	µg/g	20131204.R13na5
Mercury	0.05	0.32	µg/g	20131204.R13na5
Molybdenum	0.5	0.91	µg/g	20131204.R13na5
Nickel	0.5	83.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	342	µg/g	20131204.R13na5
Potassium	10	533	µg/g	20131204.R13na5
Rubidium	0.5	2.3	µg/g	20131204.R13na5
Scandium	0.5	9.09	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.56	µg/g	20131204.R13na5
Sodium	10	81	µg/g	20131204.R13na5
Strontium	0.5	39	µg/g	20131204.R13na5
Sulphur	400	4140	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.71	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	40.6	µg/g	20131204.R13na5
Tungsten	0.5	0.83	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	72.6	µg/g	20131204.R13na5
Yttrium	0.5	4.4	µg/g	20131204.R13na5
Zinc	5	524	µg/g	20131204.R13na5
Zirconium	0.5	2.4	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP15 Date: 11/27/2013 Matrix: Soil Lab #: 528827

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	16600	µg/g	20131204.R13na5
Antimony	5	363	µg/g	20131204.R13na5
Arsenic	5	3180	µg/g	20131204.R13na5
Barium	0.5	3.2	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.8	µg/g	20131204.R13na5
Cadmium	0.05	1.21	µg/g	20131204.R13na5
Calcium	30	54500	µg/g	20131204.R13na5
Cerium	0.5	7.14	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	45.7	µg/g	20131204.R13na5
Cobalt	0.05	45.9	µg/g	20131204.R13na5
Copper	0.5	63	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP15 Date: 11/27/2013 Matrix: Soil Lab #: 528827

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Europium	0.5	0.54	µg/g	20131204.R13na5
Gallium	0.5	4.3	µg/g	20131204.R13na5
Iron	100	67400	µg/g	20131204.R13na5
Lanthanum	0.5	3.2	µg/g	20131204.R13na5
Lead	0.5	189	µg/g	20131204.R13na5
Lithium	3	25.9	µg/g	20131204.R13na5
Magnesium	2	30100	µg/g	20131204.R13na5
Manganese	5	1230	µg/g	20131204.R13na5
Mercury	0.05	0.14	µg/g	20131204.R13na5
Molybdenum	0.5	0.94	µg/g	20131204.R13na5
Nickel	0.5	88.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	269	µg/g	20131204.R13na5
Potassium	10	259	µg/g	20131204.R13na5
Rubidium	0.5	1.4	µg/g	20131204.R13na5
Scandium	0.5	7.94	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.82	µg/g	20131204.R13na5
Sodium	10	65	µg/g	20131204.R13na5
Strontium	0.5	35.9	µg/g	20131204.R13na5
Sulphur	400	4820	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	66.3	µg/g	20131204.R13na5
Tungsten	0.5	2.1	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	60.4	µg/g	20131204.R13na5
Yttrium	0.5	6.02	µg/g	20131204.R13na5
Zinc	5	228	µg/g	20131204.R13na5
Zirconium	0.5	1.4	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP16 Date: 11/27/2013 Matrix: Soil Lab #: 528828

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18400	µg/g	20131204.R13na5
Antimony	5	271	µg/g	20131204.R13na5
Arsenic	5	3050	µg/g	20131204.R13na5
Barium	0.5	3.8	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.8	µg/g	20131204.R13na5
Cadmium	0.05	1.04	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP16 Date: 11/27/2013 Matrix: Soil Lab #: 528828

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Calcium	30	62200	µg/g	20131204.R13na5
Cerium	0.5	8.76	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	49.7	µg/g	20131204.R13na5
Cobalt	0.05	41	µg/g	20131204.R13na5
Copper	0.5	57	µg/g	20131204.R13na5
Europium	0.5	0.6	µg/g	20131204.R13na5
Gallium	0.5	4.6	µg/g	20131204.R13na5
Iron	100	67800	µg/g	20131204.R13na5
Lanthanum	0.5	3.9	µg/g	20131204.R13na5
Lead	0.5	175	µg/g	20131204.R13na5
Lithium	3	28.7	µg/g	20131204.R13na5
Magnesium	2	32700	µg/g	20131204.R13na5
Manganese	5	1410	µg/g	20131204.R13na5
Mercury	0.05	0.11	µg/g	20131204.R13na5
Molybdenum	0.5	0.8	µg/g	20131204.R13na5
Nickel	0.5	79.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	300	µg/g	20131204.R13na5
Potassium	10	294	µg/g	20131204.R13na5
Rubidium	0.5	1.4	µg/g	20131204.R13na5
Scandium	0.5	8.96	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.8	µg/g	20131204.R13na5
Sodium	10	80	µg/g	20131204.R13na5
Strontium	0.5	37.3	µg/g	20131204.R13na5
Sulphur	400	3860	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	65	µg/g	20131204.R13na5
Tungsten	0.5	2.1	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	67.9	µg/g	20131204.R13na5
Yttrium	0.5	6.59	µg/g	20131204.R13na5
Zinc	5	266	µg/g	20131204.R13na5
Zirconium	0.5	1.6	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP18 Date: 11/27/2013 Matrix: Soil Lab #: 528829

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	20600	µg/g	20131204.R13na5
Antimony	5	335	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP18 Date: 11/27/2013 Matrix: Soil Lab #: 528829

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Arsenic	5	3220	µg/g	20131204.R13na5
Barium	0.5	4.8	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.7	µg/g	20131204.R13na5
Cadmium	0.05	1.87	µg/g	20131204.R13na5
Calcium	30	52200	µg/g	20131204.R13na5
Cerium	0.5	8.63	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	55.1	µg/g	20131204.R13na5
Cobalt	0.05	48	µg/g	20131204.R13na5
Copper	0.5	66.7	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	4.7	µg/g	20131204.R13na5
Iron	100	75500	µg/g	20131204.R13na5
Lanthanum	0.5	3.9	µg/g	20131204.R13na5
Lead	0.5	188	µg/g	20131204.R13na5
Lithium	3	26.7	µg/g	20131204.R13na5
Magnesium	2	30700	µg/g	20131204.R13na5
Manganese	5	1320	µg/g	20131204.R13na5
Mercury	0.05	0.23	µg/g	20131204.R13na5
Molybdenum	0.5	0.86	µg/g	20131204.R13na5
Nickel	0.5	91.7	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	314	µg/g	20131204.R13na5
Potassium	10	339	µg/g	20131204.R13na5
Rubidium	0.5	1.6	µg/g	20131204.R13na5
Scandium	0.5	8.56	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.89	µg/g	20131204.R13na5
Sodium	10	58	µg/g	20131204.R13na5
Strontium	0.5	33.4	µg/g	20131204.R13na5
Sulphur	400	4810	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	56.5	µg/g	20131204.R13na5
Tungsten	0.5	1.7	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	67.2	µg/g	20131204.R13na5
Yttrium	0.5	5.88	µg/g	20131204.R13na5
Zinc	5	394	µg/g	20131204.R13na5
Zirconium	0.5	1.7	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP19   Date: 11/27/2013   Matrix: Soil   Lab #: 528830

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	13200	µg/g	20131204.R13na5
Antimony	5	387	µg/g	20131204.R13na5
Arsenic	5	2920	µg/g	20131204.R13na5
Barium	0.5	3.9	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	0.58	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.1	µg/g	20131204.R13na5
Cadmium	0.05	1.48	µg/g	20131204.R13na5
Calcium	30	55800	µg/g	20131204.R13na5
Cerium	0.5	7.17	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	38.9	µg/g	20131204.R13na5
Cobalt	0.05	40.2	µg/g	20131204.R13na5
Copper	0.5	60	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	3.6	µg/g	20131204.R13na5
Iron	100	62400	µg/g	20131204.R13na5
Lanthanum	0.5	3.2	µg/g	20131204.R13na5
Lead	0.5	248	µg/g	20131204.R13na5
Lithium	3	19.4	µg/g	20131204.R13na5
Magnesium	2	30200	µg/g	20131204.R13na5
Manganese	5	1290	µg/g	20131204.R13na5
Mercury	0.05	0.097	µg/g	20131204.R13na5
Molybdenum	0.5	1.2	µg/g	20131204.R13na5
Nickel	0.5	74.7	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	256	µg/g	20131204.R13na5
Potassium	10	315	µg/g	20131204.R13na5
Rubidium	0.5	1.5	µg/g	20131204.R13na5
Scandium	0.5	7.26	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1.1	µg/g	20131204.R13na5
Sodium	10	136	µg/g	20131204.R13na5
Strontium	0.5	37	µg/g	20131204.R13na5
Sulphur	400	3950	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	68.3	µg/g	20131204.R13na5
Tungsten	0.5	1.5	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	52.1	µg/g	20131204.R13na5
Yttrium	0.5	5.72	µg/g	20131204.R13na5
Zinc	5	311	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP19 Date: 11/27/2013 Matrix: Soil Lab #: 528830

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Zirconium	0.5	2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP20 Date: 11/27/2013 Matrix: Soil Lab #: 528831

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18300	µg/g	20131204.R13na5
Antimony	5	333	µg/g	20131204.R13na5
Arsenic	5	2970	µg/g	20131204.R13na5
Barium	0.5	5.46	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	0.56	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.7	µg/g	20131204.R13na5
Cadmium	0.05	1.38	µg/g	20131204.R13na5
Calcium	30	49200	µg/g	20131204.R13na5
Cerium	0.5	7.79	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	47.1	µg/g	20131204.R13na5
Cobalt	0.05	36.9	µg/g	20131204.R13na5
Copper	0.5	62.9	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	4.3	µg/g	20131204.R13na5
Iron	100	63800	µg/g	20131204.R13na5
Lanthanum	0.5	3.6	µg/g	20131204.R13na5
Lead	0.5	218	µg/g	20131204.R13na5
Lithium	3	25.2	µg/g	20131204.R13na5
Magnesium	2	29000	µg/g	20131204.R13na5
Manganese	5	1210	µg/g	20131204.R13na5
Mercury	0.05	0.093	µg/g	20131204.R13na5
Molybdenum	0.5	1.1	µg/g	20131204.R13na5
Nickel	0.5	74.4	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	271	µg/g	20131204.R13na5
Potassium	10	449	µg/g	20131204.R13na5
Rubidium	0.5	2.2	µg/g	20131204.R13na5
Scandium	0.5	8.02	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1	µg/g	20131204.R13na5
Sodium	10	94	µg/g	20131204.R13na5
Strontium	0.5	34.1	µg/g	20131204.R13na5
Sulphur	400	3650	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP20 Date: 11/27/2013 Matrix: Soil Lab #: 528831

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Titanium	0.5	52.3	µg/g	20131204.R13na5
Tungsten	0.5	1.4	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	60.7	µg/g	20131204.R13na5
Yttrium	0.5	5.53	µg/g	20131204.R13na5
Zinc	5	296	µg/g	20131204.R13na5
Zirconium	0.5	2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP26 Date: 11/27/2013 Matrix: Soil Lab #: 528832

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	24100	µg/g	20131204.R13na5
Antimony	0.5	139	µg/g	20131204.R13na5
Arsenic	5	2340	µg/g	20131204.R13na5
Barium	0.5	5.85	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.5	µg/g	20131204.R13na5
Cadmium	0.05	1.83	µg/g	20131204.R13na5
Calcium	30	52700	µg/g	20131204.R13na5
Cerium	0.5	9.78	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	79.2	µg/g	20131204.R13na5
Cobalt	0.05	37.1	µg/g	20131204.R13na5
Copper	0.5	53.3	µg/g	20131204.R13na5
Europium	0.5	0.52	µg/g	20131204.R13na5
Gallium	0.5	6.24	µg/g	20131204.R13na5
Iron	100	62700	µg/g	20131204.R13na5
Lanthanum	0.5	4.4	µg/g	20131204.R13na5
Lead	0.5	169	µg/g	20131204.R13na5
Lithium	3	37.3	µg/g	20131204.R13na5
Magnesium	2	32400	µg/g	20131204.R13na5
Manganese	5	1220	µg/g	20131204.R13na5
Mercury	0.05	0.16	µg/g	20131204.R13na5
Molybdenum	0.5	0.94	µg/g	20131204.R13na5
Nickel	0.5	84.4	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	331	µg/g	20131204.R13na5
Potassium	10	523	µg/g	20131204.R13na5
Rubidium	0.5	2.3	µg/g	20131204.R13na5
Scandium	0.5	10.5	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.67	µg/g	20131204.R13na5
Sodium	10	94	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP26 Date: 11/27/2013 Matrix: Soil Lab #: 528832

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Strontium	0.5	37.6	µg/g	20131204.R13na5
Sulphur	400	3880	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	54.3	µg/g	20131204.R13na5
Tungsten	0.5	1	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	86.1	µg/g	20131204.R13na5
Yttrium	0.5	5.6	µg/g	20131204.R13na5
Zinc	5	403	µg/g	20131204.R13na5
Zirconium	0.5	2.2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP27 Date: 11/27/2013 Matrix: Soil Lab #: 528833

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18800	µg/g	20131204.R13na5
Antimony	5	451	µg/g	20131204.R13na5
Arsenic	5	2810	µg/g	20131204.R13na5
Barium	0.5	4.7	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.5	µg/g	20131204.R13na5
Cadmium	0.05	1.82	µg/g	20131204.R13na5
Calcium	30	64000	µg/g	20131204.R13na5
Cerium	0.5	10.8	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	55.2	µg/g	20131204.R13na5
Cobalt	0.05	42.8	µg/g	20131204.R13na5
Copper	0.5	67.6	µg/g	20131204.R13na5
Europium	0.5	0.53	µg/g	20131204.R13na5
Gallium	0.5	5.02	µg/g	20131204.R13na5
Iron	100	71600	µg/g	20131204.R13na5
Lanthanum	0.5	4.9	µg/g	20131204.R13na5
Lead	0.5	340	µg/g	20131204.R13na5
Lithium	3	26.4	µg/g	20131204.R13na5
Magnesium	2	27500	µg/g	20131204.R13na5
Manganese	5	1420	µg/g	20131204.R13na5
Mercury	0.05	0.23	µg/g	20131204.R13na5
Molybdenum	0.5	0.83	µg/g	20131204.R13na5
Nickel	0.5	79.5	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	357	µg/g	20131204.R13na5
Potassium	10	365	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 CTP - GA13-TP27 Date: 11/27/2013 Matrix: Soil Lab #: 528833

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Rubidium	0.5	1.7	µg/g	20131204.R13na5
Scandium	0.5	7.95	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.85	µg/g	20131204.R13na5
Sodium	10	54	µg/g	20131204.R13na5
Strontium	0.5	46.6	µg/g	20131204.R13na5
Sulphur	400	3710	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.63	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	63.7	µg/g	20131204.R13na5
Tungsten	0.5	1.2	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	65.9	µg/g	20131204.R13na5
Yttrium	0.5	4.6	µg/g	20131204.R13na5
Zinc	5	434	µg/g	20131204.R13na5
Zirconium	0.5	2.9	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP35 Date: 11/27/2013 Matrix: Soil Lab #: 528834

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18400	µg/g	20131204.R13na5
Aluminum (Dup)	5	19600	µg/g	20131204.R13na5
Antimony	5	462	µg/g	20131204.R13na5
Antimony (Dup)	5	496	µg/g	20131204.R13na5
Arsenic	5	2910	µg/g	20131204.R13na5
Arsenic (Dup)	5	3100	µg/g	20131204.R13na5
Barium	0.5	6.12	µg/g	20131204.R13na5
Barium (Dup)	0.5	6.1	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Beryllium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Bismuth (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.1	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable) (Dup)	1	1.4	µg/g	20131204.R13na5
Cadmium	0.05	1.42	µg/g	20131204.R13na5
Cadmium (Dup)	0.05	1.41	µg/g	20131204.R13na5
Calcium	30	46800	µg/g	20131204.R13na5
Calcium (Dup)	30	54800	µg/g	20131204.R13na5
Cerium	0.5	9.5	µg/g	20131204.R13na5
Cerium (Dup)	0.5	9.59	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Cesium (Dup)	0.5	<0.5	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP35 Date: 11/27/2013 Matrix: Soil Lab #: 528834

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Chromium	0.5	51.1	µg/g	20131204.R13na5
Chromium (Dup)	0.5	59.8	µg/g	20131204.R13na5
Cobalt	0.05	49.7	µg/g	20131204.R13na5
Cobalt (Dup)	0.05	57.4	µg/g	20131204.R13na5
Copper	5	139	µg/g	20131204.R13na5
Copper (Dup)	5	154	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Europium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	4.6	µg/g	20131204.R13na5
Gallium (Dup)	0.5	5.34	µg/g	20131204.R13na5
Iron	100	81000	µg/g	20131204.R13na5
Iron (Dup)	100	86800	µg/g	20131204.R13na5
Lanthanum	0.5	4.2	µg/g	20131204.R13na5
Lanthanum (Dup)	0.5	4.4	µg/g	20131204.R13na5
Lead	0.5	328	µg/g	20131204.R13na5
Lead (Dup)	0.5	358	µg/g	20131204.R13na5
Lithium	3	24.1	µg/g	20131204.R13na5
Lithium (Dup)	3	28.4	µg/g	20131204.R13na5
Magnesium	2	25000	µg/g	20131204.R13na5
Magnesium (Dup)	2	28600	µg/g	20131204.R13na5
Manganese	5	1320	µg/g	20131204.R13na5
Manganese (Dup)	5	1410	µg/g	20131204.R13na5
Mercury	0.05	0.24	µg/g	20131204.R13na5
Mercury (Dup)	0.05	0.21	µg/g	20131204.R13na5
Molybdenum	0.5	0.95	µg/g	20131204.R13na5
Molybdenum (Dup)	0.5	1.1	µg/g	20131204.R13na5
Nickel	0.5	94.5	µg/g	20131204.R13na5
Nickel (Dup)	5	105	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Niobium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	287	µg/g	20131204.R13na5
Phosphorus (Dup)	30	332	µg/g	20131204.R13na5
Potassium	10	316	µg/g	20131204.R13na5
Potassium (Dup)	10	367	µg/g	20131204.R13na5
Rubidium	0.5	1.7	µg/g	20131204.R13na5
Rubidium (Dup)	0.5	2	µg/g	20131204.R13na5
Scandium	0.5	7.33	µg/g	20131204.R13na5
Scandium (Dup)	0.5	8.67	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Selenium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silicon (Dup)	300	<300	µg/g	20131204.R13na5
Silver	0.5	1.5	µg/g	20131204.R13na5
Silver (Dup)	0.5	1.7	µg/g	20131204.R13na5
Sodium	10	33	µg/g	20131204.R13na5
Sodium (Dup)	10	48	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP35 Date: 11/27/2013 Matrix: Soil Lab #: 528834

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Strontium	0.5	38.4	µg/g	20131204.R13na5
Strontium (Dup)	0.5	45.3	µg/g	20131204.R13na5
Sulphur	400	2280	µg/g	20131204.R13na5
Sulphur (Dup)	400	3610	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Tellurium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thallium (Dup)	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.57	µg/g	20131204.R13na5
Thorium (Dup)	0.5	0.6	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Tin (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	70.6	µg/g	20131204.R13na5
Titanium (Dup)	0.5	81.9	µg/g	20131204.R13na5
Tungsten	0.5	22.7	µg/g	20131204.R13na5
Tungsten (Dup)	0.5	25.4	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Uranium (Dup)	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	64.4	µg/g	20131204.R13na5
Vanadium (Dup)	0.5	74.8	µg/g	20131204.R13na5
Yttrium	0.5	4.7	µg/g	20131204.R13na5
Yttrium (Dup)	0.5	5.23	µg/g	20131204.R13na5
Zinc	5	325	µg/g	20131204.R13na5
Zinc (Dup)	5	363	µg/g	20131204.R13na5
Zirconium	0.5	2.1	µg/g	20131204.R13na5
Zirconium (Dup)	0.5	2.2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP36 Date: 11/27/2013 Matrix: Soil Lab #: 528835

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	27200	µg/g	20131204.R13na5
Antimony	0.5	198	µg/g	20131204.R13na5
Arsenic	5	1790	µg/g	20131204.R13na5
Barium	0.5	13.3	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	0.74	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.6	µg/g	20131204.R13na5
Cadmium	0.05	1.67	µg/g	20131204.R13na5
Calcium	30	57300	µg/g	20131204.R13na5
Cerium	0.5	14.5	µg/g	20131204.R13na5
Cesium	0.5	0.64	µg/g	20131204.R13na5
Chromium	0.5	81.6	µg/g	20131204.R13na5
Cobalt	0.05	26.2	µg/g	20131204.R13na5
Copper	0.5	65.5	µg/g	20131204.R13na5
Europium	0.5	0.61	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab   Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP36   Date: 11/27/2013   Matrix: Soil   Lab #: 528835

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Gallium	0.5	8.28	µg/g	20131204.R13na5
Iron	100	62000	µg/g	20131204.R13na5
Lanthanum	0.5	6.54	µg/g	20131204.R13na5
Lead	0.5	211	µg/g	20131204.R13na5
Lithium	3	47.4	µg/g	20131204.R13na5
Magnesium	2	39400	µg/g	20131204.R13na5
Manganese	5	1310	µg/g	20131204.R13na5
Mercury	0.05	0.093	µg/g	20131204.R13na5
Molybdenum	0.5	0.79	µg/g	20131204.R13na5
Nickel	0.5	68.4	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	476	µg/g	20131204.R13na5
Potassium	10	987	µg/g	20131204.R13na5
Rubidium	0.5	5.37	µg/g	20131204.R13na5
Scandium	0.5	12.4	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1.8	µg/g	20131204.R13na5
Sodium	10	134	µg/g	20131204.R13na5
Strontium	0.5	48.2	µg/g	20131204.R13na5
Sulphur	400	2270	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.83	µg/g	20131204.R13na5
Tin	0.5	0.53	µg/g	20131204.R13na5
Titanium	0.5	90.8	µg/g	20131204.R13na5
Tungsten	0.5	1.8	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	108	µg/g	20131204.R13na5
Yttrium	0.5	6.52	µg/g	20131204.R13na5
Zinc	5	327	µg/g	20131204.R13na5
Zirconium	0.5	4.2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP38   Date: 11/27/2013   Matrix: Soil   Lab #: 528836

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	29900	µg/g	20131204.R13na5
Antimony	0.5	166	µg/g	20131204.R13na5
Arsenic	5	1880	µg/g	20131204.R13na5
Barium	0.5	9.65	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.3	µg/g	20131204.R13na5
Cadmium	0.05	1.1	µg/g	20131204.R13na5
Calcium	30	46000	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP38 Date: 11/27/2013 Matrix: Soil Lab #: 528836

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Cerium	0.5	11.3	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	73.4	µg/g	20131204.R13na5
Cobalt	0.05	24.2	µg/g	20131204.R13na5
Copper	0.5	73.5	µg/g	20131204.R13na5
Europium	0.5	0.52	µg/g	20131204.R13na5
Gallium	0.5	7.32	µg/g	20131204.R13na5
Iron	100	62000	µg/g	20131204.R13na5
Lanthanum	0.5	4.9	µg/g	20131204.R13na5
Lead	0.5	190	µg/g	20131204.R13na5
Lithium	3	43.5	µg/g	20131204.R13na5
Magnesium	2	34200	µg/g	20131204.R13na5
Manganese	5	1150	µg/g	20131204.R13na5
Mercury	0.05	0.081	µg/g	20131204.R13na5
Molybdenum	0.5	1	µg/g	20131204.R13na5
Nickel	0.5	65.9	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	335	µg/g	20131204.R13na5
Potassium	10	661	µg/g	20131204.R13na5
Rubidium	0.5	3.1	µg/g	20131204.R13na5
Scandium	0.5	11.4	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1.1	µg/g	20131204.R13na5
Sodium	10	137	µg/g	20131204.R13na5
Strontium	0.5	34.2	µg/g	20131204.R13na5
Sulphur	400	1830	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.58	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	64.5	µg/g	20131204.R13na5
Tungsten	0.5	1.4	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	102	µg/g	20131204.R13na5
Yttrium	0.5	5.78	µg/g	20131204.R13na5
Zinc	5	275	µg/g	20131204.R13na5
Zirconium	0.5	2.6	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 CTP - GA13-TP41 Date: 11/27/2013 Matrix: Soil Lab #: 528837

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	28300	µg/g	20131204.R13na5
Antimony	0.5	124	µg/g	20131204.R13na5
Arsenic	5	1600	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab   Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP41   Date: 11/27/2013   Matrix: Soil   Lab #: 528837

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Barium	0.5	10.9	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.8	µg/g	20131204.R13na5
Cadmium	0.05	0.94	µg/g	20131204.R13na5
Calcium	30	42400	µg/g	20131204.R13na5
Cerium	0.5	14.1	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	67.8	µg/g	20131204.R13na5
Cobalt	0.05	26.3	µg/g	20131204.R13na5
Copper	0.5	47.2	µg/g	20131204.R13na5
Europium	0.5	0.63	µg/g	20131204.R13na5
Gallium	0.5	6.84	µg/g	20131204.R13na5
Iron	100	61100	µg/g	20131204.R13na5
Lanthanum	0.5	6.08	µg/g	20131204.R13na5
Lead	0.5	155	µg/g	20131204.R13na5
Lithium	3	36.8	µg/g	20131204.R13na5
Magnesium	2	38200	µg/g	20131204.R13na5
Manganese	5	1120	µg/g	20131204.R13na5
Mercury	0.05	0.079	µg/g	20131204.R13na5
Molybdenum	0.5	0.92	µg/g	20131204.R13na5
Nickel	0.5	69.3	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	472	µg/g	20131204.R13na5
Potassium	10	741	µg/g	20131204.R13na5
Rubidium	0.5	3.3	µg/g	20131204.R13na5
Scandium	0.5	11.2	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.74	µg/g	20131204.R13na5
Sodium	10	126	µg/g	20131204.R13na5
Strontium	0.5	31.9	µg/g	20131204.R13na5
Sulphur	400	1610	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.56	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	73.1	µg/g	20131204.R13na5
Tungsten	0.5	1.2	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	95.6	µg/g	20131204.R13na5
Yttrium	0.5	6.62	µg/g	20131204.R13na5
Zinc	5	276	µg/g	20131204.R13na5
Zirconium	0.5	3.2	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP52 Date: 11/27/2013 Matrix: Soil Lab #: 528838

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	16700	µg/g	20131204.R13na5
Antimony	5	322	µg/g	20131204.R13na5
Arsenic	5	2300	µg/g	20131204.R13na5
Barium	0.5	6.88	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.1	µg/g	20131204.R13na5
Cadmium	0.05	1.48	µg/g	20131204.R13na5
Calcium	30	46400	µg/g	20131204.R13na5
Cerium	0.5	10.2	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	40.7	µg/g	20131204.R13na5
Cobalt	0.05	32	µg/g	20131204.R13na5
Copper	0.5	46.6	µg/g	20131204.R13na5
Europium	0.5	0.51	µg/g	20131204.R13na5
Gallium	0.5	4.1	µg/g	20131204.R13na5
Iron	100	62100	µg/g	20131204.R13na5
Lanthanum	0.5	4.7	µg/g	20131204.R13na5
Lead	0.5	211	µg/g	20131204.R13na5
Lithium	3	24.6	µg/g	20131204.R13na5
Magnesium	2	27400	µg/g	20131204.R13na5
Manganese	5	1310	µg/g	20131204.R13na5
Mercury	0.05	0.14	µg/g	20131204.R13na5
Molybdenum	0.5	0.89	µg/g	20131204.R13na5
Nickel	0.5	59.1	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	339	µg/g	20131204.R13na5
Potassium	10	572	µg/g	20131204.R13na5
Rubidium	0.5	3	µg/g	20131204.R13na5
Scandium	0.5	7.48	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1.3	µg/g	20131204.R13na5
Sodium	10	82	µg/g	20131204.R13na5
Strontium	0.5	39.9	µg/g	20131204.R13na5
Sulphur	400	3070	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.54	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	57.1	µg/g	20131204.R13na5
Tungsten	0.5	2.9	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	55.9	µg/g	20131204.R13na5
Yttrium	0.5	5	µg/g	20131204.R13na5
Zinc	5	228	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab | Work Order: 199268

Sample Name: 13-1426-0010 CTP - GA13-TP52 Date: 11/27/2013 Matrix: Soil Lab #: 528838

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Zirconium	0.5	3	µg/g	20131204.R13na5

MDL Method detection limit or minimum reporting limit.
% Rec Surrogate compounds are added to the sample in some cases and the recovery is reported as a percent recovered.
QAQCID This is a unique reference to the quality control data set used to generate the reported value.
Data reported for organic analysis in soil samples are corrected for moisture content
Matrix If the matrix is a leachate, the sample was extracted according to regulation 558.
INT Interferences
TNTC Too numerous to count
ND Not detected

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199268

Quality Control Data:

ICPMS Soil

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	0.5	µg/g	<0.5	<0.5	2	20131204.R13na5
Antimony	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Arsenic	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Barium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Beryllium	0.5	µg/g	<0.5	<0.5	2.5	20131204.R13na5
Bismuth	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cadmium	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Calcium	30	µg/g	<30	<30	50	20131204.R13na5
Cerium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cesium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Chromium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cobalt	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Copper	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Europium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Gallium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Iron	10	µg/g	<10	<10	10	20131204.R13na5
Lanthanum	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Lead	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Magnesium	2	µg/g	<2	<2	3	20131204.R13na5
Manganese	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Mercury	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Molybdenum	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Nickel	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Niobium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Phosphorus	30	µg/g	<30	<30	30	20131204.R13na5
Potassium	10	µg/g	<10	<10	50	20131204.R13na5
Rubidium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Scandium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Selenium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Silver	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Sodium	10	µg/g	<10	<10	50	20131204.R13na5
Strontium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Thallium	0.3	µg/g	<0.3	<0.3	0.5	20131204.R13na5
Thorium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Tin	0.5	µg/g	<0.5	<0.5	2.5	20131204.R13na5
Titanium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Tungsten	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Uranium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Vanadium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Yttrium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Zinc	0.5	µg/g	<0.5	<0.5	1	20131204.R13na5
Zirconium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5

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ICPMS Soil

SS2 CRM						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	5	µg/g	6743	14900	19787	20131204.R13na5
Antimony	0.5	µg/g	3	4.8	5.3	20131204.R13na5
Arsenic	0.5	µg/g	25	81.8	125	20131204.R13na5
Barium	0.5	µg/g	149	235	281	20131204.R13na5
Cadmium	0.05	µg/g	1.2	2.07	3.2	20131204.R13na5
Calcium	30	µg/g	87443	105000	138279	20131204.R13na5
Chromium	0.5	µg/g	14	39.7	54	20131204.R13na5
Cobalt	0.05	µg/g	9	12.7	15	20131204.R13na5
Copper	5	µg/g	139	186	243	20131204.R13na5
Iron	100	µg/g	12831	23600	29261	20131204.R13na5
Lead	0.5	µg/g	68	129	184	20131204.R13na5
Lithium	3	µg/g	5	15.3	23	20131204.R13na5
Magnesium	2	µg/g	7628	11700	14502	20131204.R13na5
Manganese	5	µg/g	324	529	590	20131204.R13na5
Mercury	0.05	µg/g	0.23	0.32	0.43	20131204.R13na5
Molybdenum	0.5	µg/g	1.94	2.9	3.94	20131204.R13na5
Nickel	0.5	µg/g	33	60.3	75	20131204.R13na5
Silver	0.5	µg/g	0.5	0.69	2	20131204.R13na5
Strontium	0.5	µg/g	156	223	272	20131204.R13na5
Titanium	5	µg/g	298	1150	1402	20131204.R13na5
Uranium	0.5	µg/g	1	1.3	1.9	20131204.R13na5
Vanadium	0.5	µg/g	17	45.6	51	20131204.R13na5
Zinc	5	µg/g	337	479	597	20131204.R13na5

UCL Upper Control Limit
LCL Lower Control Limit

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Analytical Report

Client:	Mark Labelle	**Work Order Number:**	**199274**
Company:	Golder Associates Ltd - Paste Engineering Lab	**Date Order Received:**	12/2/2013
Address:	1010 Lorne St.	**Regulation:**	Information not provided
	Sudbury, ON, P3A 4S4	**PO #:**	
Phone:	(705) 524-6861	**Project #:**	13-1426-0010
Fax:	(705) 524-9636		
Email:	mlabelle@golder.com		

Analyses were performed on the following samples submitted with your order.

The results relate only to the items tested.

Sample Name	Lab #	Matrix	Type	Comments	Date Collected	Time Collected
13-1426-0010 SCTP - BS - Silty Sand	528850	Soil	Comp		11/30/2013	9:00
13-1426-0010 SCTP - BS - Mixed (Silt -	528851	Soil	Comp		11/30/2013	9:00
13-1426-0010 SCTP - BS - Clay - Silt	528852	Soil	Comp		11/30/2013	9:00

The following instrumentation and reference methods were used for your sample(s)

Method Name	Description	Reference
ICPMS Soil	Determination of Metals in Soil by ICP/MS and BCSALM Method **Instrument group:** Perkin Elmer ICPMS	Based on SW846-6020A

This report has been approved by:

Brad Woodward, H.B.Sc.
Inorganic Section Head

TESTMARK Laboratories Ltd.

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199274

Sample Data:

Sample Name: 13-1426-0010 SCTP - BS - Silty   Date: 11/30/2013   Matrix: Soil   Lab #: 528850

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	15300	µg/g	20131204.R13na5
Antimony	5	312	µg/g	20131204.R13na5
Arsenic	5	2860	µg/g	20131204.R13na5
Barium	0.5	3.4	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.7	µg/g	20131204.R13na5
Cadmium	0.05	1.06	µg/g	20131204.R13na5
Calcium	30	50700	µg/g	20131204.R13na5
Cerium	0.5	6.78	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	39.9	µg/g	20131204.R13na5
Cobalt	0.05	37.9	µg/g	20131204.R13na5
Copper	0.5	55.6	µg/g	20131204.R13na5
Europium	0.5	<0.5	µg/g	20131204.R13na5
Gallium	0.5	3.6	µg/g	20131204.R13na5
Iron	100	63900	µg/g	20131204.R13na5
Lanthanum	0.5	3.1	µg/g	20131204.R13na5
Lead	0.5	180	µg/g	20131204.R13na5
Lithium	3	21.7	µg/g	20131204.R13na5
Magnesium	2	28800	µg/g	20131204.R13na5
Manganese	5	1230	µg/g	20131204.R13na5
Mercury	0.05	0.064	µg/g	20131204.R13na5
Molybdenum	0.5	0.91	µg/g	20131204.R13na5
Nickel	0.5	74.8	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	242	µg/g	20131204.R13na5
Potassium	10	231	µg/g	20131204.R13na5
Rubidium	0.5	1.3	µg/g	20131204.R13na5
Scandium	0.5	7.41	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	1	µg/g	20131204.R13na5
Sodium	10	44	µg/g	20131204.R13na5
Strontium	0.5	33.8	µg/g	20131204.R13na5
Sulphur	400	3360	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	42.1	µg/g	20131204.R13na5
Tungsten	0.5	1.4	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	54.4	µg/g	20131204.R13na5

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Golder Associates Ltd - Paste Engineering Lab — Work Order: 199274

Sample Name: 13-1426-0010 SCTP - BS - Silty Date: 11/30/2013 Matrix: Soil Lab #: 528850

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Yttrium	0.5	5.79	µg/g	20131204.R13na5
Zinc	5	241	µg/g	20131204.R13na5
Zirconium	0.5	1.2	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 SCTP - BS - Mixed Date: 11/30/2013 Matrix: Soil Lab #: 528851

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	18400	µg/g	20131204.R13na5
Antimony	0.5	230	µg/g	20131204.R13na5
Arsenic	5	2700	µg/g	20131204.R13na5
Barium	0.5	4.5	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	1.5	µg/g	20131204.R13na5
Cadmium	0.05	1.61	µg/g	20131204.R13na5
Calcium	30	49800	µg/g	20131204.R13na5
Cerium	0.5	8.35	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	56	µg/g	20131204.R13na5
Cobalt	0.05	40.5	µg/g	20131204.R13na5
Copper	0.5	57.2	µg/g	20131204.R13na5
Europium	0.5	0.53	µg/g	20131204.R13na5
Gallium	0.5	4.7	µg/g	20131204.R13na5
Iron	100	62600	µg/g	20131204.R13na5
Lanthanum	0.5	3.7	µg/g	20131204.R13na5
Lead	0.5	193	µg/g	20131204.R13na5
Lithium	3	27.4	µg/g	20131204.R13na5
Magnesium	2	29400	µg/g	20131204.R13na5
Manganese	5	1190	µg/g	20131204.R13na5
Mercury	0.05	0.16	µg/g	20131204.R13na5
Molybdenum	0.5	0.78	µg/g	20131204.R13na5
Nickel	0.5	81.7	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	295	µg/g	20131204.R13na5
Potassium	10	316	µg/g	20131204.R13na5
Rubidium	0.5	1.7	µg/g	20131204.R13na5
Scandium	0.5	8.39	µg/g	20131204.R13na5
Selenium	0.5	0.59	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5
Silver	0.5	0.92	µg/g	20131204.R13na5
Sodium	10	54	µg/g	20131204.R13na5
Strontium	0.5	34.7	µg/g	20131204.R13na5
Sulphur	400	3490	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 SCTP - BS - Mixed Date: 11/30/2013 Matrix: Soil Lab #: 528851

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Thorium	0.5	<0.5	µg/g	20131204.R13na5
Tin	0.5	<0.5	µg/g	20131204.R13na5
Titanium	0.5	58.9	µg/g	20131204.R13na5
Tungsten	0.5	1.5	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	67.2	µg/g	20131204.R13na5
Yttrium	0.5	5.56	µg/g	20131204.R13na5
Zinc	5	351	µg/g	20131204.R13na5
Zirconium	0.5	1.8	µg/g	20131204.R13na5

Sample Name: 13-1426-0010 SCTP - BS - Clay - Date: 11/30/2013 Matrix: Soil Lab #: 528852

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Aluminum	5	24300	µg/g	20131204.R13na5
Antimony	0.5	170	µg/g	20131204.R13na5
Arsenic	5	2320	µg/g	20131204.R13na5
Barium	0.5	7.75	µg/g	20131204.R13na5
Beryllium	0.5	<0.5	µg/g	20131204.R13na5
Bismuth	0.5	<0.5	µg/g	20131204.R13na5
Boron (Not Hot Water Extractable)	1	2.7	µg/g	20131204.R13na5
Cadmium	0.05	1.52	µg/g	20131204.R13na5
Calcium	30	46800	µg/g	20131204.R13na5
Cerium	0.5	12	µg/g	20131204.R13na5
Cesium	0.5	<0.5	µg/g	20131204.R13na5
Chromium	0.5	68.7	µg/g	20131204.R13na5
Cobalt	0.05	32.4	µg/g	20131204.R13na5
Copper	0.5	53.8	µg/g	20131204.R13na5
Europium	0.5	0.52	µg/g	20131204.R13na5
Gallium	0.5	5.88	µg/g	20131204.R13na5
Iron	100	64100	µg/g	20131204.R13na5
Lanthanum	0.5	5.59	µg/g	20131204.R13na5
Lead	0.5	204	µg/g	20131204.R13na5
Lithium	3	35.3	µg/g	20131204.R13na5
Magnesium	2	32500	µg/g	20131204.R13na5
Manganese	5	1230	µg/g	20131204.R13na5
Mercury	0.05	0.16	µg/g	20131204.R13na5
Molybdenum	0.5	0.86	µg/g	20131204.R13na5
Nickel	0.5	75.9	µg/g	20131204.R13na5
Niobium	0.5	<0.5	µg/g	20131204.R13na5
Phosphorus	30	346	µg/g	20131204.R13na5
Potassium	10	555	µg/g	20131204.R13na5
Rubidium	0.5	2.7	µg/g	20131204.R13na5
Scandium	0.5	9.62	µg/g	20131204.R13na5
Selenium	0.5	<0.5	µg/g	20131204.R13na5
Silicon	300	<300	µg/g	20131204.R13na5

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Sample Name: 13-1426-0010 SCTP - BS - Clay - Date: 11/30/2013 Matrix: Soil Lab #: 528852

ICPMS Soil				
Parameter	**MDL**	**Result**	**Units**	**QAQCID**
Silver	0.5	0.82	µg/g	20131204.R13na5
Sodium	10	80	µg/g	20131204.R13na5
Strontium	0.5	35.4	µg/g	20131204.R13na5
Sulphur	400	2420	µg/g	20131204.R13na5
Tellurium	0.5	<0.5	µg/g	20131204.R13na5
Thallium	0.3	<0.3	µg/g	20131204.R13na5
Thorium	0.5	0.57	µg/g	20131204.R13na5
Tin	0.5	0.56	µg/g	20131204.R13na5
Titanium	0.5	67.1	µg/g	20131204.R13na5
Tungsten	0.5	1.5	µg/g	20131204.R13na5
Uranium	0.5	<0.5	µg/g	20131204.R13na5
Vanadium	0.5	81.4	µg/g	20131204.R13na5
Yttrium	0.5	5.71	µg/g	20131204.R13na5
Zinc	5	369	µg/g	20131204.R13na5
Zirconium	0.5	2.5	µg/g	20131204.R13na5

MDL Method detection limit or minimum reporting limit.
% Rec Surrogate compounds are added to the sample in some cases and the recovery is reported as a percent recovered.
QAQCID This is a unique reference to the quality control data set used to generate the reported value.
Data reported for organic analysis in soil samples are corrected for moisture content
Matrix If the matrix is a leachate, the sample was extracted according to regulation 558.
INT Interferences
TNTC Too numerous to count
ND Not detected

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Quality Control Data:

ICPMS Soil

Method Blank						
Parameter	**MDL**	**Units**	**LCL**	**Result**	**UCL**	**QAQCID**
Aluminum	0.5	µg/g	<0.5	<0.5	2	20131204.R13na5
Antimony	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Arsenic	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Barium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Beryllium	0.5	µg/g	<0.5	<0.5	2.5	20131204.R13na5
Bismuth	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cadmium	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Calcium	30	µg/g	<30	<30	50	20131204.R13na5
Cerium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cesium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Chromium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Cobalt	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Copper	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Europium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Gallium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Iron	10	µg/g	<10	<10	10	20131204.R13na5
Lanthanum	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Lead	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Magnesium	2	µg/g	<2	<2	3	20131204.R13na5
Manganese	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Mercury	0.05	µg/g	<0.05	<0.05	0.5	20131204.R13na5
Molybdenum	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Nickel	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Niobium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Phosphorus	30	µg/g	<30	<30	30	20131204.R13na5
Potassium	10	µg/g	<10	<10	50	20131204.R13na5
Rubidium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Scandium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Selenium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Silver	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Sodium	10	µg/g	<10	<10	50	20131204.R13na5
Strontium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Thallium	0.3	µg/g	<0.3	<0.3	0.5	20131204.R13na5
Thorium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Tin	0.5	µg/g	<0.5	<0.5	2.5	20131204.R13na5
Titanium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Tungsten	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Uranium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Vanadium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Yttrium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5
Zinc	0.5	µg/g	<0.5	<0.5	1	20131204.R13na5
Zirconium	0.5	µg/g	<0.5	<0.5	0.5	20131204.R13na5

APPENDIX B

Photos

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 1

13-1426-0010 CTP GA13-TP09 as received

Observations:

- -Received weight = 20.97Kg
- -Till and lots of clay
- -mixed well, no clay balls after mixing
- -no water bleed
- -sticky material
- -As received moisture = 81.27wt% solids
- -Water added = 1580mL
- -Final moisture = 74.61 wt% solids

Photograph 2

13-1426-0010 CTP GA13-TP09 as received - cross section

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 3

13-1426-0010 CTP GA13-TP09 homogenized

Photograph 4

13-1426-0010 CTP GA13-TP10 as received

Observations:
- received weight = 7.41 Kg
- sample came in wet
- pail had hole in bottom, lost some sample and water
- till + lots of clay present
- mixed well, no clay balls after mixing
- small amount of water bleed
- sticky material
- as received moisture= 74.96 wt% solids
- water added = 320 mL
- Final moisture = 71.74 wt% solids

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Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 5

13-1426-0010 CTP GA13-TP10 as received - cross section

Photograph 6

13-1426-0010 CTP GA13-TP10 homogenized

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 7

13-1426-0010 CTP – GA13-TP11 as received

Observations:

- received weight = 14.98 Kg
- Till + clay
- sticky material
- No water bleed
- mixed well, no clay balls present after mixing
- as received moisture = 80.5 wt% solids
- water added = 470 mL
- final moisture = 75.48 wt% solids

Photograph 8

13-1426-0010 CTP – GA13-TP11 as received - cross section

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 9

13-1426-0010 CTP – GA13-TP11 homogenized

Photograph 10

13-1426-0010 CTP - GA13-TP14-1 as received

Observations:

- received weight = 12 Kg
- sand, silt and small amount of clay present
- mixed well, no clay balls present after mixing
- bleeds water as soon as mixing stops
- as received moisture = 88.4 wt% solids
- water added = 1600 mL
- final moisture = 76.73 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 11	
13-1426-0010 CTP - GA13-TP14-1 as received - cross section	
Photograph 12	
13-1426-0010 CTP - GA13-TP14-1 homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 13

13-1426-0010 CTP - GA13-TP14-2 as received

Observations:

- received weight – 15.18 Kg
- silt and clay present
- mixed well, no clay balls present after mixing
- slow water bleed after mixing stops
- sticky material
- as received moisture = 76.27 wt% solids
- water added = 1000 mL

Final moisture = 71.24 wt% solids

Photograph 14

13-1426-0010 CTP - GA13-TP14-2 as received – cross section

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Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 15

13-1426-0010 CTP - GA13-TP14-2 homogenized

Photograph 16

13-1426-0010 CTP - GA13-TP15 as received

Observations:

- received weight = 13.82 Kg
- silt and sand with very little clay visible
- bleeds water
- Mixed well, no clay balls present after mixing
- as received moisture = 92.83 wt% solids
- water added = 2770 mL
- final moisture = 77.14 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 17

13-1426-0010 CTP - GA13-TP15 as received – cross section

Photograph 18

13-1426-0010 CTP - GA13-TP15 homogenized

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 19 13-1426-0010 CTP - GA13-TP16 as received Observations: - received weight = 12.76 Kg - silt, sand, and some clay present - Bleeds water - mixes well, no clay balls present after mixing - as received moisture = 89.22 wt% solids - water added = 2270 mL - final moisture = 77.35 wt% solids	
Photograph 20 13-1426-0010 CTP - GA13-TP16 as received – cross section	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 21

13-1426-0010 CTP - GA13-TP16 Homogenized

Photograph 22

13-1426-0010 CTP - GA13-TP18 as received

Observations:

- received weight – 13.49 Kg
- sand, silt, and very little clay present
- bleeds water
- mixes well, no clay balls present after mixing
- as received moisture = 89.12 wt% solids
- water added = 1700 mL
- final moisture = 76.17 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	
Photograph 23 13-1426-0010 CTP - GA13-TP18 as received – cross section	
Photograph 24 13-1426-0010 CTP - GA13-TP18 Homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 25

13-1426-0010 CTP - GA13-TP19 as received

Observations:

- received weight = 12.04 Kg
- sand, silt, and small amount of clay present
- bleeds water
- mixes well, no clay balls present after mixing
- as received moisture = 90.06 wt% solids
- water added = 2000 mL
- final moisture = 76.11 wt% solids

Photograph 26

13-1426-0010 CTP - GA13-TP19 as received – cross section

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 27

13-1426-0010 CTP - GA13-TP19 Homogenized

Photograph 28

13-1426-0010 CTP - GA13-TP20 as received

Observations:

- received weight = 8.96 Kg
- sand, silt, and some clay present
- mixes well, no clay balls present after mixing
- bleeds water
- as received moisture = 82.17 wt% solids
- water added = 1300 mL
- final moisture = 72.64 wt% solids

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Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 29 13-1426-0010 CTP - GA13-TP20 as received – cross section	
Photograph 30 13-1426-0010 CTP - GA13-TP20 Homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 31 13-1426-0010 CTP - GA13-TP26 as received Observations: - received weight – 13.61 Kg - silt and clay mix - mixed well, no clay balls present after mixing - no water bleed - as received moisture = 81.12 wt% solids - water added = 1500 mL - final moisture = 72.60 wt% solids	
Photograph 32 13-1426-0010 CTP - GA13-TP26 as received – cross section	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 33

13-1426-0010 CTP - GA13-TP26 Homogenized

Photograph 34

13-1426-0010 STP - GA13-TP27 as received

Observations:

- received weight = 18.44 Kg
- silt, sand, and clay
- various colours present in sample (orange, gold, brown)
- mixes well, no clay balls present after mixing
- bleeds water slightly
- slightly sticky
- as received moisture = 81.99 wt% solids
- water added = 1400 mL
- final moisture = 74.73 wt%solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	
Photograph 35 13-1426-0010 STP - GA13-TP27 as received – cross section	
Photograph 36 13-1426-0010 STP - GA13-TP27 Homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 37 13-1426-0010 STP - GA13-TP35 as received Observations: - received weight = 10.5 Kg - till and clay present - mizes well, no clay balls present after mixing - bleeds water slightly - as received moisture = 86.28 wt% solids - water added = 1000 mL - final moisture = 76.70 wt% solids	
Photograph 38 13-1426-0010 STP - GA13-TP35 as received – cross section	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 39 13-1426-0010 STP - GA13-TP35 homogenized	
Photograph 40 13-1426-0010 STP - GA13-TP36 as received Observations: - received weight = 12.61 Kg - mostly clay with some silt present - no water bleed - mixed well, no clay balls present after mixing - very sticky material - as received moisture = 71.61 wt% solids - water added = 770m mL - final moisture = 68.3 wt% solids	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 41

13-1426-0010 STP - GA13-TP36 as received – cross section

Photograph 42

13-1426-0010 STP - GA13-TP36 homogenized

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 43

13-1426-0010 STP - GA13-TP38 as received

Observations:

- received weight = 16.93 Kg
- Till and clay (very moist)
- mixes well, no clay balls present after mixing
- bleeds water slightly
- sticy material
- as received moisture = 70.54 wt% solids
- water added = 1160 mL
- final moisture = 66.9 wt% solids

Photograph 44

13-1426-0010 STP - GA13-TP38 as received – cross section

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 45

13-1426-0010 STP - GA13-TP38 homogenized

Photograph 46

13-1426-0010 STP - GA13-TP41 as received

Observations:

- received weight = 7.77 Kg
- till and clay
- received sample wet
- no water bleed
- mixes well, no clay balls present and mixing
- sticky material
- as received moisture = 68.12 wt% solids
- no water added to sample to homogenize

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	
Photograph 47 13-1426-0010 STP - GA13-TP41 as received – cross section	
Photograph 48 13-1426-0010 STP - GA13-TP41 homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 49 13-1426-0010 STP - GA13-TP52 as received Observations: - received weight = 15.78 Kg - till and clay - no water bleed - slightly sticky material - mixes well, no clay balls present after mixing - as received moisture = 76.75 wt% solids - water added = 500 mL - final moisture = 72.92 wt% solids	
Photograph 50 13-1426-0010 STP - GA13-TP52 as received – cross section	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

Photograph 51

13-1426-0010 STP - GA13-TP52 homogenized

Photograph 52

13-1426-0010 SCTP - BS - Silty Sand as received

Observations:

- received weight – 244.8 Kg
- sand/silt with some clay balls present
- bleeds water as soon as mixing stops
- no clay balls present after mixing
- as received moisture = 90.4 wt% solids
- water added = 38.6L
- final moisture = 75.71 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 53

13-1426-0010 SCTP - BS - Silty Sand as received – cross section

Photograph 54

13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay) as received

Observations:

- received weight = 271.56 Kg
- sand, silt, and clay chunks
- bleeds water as soon as mixing stops
- took a while to break clay balls with mixer
- as received moisture = 86.94 wt% solids
- water added = 35.15L
- final moisture = 72.92 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 55

13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay) as received – cross section

Photograph 56

13-1426-0010 SCTP - BS - Clay – Silt as received

Observations:

- received weight = 127.27 Kg
- chunks of clay with silt
- sample came in wet
- very sticky material
- no water bleed
- mixed well with no clay balls present after mixing
- as received moisture = 74.07 wt% solids
- water added = 7.26L
- final moisture = 69.84 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 57

13-1426-0010 SCTP - BS - Clay – Silt as received – cross section

Photograph 58

13-1426-0010 SCTP - BS - Clay - Silt (S2) as received

Observations:

- received weight – 191.96 Kg
- mostly sand with some balls/chunks of clay
- bleeds water as soon as mixing stops
- bottom of drum had more clay than the top portion
- mixes well with no clay chunks after mixing
- as received moisture = 92.49 wt% solids
- water added = 11.83 Kg
- final moisture = 76.98 wt% solids

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 59 13-1426-0010 SCTP - BS - Clay - Silt (S2) as received – cross section	
Photograph 60 13-1426-0010 SCTP - BS - Clay - Silt (S2) homogenized	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 61 13-1426-0010 CTP - GA13-TP15 178mm Slump	
Photograph 62 13-1426-0010 CTP - GA13-TP15 254mm Slump	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 63 13-1426-0010 STP - GA13-TP38 178mm Slump	
Photograph 64 13-1426-0010 STP - GA13-TP38 254mm Slump	

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 65 13-1426-0010 SCTP - BS - Silty Sand 178mm Slump	
Photograph 66 13-1426-0010 SCTP - BS - Silty Sand 254mm Slump	

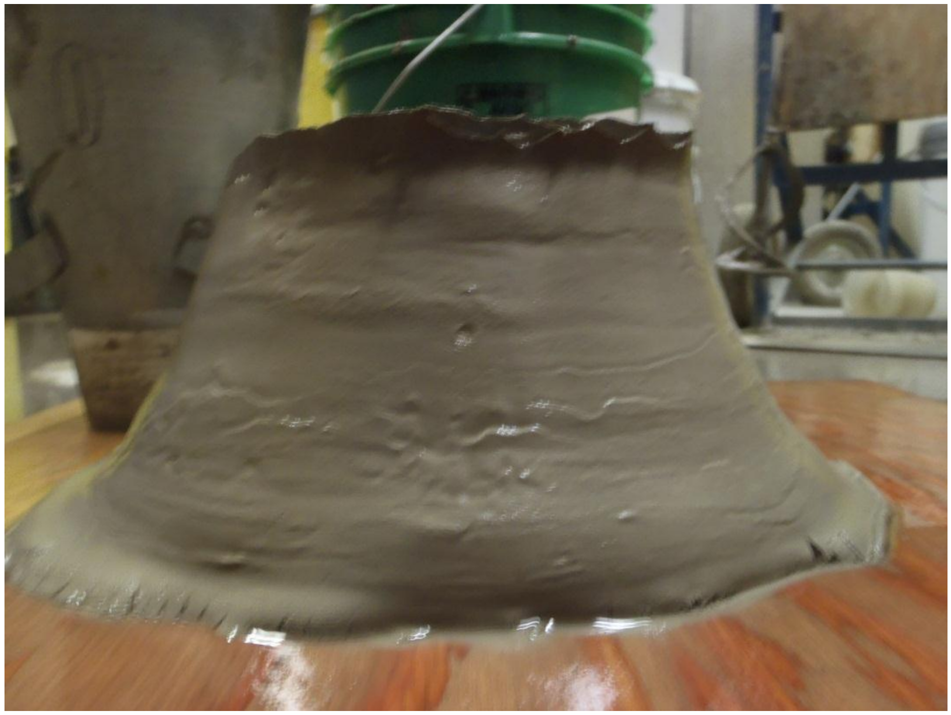
Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 67 13-1426-0010 CTP – GA13 –TP14-2 178mm Slump	
Photograph 68 13-1426-0010 CTP – GA13 –TP14-2 254mm Slump	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	

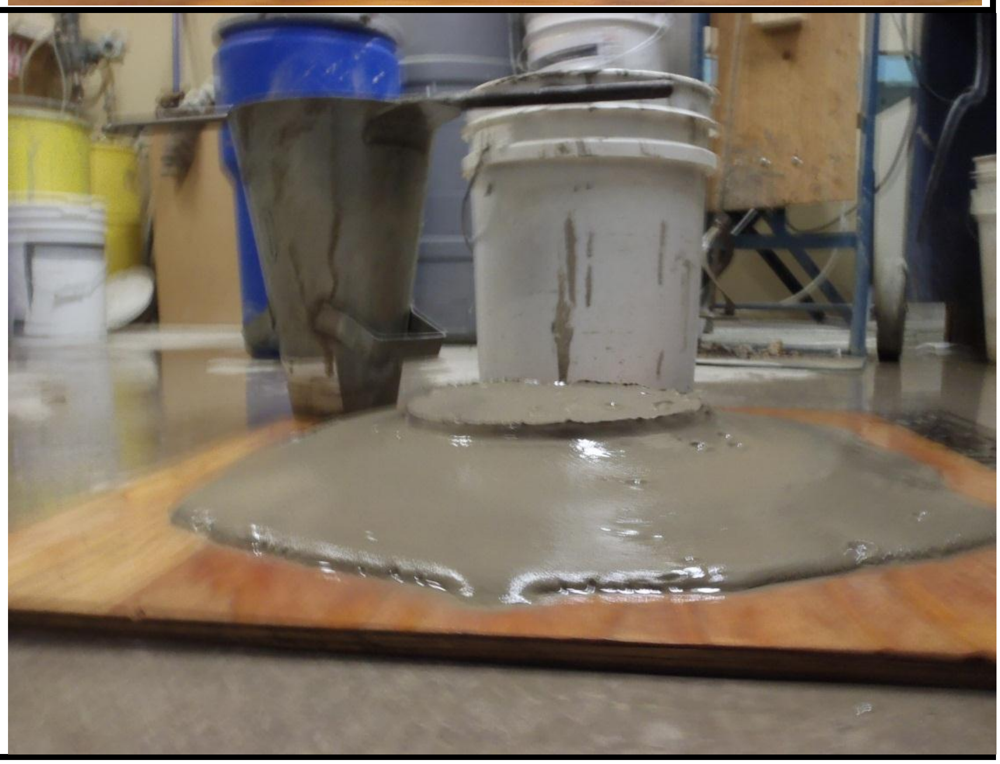
Photograph 69

13-1426-0010 SCTP - BS – Clay-Silt 178mm Slump



Photograph 70

13-1426-0010 SCTP - BS – Clay-Silt 254mm Slump

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Sudbury Laboratory	
Photograph 71 13-1426-0010 SCTP – BS – Mixed (Silt - Sand - Clay) 178mm Slump	
Photograph 72 13-1426-0010 SCTP – BS – Mixed (Silt - Sand - Clay) 254mm Slump	

Golder Associates

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Sudbury Laboratory	

Photograph 73 13-1426-0010 STP – GA13 – TP27 178mm Slump	
Photograph 74 13-1426-0010 STP – GA13 – TP27 254mm Slump	

END OF DOCUMENT

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APPENDIX C

Rheograms

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	12/3/2013
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**12/5/2013**
Data Review	**1st Review**	**Complete**	**CA**	**12/5/2013**
	2nd Review	**Complete**	**ML**	**12/5/2013**

Sample ID:	13-1426-0010 CTP - GA13-TP15
Sample Description:	coarse, dark brown material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.83

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	0.5338	0.4903	0.4413	0.488
2	0.3610	0.3796	0.3576	0.366
3	0.2649	0.2693	0.2652	0.266
4	0.1108	0.1132	0.1089	0.111
5	0.0335	0.0329	0.0330	0.033
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
0.5011	0.4852	0.4746	0.487
0.3885	0.3919	0.3646	0.382
0.3050	0.3041	0.3080	0.306
0.1197	0.1209	0.1175	0.119
0.0368	0.0371	0.0364	0.037

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	48.2150	53.1899	71.2924	58
2	52.3876	49.2982	43.9033	49
3	52.6106	49.9730	55.4771	53
4	19.5248	18.7665	19.3227	19
5	5.7117	5.9028	5.3996	6
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
58.6723	56.3238	51.8377	56
38.2012	40.0758	39.0847	39
23.9359	24.1377	24.9465	24
10.8839	10.8103	10.9874	11
3.3477	3.2378	3.2942	3

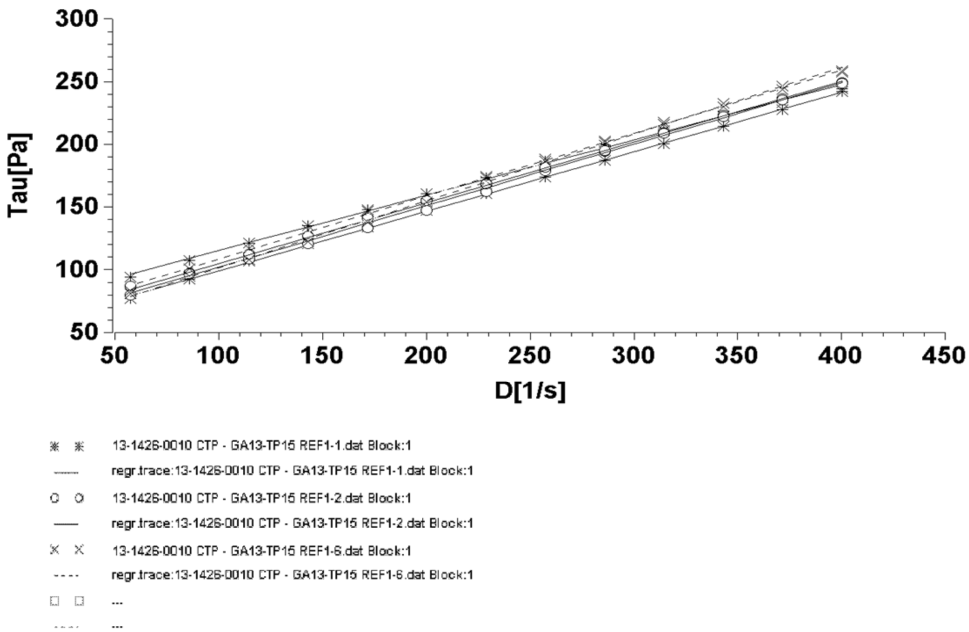
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	12	29.80	54.84	49.30	77.9%	0.55
2	58	30.36	62.63	55.16	76.9%	0.54
3	14	30.12	61.46	53.44	74.4%	0.51
4	35	30.26	53.16	46.78	72.1%	0.48
5	3	30.33	59.97	50.61	68.4%	0.43
6						
7						

Additional Notes:

multiple data sources page 1

09:10 04/12/13
Manual Report Analysis/Regression

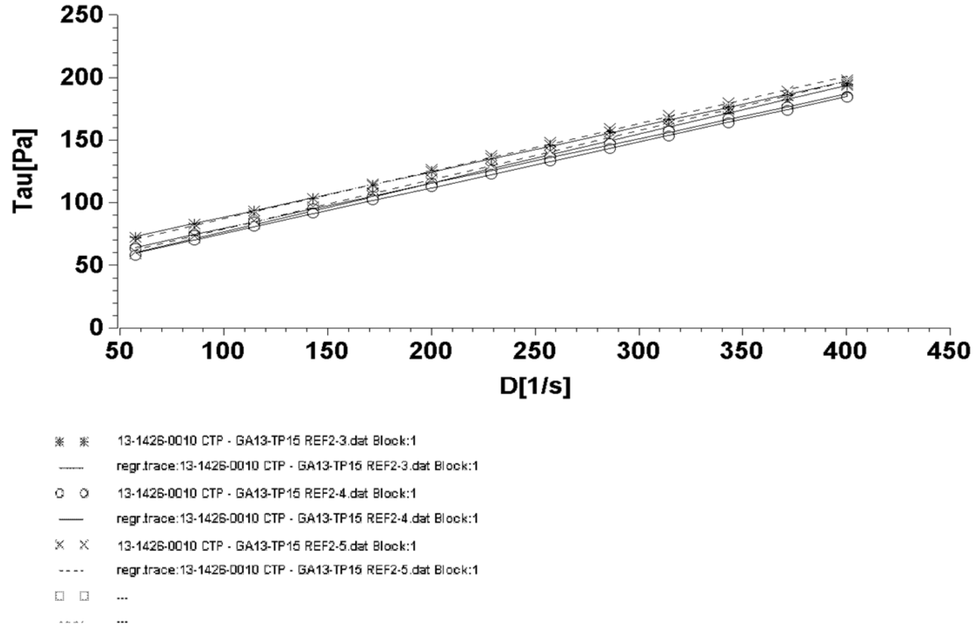


Analysis-results
Analysis data source: 13-1426-0010 CTP - GA13-TP15 REF1-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=71.292+0.44129*X ;B=0.99849; S=1.99
step1: Bingham yieldstress[Pa]=71.2924
step1: Bingham viscosity[Pas]=0.4413
step2: Bingham: Y=51.838+0.47464*X ;B=0.99975; S=0.878
step2: Bingham yieldstress[Pa]=51.8377
step2: Bingham viscosity[Pas]=0.4746

filter activated: D[1/s]>40
step1: Bingham: Y=53.19+0.49028*X ;B=0.99745; S=2.88
step1: Bingham yieldstress[Pa]=53.1899
step1: Bingham viscosity[Pas]=0.4903
step2: Bingham: Y=56.324+0.48518*X ;B=0.99909; S=1.7
step2: Bingham yieldstress[Pa]=56.3238
step2: Bingham viscosity[Pas]=0.4852

filter activated: D[1/s]>40
step1: Bingham: Y=48.215+0.53379*X ;B=0.99921; S=1.74
step1: Bingham yieldstress[Pa]=48.215
step1: Bingham viscosity[Pas]=0.5338
step2: Bingham: Y=58.672+0.50112*X ;B=0.99899; S=1.85
step2: Bingham yieldstress[Pa]=58.6723
step2: Bingham viscosity[Pas]=0.5011
End of report

09:11 04/12/13
Manual Report Analysis/Regression



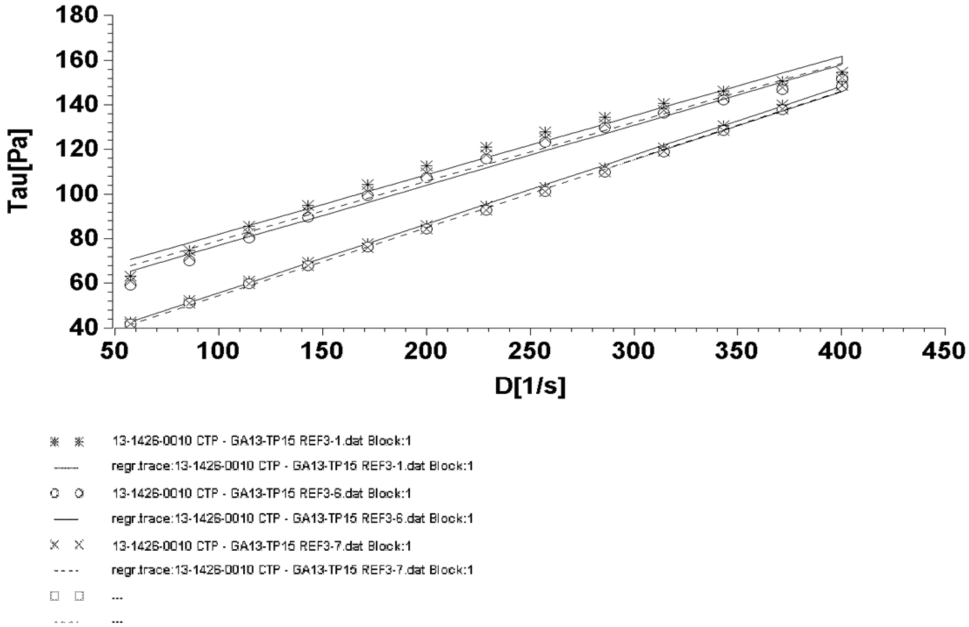
Analysis-results
Analysis data source: 13-1426-0010 CTP - GA13-TP15 REF2-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=52.388+0.36099*X ;B=0.99944; S=0.99
step1: Bingham yieldstress[Pa]=52.3876
step1: Bingham viscosity[Pas]=0.361
step2: Bingham: Y=38.201+0.38854*X ;B=0.99983; S=0.585
step2: Bingham yieldstress[Pa]=38.2012
step2: Bingham viscosity[Pas]=0.3885

filter activated: D[1/s]>40
step1: Bingham: Y=43.903+0.35761*X ;B=0.99961; S=0.823
step1: Bingham yieldstress[Pa]=43.9033
step1: Bingham viscosity[Pas]=0.3576
step2: Bingham: Y=39.085+0.3646*X ;B=0.99963; S=0.817
step2: Bingham yieldstress[Pa]=39.0847
step2: Bingham viscosity[Pas]=0.3646

filter activated: D[1/s]>40
step1: Bingham: Y=49.298+0.37957*X ;B=0.99868; S=1.6
step1: Bingham yieldstress[Pa]=49.2982
step1: Bingham viscosity[Pas]=0.3796
step2: Bingham: Y=40.076+0.39195*X ;B=0.99975; S=0.717
step2: Bingham yieldstress[Pa]=40.0758
step2: Bingham viscosity[Pas]=0.3919
End of report

multiple data sources

09:12 04/12/13
Manual Report Analysis/Regression

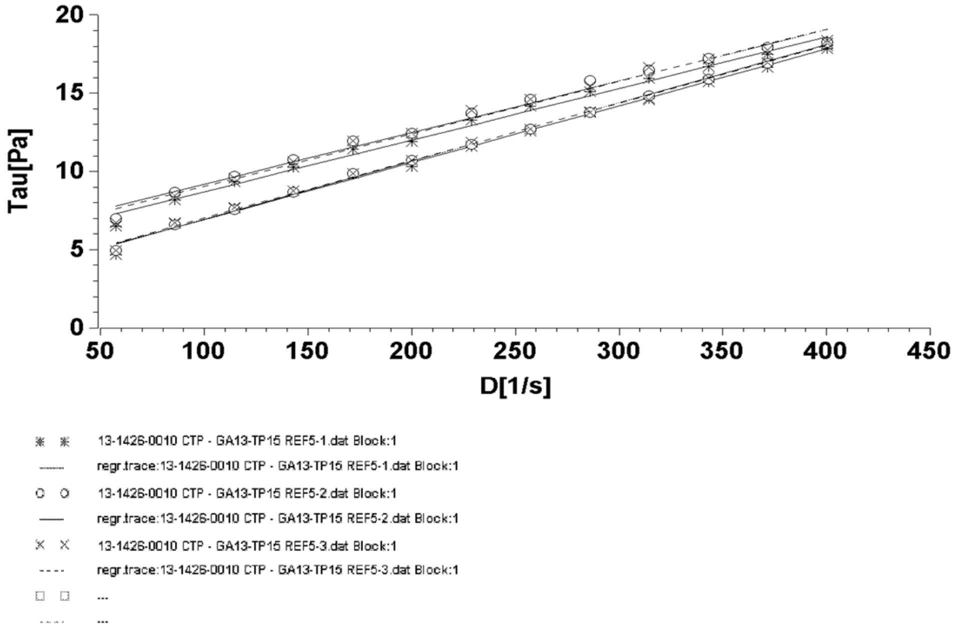


Analysis-results
Analysis data source: 13-1426-0010 CTP - GA13-TP15 REF3-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=55.477+0.26522*X ;B=0.98039; S=4.36
step1: Bingham yieldstress[Pa]=55.4771
step1: Bingham viscosity[Pas]=0.2652
step2: Bingham: Y=24.946+0.308*X ;B=0.99895; S=1.16
step2: Bingham yieldstress[Pa]=24.9465
step2: Bingham viscosity[Pas]=0.308

filter activated: D[1/s]>40
step1: Bingham: Y=49.973+0.26928*X ;B=0.9851; S=3.85
step1: Bingham yieldstress[Pa]=49.973
step1: Bingham viscosity[Pas]=0.2693
step2: Bingham: Y=24.138+0.30406*X ;B=0.99906; S=1.08
step2: Bingham yieldstress[Pa]=24.1377
step2: Bingham viscosity[Pas]=0.3041

filter activated: D[1/s]>40
step1: Bingham: Y=52.611+0.26494*X ;B=0.98283; S=4.07
step1: Bingham yieldstress[Pa]=52.6106
step1: Bingham viscosity[Pas]=0.2649
step2: Bingham: Y=23.936+0.30504*X ;B=0.99891; S=1.17
step2: Bingham yieldstress[Pa]=23.9359
step2: Bingham viscosity[Pas]=0.305
End of report

09:16 04/12/13
Manual Report Analysis/Regression



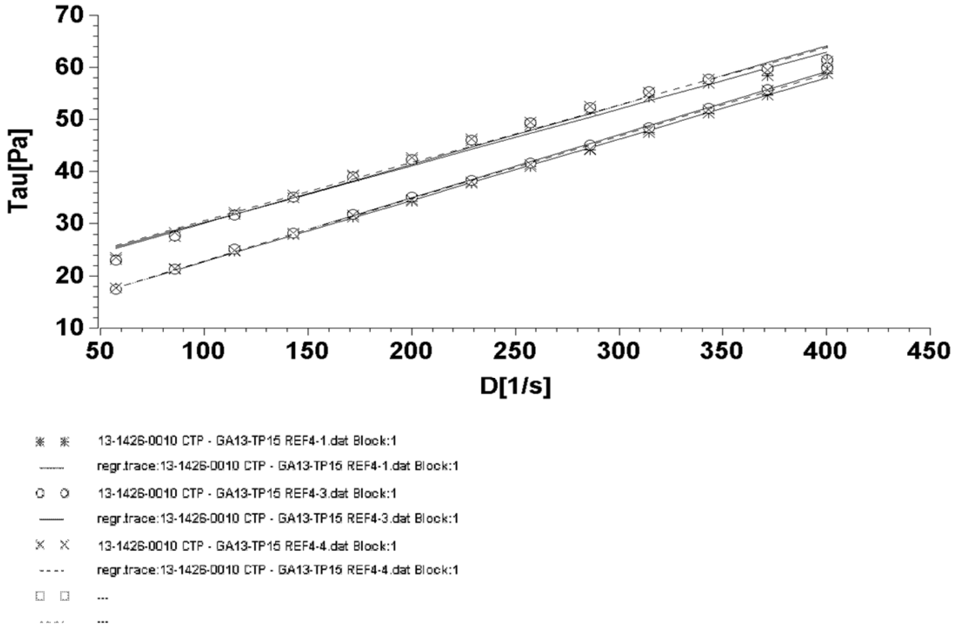
Analysis-results
Analysis data source: 13-1426-0010 CTP - GA13-TP15 REF5-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=5.3996+0.033023*X ;B=0.99131; S=0.359
step1: Bingham yieldstress[Pa]=5.3996
step1: Bingham viscosity[Pas]=0.033
step2: Bingham: Y=3.2942+0.036369*X ;B=0.99562; S=0.28
step2: Bingham yieldstress[Pa]=3.2942
step2: Bingham viscosity[Pas]=0.0364

filter activated: D[1/s]>40
step1: Bingham: Y=5.9028+0.032919*X ;B=0.98757; S=0.429
step1: Bingham yieldstress[Pa]=5.9028
step1: Bingham viscosity[Pas]=0.0329
step2: Bingham: Y=3.2378+0.037144*X ;B=0.99826; S=0.18
step2: Bingham yieldstress[Pa]=3.2378
step2: Bingham viscosity[Pas]=0.0371

filter activated: D[1/s]>40
step1: Bingham: Y=5.7117+0.033501*X ;B=0.98613; S=0.462
step1: Bingham yieldstress[Pa]=5.7117
step1: Bingham viscosity[Pas]=0.0335
step2: Bingham: Y=3.3477+0.036764*X ;B=0.99719; S=0.227
step2: Bingham yieldstress[Pa]=3.3477
step2: Bingham viscosity[Pas]=0.0368
End of report

multiple data sources page 1

09:14 04/12/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 CTP - GA13-TP15 REF4-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=19.323+0.1089*X ;B=0.98468; S=1.58
step1: Bingham yieldstress[Pa]=19.3227
step1: Bingham viscosity[Pas]=0.1089
step2: Bingham: Y=10.987+0.11748*X ;B=0.99938; S=0.339
step2: Bingham yieldstress[Pa]=10.9874
step2: Bingham viscosity[Pas]=0.1175

filter activated: D[1/s]>40
step1: Bingham: Y=18.767+0.11322*X ;B=0.98892; S=1.39
step1: Bingham yieldstress[Pa]=18.7665
step1: Bingham viscosity[Pas]=0.1132
step2: Bingham: Y=10.81+0.12089*X ;B=0.99945; S=0.33
step2: Bingham yieldstress[Pa]=10.8103
step2: Bingham viscosity[Pas]=0.1209

filter activated: D[1/s]>40
step1: Bingham: Y=19.525+0.11078*X ;B=0.98785; S=1.43
step1: Bingham yieldstress[Pa]=19.5248
step1: Bingham viscosity[Pas]=0.1108
step2: Bingham: Y=10.884+0.11971*X ;B=0.9989; S=0.462
step2: Bingham yieldstress[Pa]=10.8839
step2: Bingham viscosity[Pas]=0.1197
End of report

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mine
Project Number:	13-1426-0010
Date:	12/3/2013
Technologist	CJC

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**12/4/2013**
Data Review	**1st Review**	**Complete**	**CA**	**12/4/2013**
	2nd Review	**Complete**	**ML**	**12/4/2013**

Sample ID:	13-1426-0010 STP - GA13 - TP38
Sample Description:	Fine greyish brown material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.69

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	1.5975	1.6049	1.7287	1.644
2	0.9609	1.0312	1.0082	1.000
3	0.4560	0.5517	0.5776	0.528
4	0.2304	0.2297	0.2399	0.233
5	0.0919	0.0937	0.0956	0.094
6	0.0494	0.0493	0.0521	0.050
7	0.0238	0.0239	0.0235	0.024

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
1.8213	1.8516	1.7764	1.816
1.0401	1.0720	1.0855	1.066
0.5892	0.6197	0.6216	0.610
0.2838	0.2668	0.2891	0.280
0.1141	0.1119	0.1142	0.113
0.0531	0.0532	0.0538	0.053
0.0233	0.0230	0.0240	0.023

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	805.8629	768.3056	781.5014	785
2	494.6412	477.5789	491.0321	488
3	354.2079	335.6710	321.6282	337
4	183.0677	172.3010	182.7526	179
5	91.5078	88.9613	90.9444	90
6	47.0538	47.5368	47.4477	47
7	19.7419	18.9251	19.9241	20

Ramp Down

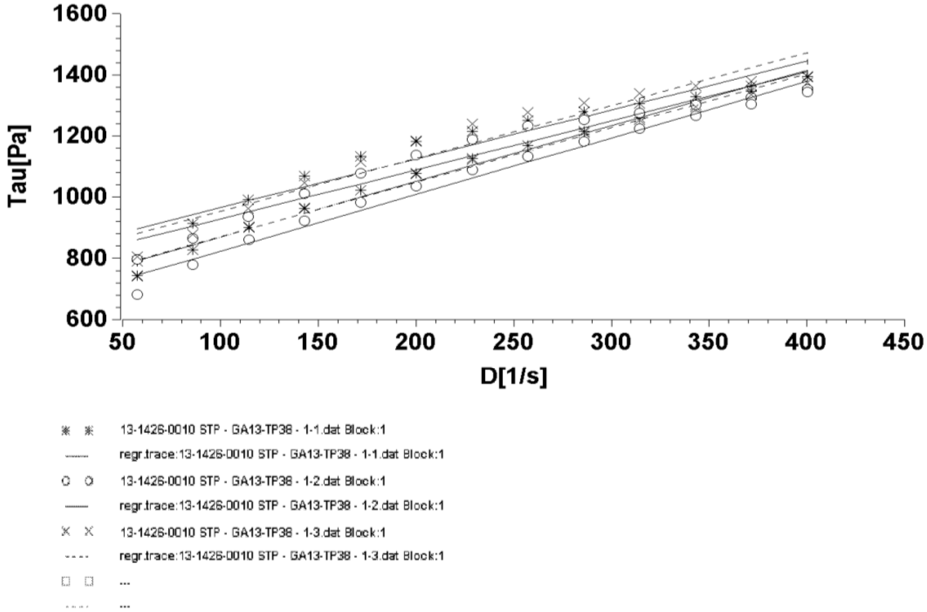
Trial 1	Trial 2	Trial 3	AVG
687.2435	638.8650	693.7880	673
450.9390	449.2406	458.1900	453
304.5041	309.9102	306.1957	307
168.0362	162.3977	169.1041	167
85.2695	84.3810	86.3901	85
46.1139	46.7091	47.0746	47
20.0277	19.3358	19.8079	20

WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	55	6.84	19.26	15.09	66.4%	0.42
2	65	6.68	21.91	16.61	65.2%	0.41
3	11x	6.10	18.69	14.15	63.9%	0.40
4	57	6.75	17.10	13.13	61.6%	0.37
5	x10	6.08	22.33	15.68	59.1%	0.35
6	x24	6.24	23.77	16.14	56.5%	0.33
7	x15	6.03	21.03	13.93	52.7%	0.29

Additional Notes:

14:29 03/12/13
Manual Report Analysis/Regression



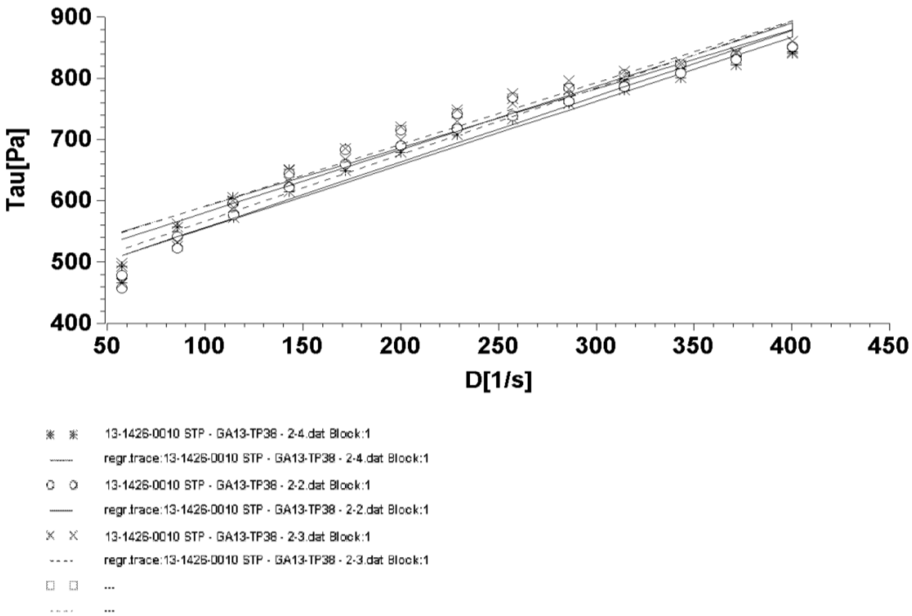
Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 1-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=805.86+1.5975*X ;B=0.93182; S=50.2
step1: Bingham yieldstress[Pa]=805.8629
step1: Bingham viscosity[Pas]=1.5975
step2: Bingham: Y=687.24+1.8213*X ;B=0.98851; S=22.8
step2: Bingham yieldstress[Pa]=687.2435
step2: Bingham viscosity[Pas]=1.8213

filter activated: D[1/s]>40
step1: Bingham: Y=768.31+1.6049*X ;B=0.94738; S=44
step1: Bingham yieldstress[Pa]=768.3056
step1: Bingham viscosity[Pas]=1.6049
step2: Bingham: Y=638.87+1.8516*X ;B=0.98217; S=29
step2: Bingham yieldstress[Pa]=638.865
step2: Bingham viscosity[Pas]=1.8516

filter activated: D[1/s]>40
step1: Bingham: Y=781.5+1.7287*X ;B=0.93725; S=52
step1: Bingham yieldstress[Pa]=781.5014
step1: Bingham viscosity[Pas]=1.7287
step2: Bingham: Y=693.79+1.7764*X ;B=0.98479; S=25.7
step2: Bingham yieldstress[Pa]=693.788
step2: Bingham viscosity[Pas]=1.7764
End of report

multiple data sources

14:33 03/12/13
Manual Report Analysis/Regression

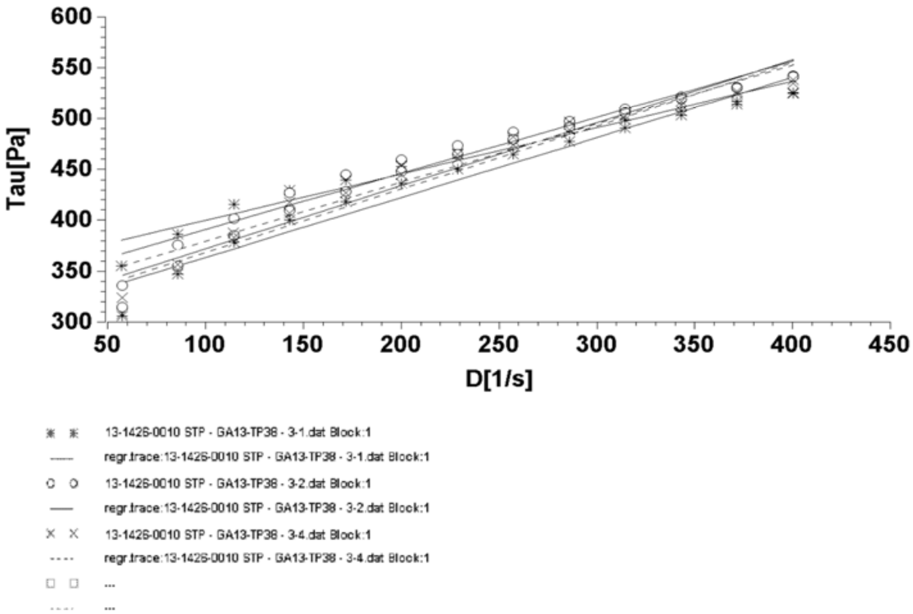


Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 2-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=494.64+0.96089*X ;B=0.93927; S=28.4
step1: Bingham yieldstress[Pa]=494.6412
step1: Bingham viscosity[Pas]=0.9609
step2: Bingham: Y=450.94+1.0401*X ;B=0.96998; S=21.3
step2: Bingham yieldstress[Pa]=450.939
step2: Bingham viscosity[Pas]=1.0401

filter activated: D[1/s]>40
step1: Bingham: Y=477.58+1.0312*X ;B=0.94067; S=30.1
step1: Bingham yieldstress[Pa]=477.5789
step1: Bingham viscosity[Pas]=1.0312
step2: Bingham: Y=449.24+1.072*X ;B=0.9615; S=24.9
step2: Bingham yieldstress[Pa]=449.2406
step2: Bingham viscosity[Pas]=1.072

filter activated: D[1/s]>40
step1: Bingham: Y=491.03+1.0082*X ;B=0.95124; S=26.5
step1: Bingham yieldstress[Pa]=491.0321
step1: Bingham viscosity[Pas]=1.0082
step2: Bingham: Y=458.19+1.0855*X ;B=0.95856; S=26.2
step2: Bingham yieldstress[Pa]=458.19
step2: Bingham viscosity[Pas]=1.0855
End of report

14:37 03/12/13
Manual Report Analysis/Regression

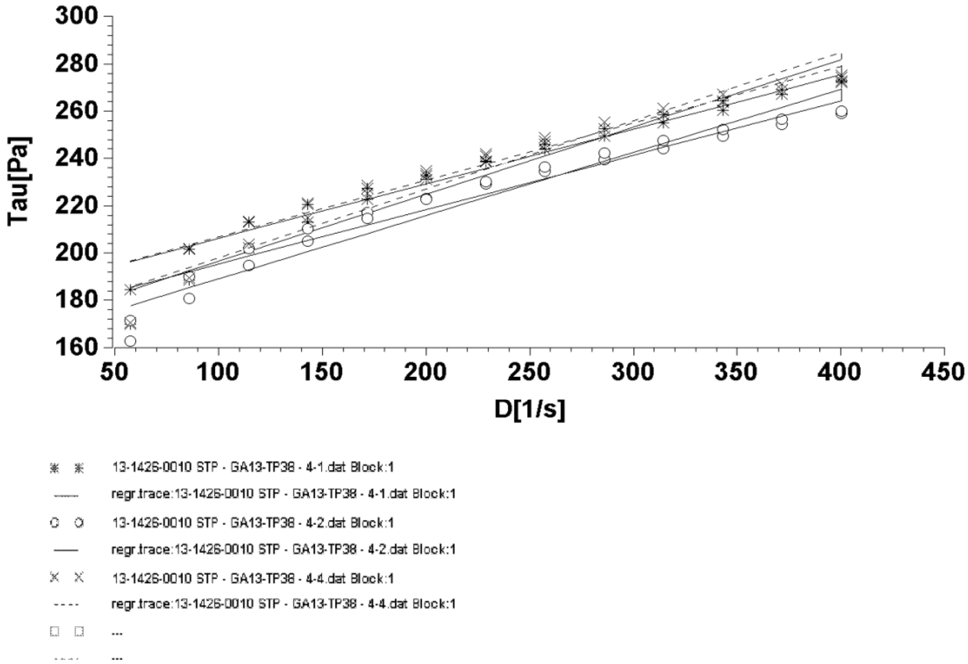


Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 3-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=354.21+0.45604*X ;B=0.95997; S=10.8
step1: Bingham yieldstress[Pa]=354.2079
step1: Bingham viscosity[Pas]=0.456
step2: Bingham: Y=304.5+0.5892*X ;B=0.95892; S=14.2
step2: Bingham yieldstress[Pa]=304.5041
step2: Bingham viscosity[Pas]=0.5892

filter activated: D[1/s]>40
step1: Bingham: Y=335.67+0.5517*X ;B=0.95528; S=13.9
step1: Bingham yieldstress[Pa]=335.671
step1: Bingham viscosity[Pas]=0.5517
step2: Bingham: Y=309.91+0.61971*X ;B=0.96288; S=14.1
step2: Bingham yieldstress[Pa]=309.9102
step2: Bingham viscosity[Pas]=0.6197

filter activated: D[1/s]>40
step1: Bingham: Y=321.63+0.57758*X ;B=0.94632; S=16
step1: Bingham yieldstress[Pa]=321.6282
step1: Bingham viscosity[Pas]=0.5776
step2: Bingham: Y=306.2+0.62163*X ;B=0.95884; S=15
step2: Bingham yieldstress[Pa]=306.1957
step2: Bingham viscosity[Pas]=0.6216
End of report

14:38 03/12/13
Manual Report Analysis/Regression

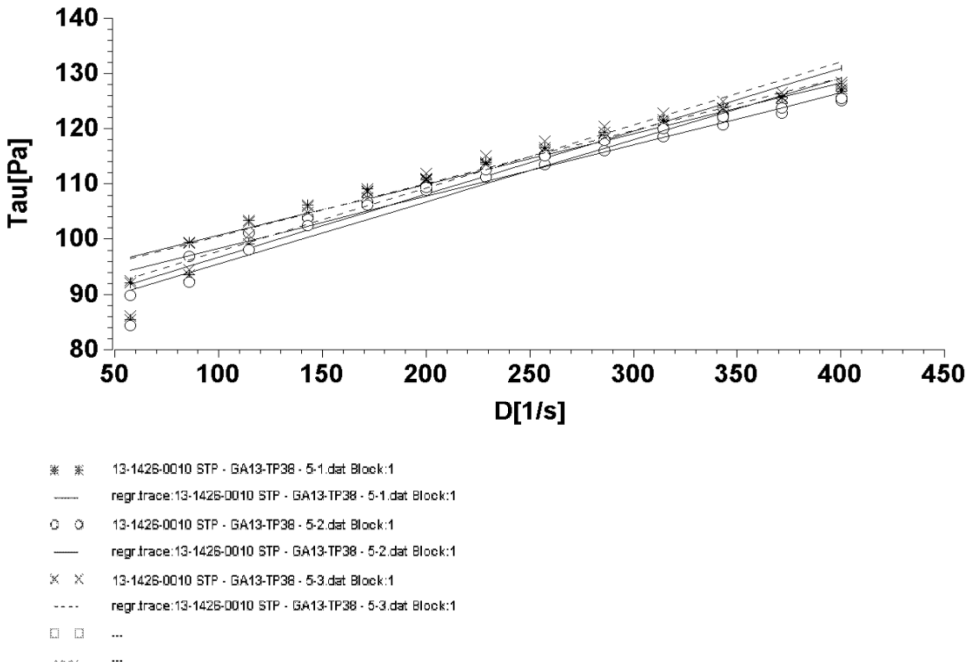


Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 4-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=183.07+0.23043*X ;B=0.97134; S=4.6
step1: Bingham yieldstress[Pa]=183.0677
step1: Bingham viscosity[Pas]=0.2304
step2: Bingham: Y=168.04+0.28377*X ;B=0.96112; S=6.63
step2: Bingham yieldstress[Pa]=168.0362
step2: Bingham viscosity[Pas]=0.2838

filter activated: D[1/s]>40
step1: Bingham: Y=172.3+0.22967*X ;B=0.95718; S=5.65
step1: Bingham yieldstress[Pa]=172.301
step1: Bingham viscosity[Pas]=0.2297
step2: Bingham: Y=162.4+0.26676*X ;B=0.95051; S=7.07
step2: Bingham yieldstress[Pa]=162.3977
step2: Bingham viscosity[Pas]=0.2668

filter activated: D[1/s]>40
step1: Bingham: Y=182.75+0.23987*X ;B=0.97004; S=4.9
step1: Bingham yieldstress[Pa]=182.7526
step1: Bingham viscosity[Pas]=0.2399
step2: Bingham: Y=169.1+0.28909*X ;B=0.95684; S=7.14
step2: Bingham yieldstress[Pa]=169.1041
step2: Bingham viscosity[Pas]=0.2891
End of report

14:40 03/12/13
Manual Report Analysis/Regression



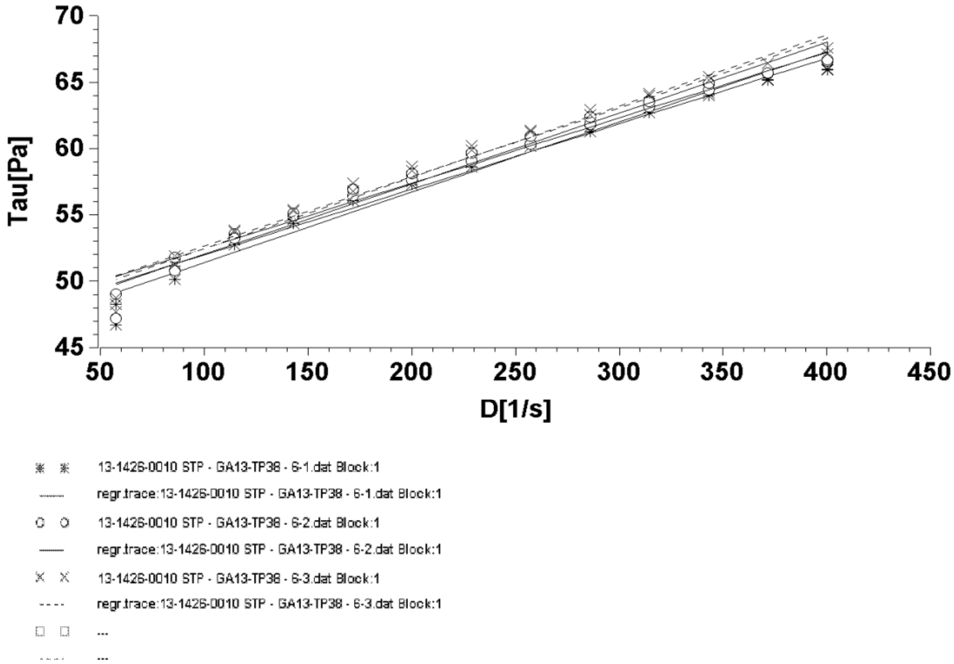
Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 5-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=91.508+0.091927*X ;B=0.97264; S=1.79
step1: Bingham yieldstress[Pa]=91.5078
step1: Bingham viscosity[Pas]=0.0919
step2: Bingham: Y=85.27+0.11413*X ;B=0.95524; S=2.87
step2: Bingham yieldstress[Pa]=85.2695
step2: Bingham viscosity[Pas]=0.1141

filter activated: D[1/s]>40
step1: Bingham: Y=88.961+0.093694*X ;B=0.9754; S=1.73
step1: Bingham yieldstress[Pa]=88.9613
step1: Bingham viscosity[Pas]=0.0937
step2: Bingham: Y=84.381+0.11185*X ;B=0.95143; S=2.94
step2: Bingham yieldstress[Pa]=84.381
step2: Bingham viscosity[Pas]=0.1119

filter activated: D[1/s]>40
step1: Bingham: Y=90.944+0.095622*X ;B=0.98246; S=1.48
step1: Bingham yieldstress[Pa]=90.9444
step1: Bingham viscosity[Pas]=0.0956
step2: Bingham: Y=86.39+0.11423*X ;B=0.95007; S=3.04
step2: Bingham yieldstress[Pa]=86.3901
step2: Bingham viscosity[Pas]=0.1142
End of report

multiple data sources

14:43 03/12/13
Manual Report Analysis/Regression

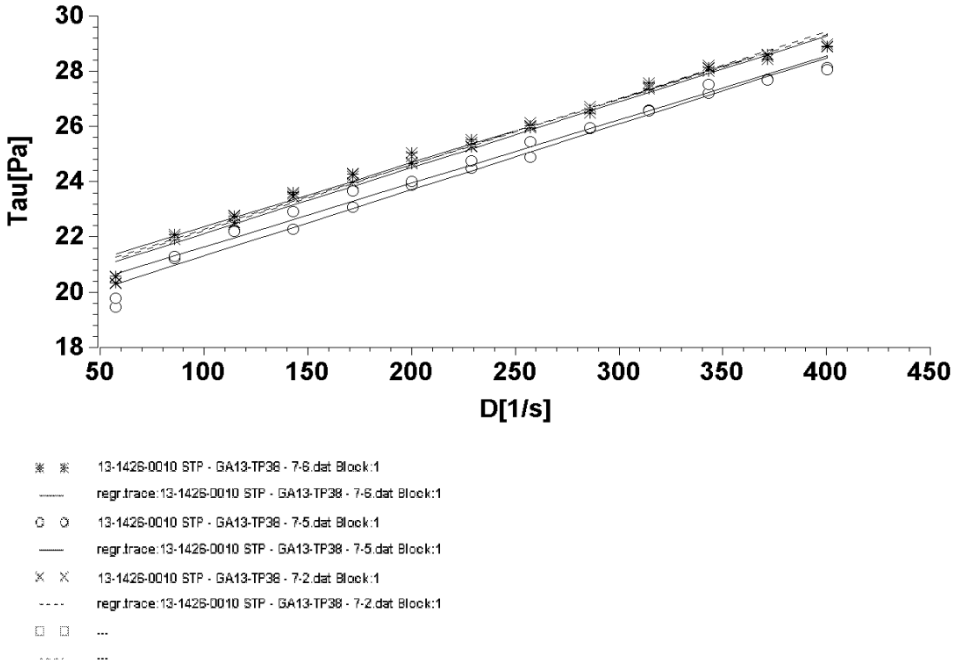


Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 6-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=47.054+0.049404*X ;B=0.98765; S=0.642
step1: Bingham yieldstress[Pa]=47.0538
step1: Bingham viscosity[Pas]=0.0494
step2: Bingham: Y=46.114+0.053052*X ;B=0.97093; S=1.07
step2: Bingham yieldstress[Pa]=46.1139
step2: Bingham viscosity[Pas]=0.0531

filter activated: D[1/s]>40
step1: Bingham: Y=47.537+0.049299*X ;B=0.99222; S=0.507
step1: Bingham yieldstress[Pa]=47.5368
step1: Bingham viscosity[Pas]=0.0493
step2: Bingham: Y=46.709+0.053244*X ;B=0.97035; S=1.08
step2: Bingham yieldstress[Pa]=46.7091
step2: Bingham viscosity[Pas]=0.0532

filter activated: D[1/s]>40
step1: Bingham: Y=47.448+0.052131*X ;B=0.98855; S=0.652
step1: Bingham yieldstress[Pa]=47.4477
step1: Bingham viscosity[Pas]=0.0521
step2: Bingham: Y=47.075+0.053803*X ;B=0.97126; S=1.08
step2: Bingham yieldstress[Pa]=47.0746
step2: Bingham viscosity[Pas]=0.0538
End of report

14:48 03/12/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 STP - GA13-TP38 - 7-6.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=19.742+0.023801*X ;B=0.98678; S=0.32
step1: Bingham yieldstress[Pa]=19.7419
step1: Bingham viscosity[Pas]=0.0238
step2: Bingham: Y=20.028+0.023263*X ;B=0.98614; S=0.32
step2: Bingham yieldstress[Pa]=20.0277
step2: Bingham viscosity[Pas]=0.0233
step1: Bingham: Y=19.742+0.023801*X ;B=0.98678; S=0.32
step1: Bingham yieldstress[Pa]=19.7419
step1: Bingham viscosity[Pas]=0.0238
step2: Bingham: Y=20.028+0.023263*X ;B=0.98614; S=0.32
step2: Bingham yieldstress[Pa]=20.0277
step2: Bingham viscosity[Pas]=0.0233

filter activated: D[1/s]>40
step1: Bingham: Y=18.925+0.023877*X ;B=0.98438; S=0.35
step1: Bingham yieldstress[Pa]=18.9251
step1: Bingham viscosity[Pas]=0.0239
step2: Bingham: Y=19.336+0.023007*X ;B=0.98172; S=0.365
step2: Bingham yieldstress[Pa]=19.3358
step2: Bingham viscosity[Pas]=0.023

filter activated: D[1/s]>40
step1: Bingham: Y=19.924+0.023479*X ;B=0.98926; S=0.284
step1: Bingham yieldstress[Pa]=19.9241
step1: Bingham viscosity[Pas]=0.0235
step2: Bingham: Y=19.808+0.024034*X ;B=0.98539; S=0.34
step2: Bingham yieldstress[Pa]=19.8079
step2: Bingham viscosity[Pas]=0.024

Golder Associates

Golder Associates Ltd.
Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	1/7/2014
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**1/9/2014**
Data Review	**1st Review**	**Complete**	**CA**	**1/9/2014**
	2nd Review	**Complete**	**ML**	**1/27/2014**

Sample ID:	13-1426-0010 CTP - GA13-TP14-2
Sample Description:	fine, sticky, grey material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.81

VISCOSITY DATA

	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	1.4802	1.5314	1.3318	1.448	1.5794	1.6016	1.6689	1.617
2	1.0516	1.0585	1.0136	1.041	1.0715	1.1022	1.0948	1.090
3	0.6656	0.6636	0.6686	0.666	0.7033	0.7013	0.6898	0.698
4	0.4243	0.4098	0.4110	0.415	0.4383	0.4259	0.4345	0.433
5	0.2059	0.1929	0.1944	0.198	0.2088	0.2039	0.2024	0.205
6	0.0677	0.0673	0.0641	0.066	0.0704	0.0697	0.0674	0.069
7	0.0296	0.0307	0.0301	0.030	0.0312	0.0306	0.0316	0.031

YIELD STRESS DATA

	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	597.5729	592.6002	610.9867	600	547.0058	563.2819	476.8242	529
2	417.2371	424.9920	410.0059	417	403.4689	401.8788	383.6234	396
3	291.0699	305.0972	292.0489	296	281.0569	293.0721	289.2823	288
4	201.9752	204.2052	205.1375	204	204.5816	203.8495	204.3042	204
5	124.0283	124.2351	122.3630	124	125.8655	122.7039	122.0837	124
6	55.4439	55.1196	54.8252	55	54.3127	54.1838	53.4292	54
7	23.3275	22.9330	23.2173	23	22.9169	22.8936	22.8351	23

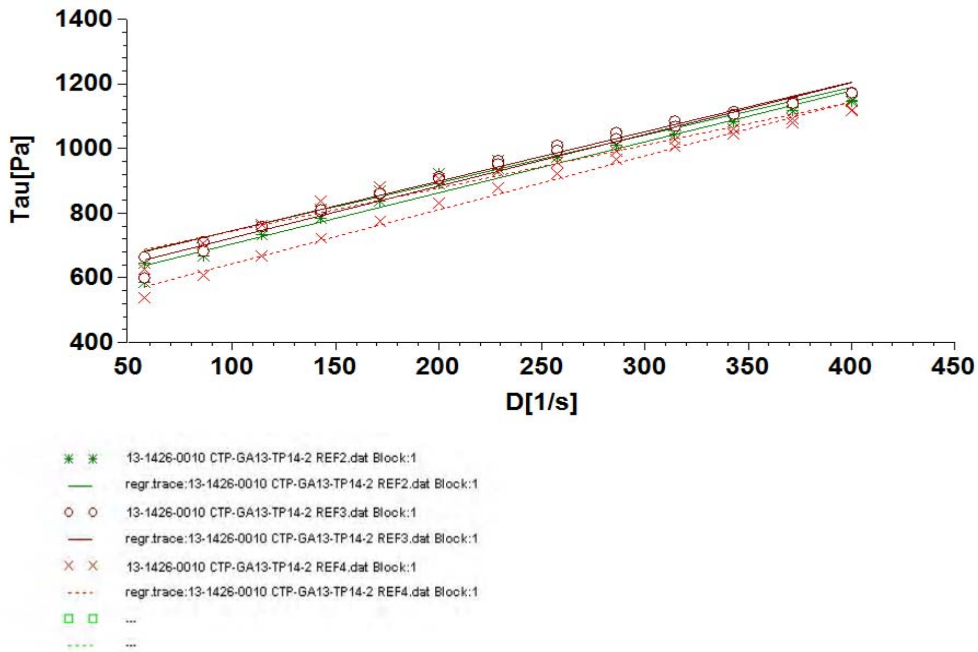
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	X6	6.00	27.40	21.30	71.50%	0.47
2	X13	6.02	33.15	25.11	70.36%	0.46
3	57	6.74	32.65	24.67	69.20%	0.44
4	24Z	30.31	60.55	50.90	68.09%	0.43
5	22B	30.23	63.64	52.37	66.27%	0.41
6	24	31.47	66.82	53.79	63.14%	0.38
7	24F	30.26	63.16	49.96	59.88%	0.35

Additional Notes:

multiple data sources page 1

10:44 08/01/14
Manual Report Analysis/Regression

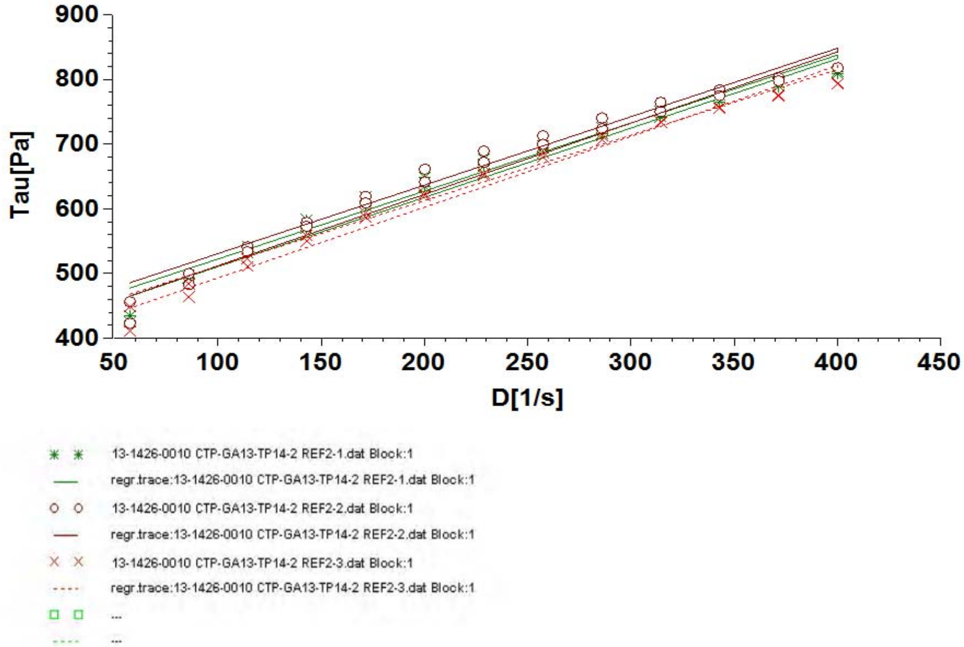


Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF2.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=597.57+1.4802*X ;B=0.98016; S=24.5
step1: Bingham yieldstress[Pa]=597.5729
step1: Bingham viscosity[Pas]=1.4802
step2: Bingham: Y=547.01+1.5794*X ;B=0.98126; S=25.4
step2: Bingham yieldstress[Pa]=547.0058
step2: Bingham viscosity[Pas]=1.5794

filter activated: D[1/s]>40
step1: Bingham: Y=592.6+1.5314*X ;B=0.99029; S=17.6
step1: Bingham yieldstress[Pa]=592.6002
step1: Bingham viscosity[Pas]=1.5314
step2: Bingham: Y=563.28+1.6016*X ;B=0.98115; S=25.8
step2: Bingham yieldstress[Pa]=563.2819
step2: Bingham viscosity[Pas]=1.6016

filter activated: D[1/s]>40
step1: Bingham: Y=610.99+1.3318*X ;B=0.96757; S=28.3
step1: Bingham yieldstress[Pa]=610.9867
step1: Bingham viscosity[Pas]=1.3318
step2: Bingham: Y=476.82+1.6689*X ;B=0.99121; S=18.3
step2: Bingham yieldstress[Pa]=476.8242
step2: Bingham viscosity[Pas]=1.6689
End of report

11:15 08/01/14
Manual Report Analysis/Regression



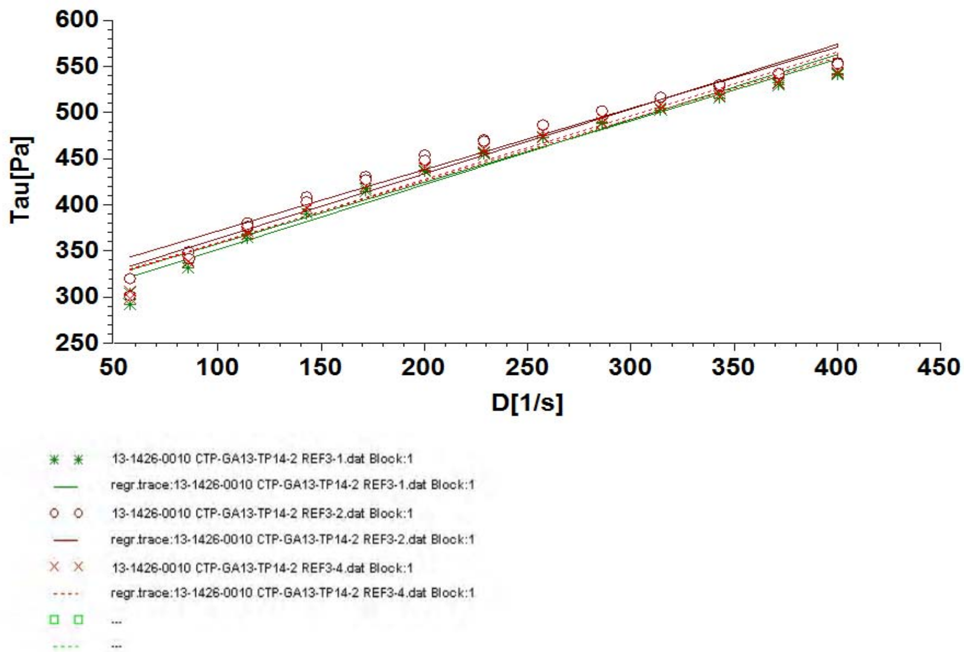
Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF2-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=417.24+1.0516*X ;B=0.97259; S=20.5
step1: Bingham yieldstress[Pa]=417.2371
step1: Bingham viscosity[Pas]=1.0516
step2: Bingham: Y=403.47+1.0715*X ;B=0.97783; S=18.8
step2: Bingham yieldstress[Pa]=403.4689
step2: Bingham viscosity[Pas]=1.0715

filter activated: D[1/s]>40
step1: Bingham: Y=424.99+1.0585*X ;B=0.97598; S=19.3
step1: Bingham yieldstress[Pa]=424.992
step1: Bingham viscosity[Pas]=1.0585
step2: Bingham: Y=401.88+1.1022*X ;B=0.97674; S=19.8
step2: Bingham yieldstress[Pa]=401.8788
step2: Bingham viscosity[Pas]=1.1022

filter activated: D[1/s]>40
step1: Bingham: Y=410.01+1.0136*X ;B=0.98705; S=13.5
step1: Bingham yieldstress[Pa]=410.0059
step1: Bingham viscosity[Pas]=1.0136
step2: Bingham: Y=383.62+1.0948*X ;B=0.97992; S=18.2
step2: Bingham yieldstress[Pa]=383.6234
step2: Bingham viscosity[Pas]=1.0948
End of report

multiple data sources

11:43 08/01/14
Manual Report Analysis/Regression

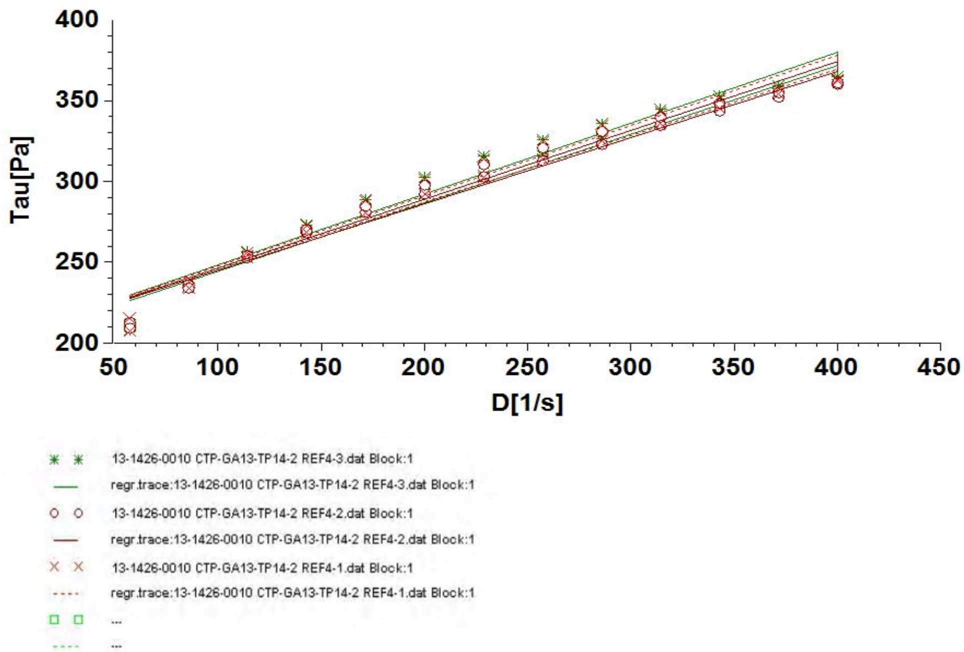


Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF3-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=291.07+0.66564*X ;B=0.97386; S=12.7
step1: Bingham yieldstress[Pa]=291.0699
step1: Bingham viscosity[Pas]=0.6656
step2: Bingham: Y=281.06+0.70328*X ;B=0.9691; S=14.6
step2: Bingham yieldstress[Pa]=281.0569
step2: Bingham viscosity[Pas]=0.7033

filter activated: D[1/s]>40
step1: Bingham: Y=305.1+0.6636*X ;B=0.97142; S=13.2
step1: Bingham yieldstress[Pa]=305.0972
step1: Bingham viscosity[Pas]=0.6636
step2: Bingham: Y=293.07+0.70131*X ;B=0.96448; S=15.6
step2: Bingham yieldstress[Pa]=293.0721
step2: Bingham viscosity[Pas]=0.7013

filter activated: D[1/s]>40
step1: Bingham: Y=292.05+0.66856*X ;B=0.97342; S=12.8
step1: Bingham yieldstress[Pa]=292.0489
step1: Bingham viscosity[Pas]=0.6686
step2: Bingham: Y=289.28+0.68976*X ;B=0.96822; S=14.5
step2: Bingham yieldstress[Pa]=289.2823
step2: Bingham viscosity[Pas]=0.6898
End of report

12:22 08/01/14
Manual Report Analysis/Regression



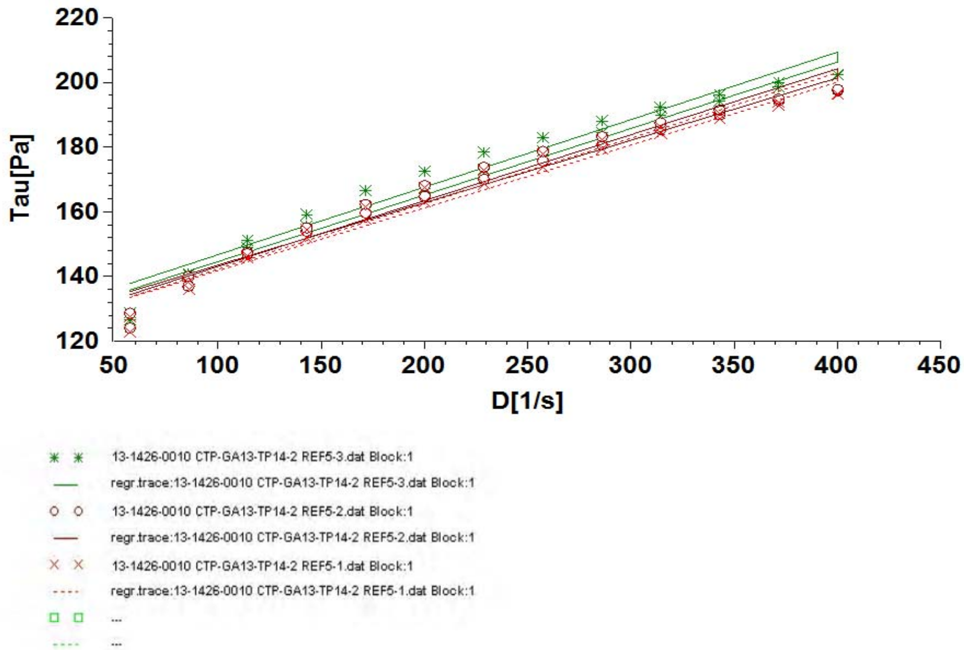
Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF4-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=201.98+0.4243*X ;B=0.98177; S=6.72
step1: Bingham yieldstress[Pa]=201.9752
step1: Bingham viscosity[Pas]=0.4243
step2: Bingham: Y=204.58+0.43834*X ;B=0.95705; S=10.8
step2: Bingham yieldstress[Pa]=204.5816
step2: Bingham viscosity[Pas]=0.4383

filter activated: D[1/s]>40
step1: Bingham: Y=204.21+0.40978*X ;B=0.9816; S=6.52
step1: Bingham yieldstress[Pa]=204.2052
step1: Bingham viscosity[Pas]=0.4098
step2: Bingham: Y=203.85+0.42592*X ;B=0.96528; S=9.39
step2: Bingham yieldstress[Pa]=203.8495
step2: Bingham viscosity[Pas]=0.4259

filter activated: D[1/s]>40
step1: Bingham: Y=205.14+0.41097*X ;B=0.98566; S=5.76
step1: Bingham yieldstress[Pa]=205.1375
step1: Bingham viscosity[Pas]=0.411
step2: Bingham: Y=204.3+0.43446*X ;B=0.95676; S=10.7
step2: Bingham yieldstress[Pa]=204.3042
step2: Bingham viscosity[Pas]=0.4345
End of report

multiple data sources

13:17 08/01/14
Manual Report Analysis/Regression

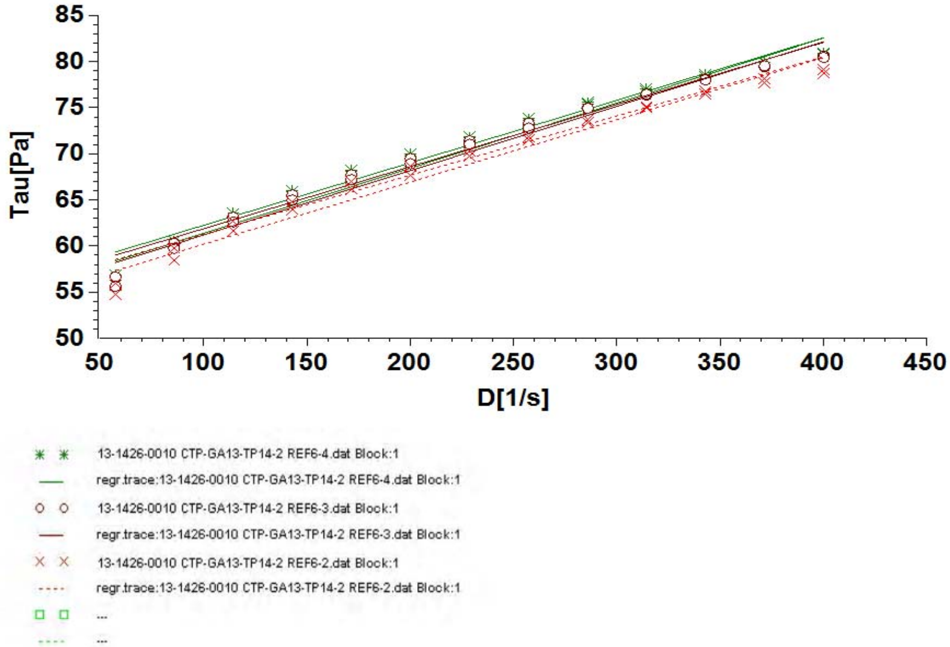


Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF5-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=124.03+0.20586*X ;B=0.98484; S=2.97
step1: Bingham yieldstress[Pa]=124.0283
step1: Bingham viscosity[Pas]=0.2059
step2: Bingham: Y=125.87+0.20884*X ;B=0.95582; S=5.22
step2: Bingham yieldstress[Pa]=125.8655
step2: Bingham viscosity[Pas]=0.2088

filter activated: D[1/s]>40
step1: Bingham: Y=124.24+0.19294*X ;B=0.98448; S=2.82
step1: Bingham yieldstress[Pa]=124.2351
step1: Bingham viscosity[Pas]=0.1929
step2: Bingham: Y=122.7+0.20386*X ;B=0.95874; S=4.91
step2: Bingham yieldstress[Pa]=122.7039
step2: Bingham viscosity[Pas]=0.2039

filter activated: D[1/s]>40
step1: Bingham: Y=122.36+0.19436*X ;B=0.98651; S=2.64
step1: Bingham yieldstress[Pa]=122.363
step1: Bingham viscosity[Pas]=0.1944
step2: Bingham: Y=122.08+0.20241*X ;B=0.95592; S=5.05
step2: Bingham yieldstress[Pa]=122.0837
step2: Bingham viscosity[Pas]=0.2024
End of report

13:40 08/01/14
Manual Report Analysis/Regression



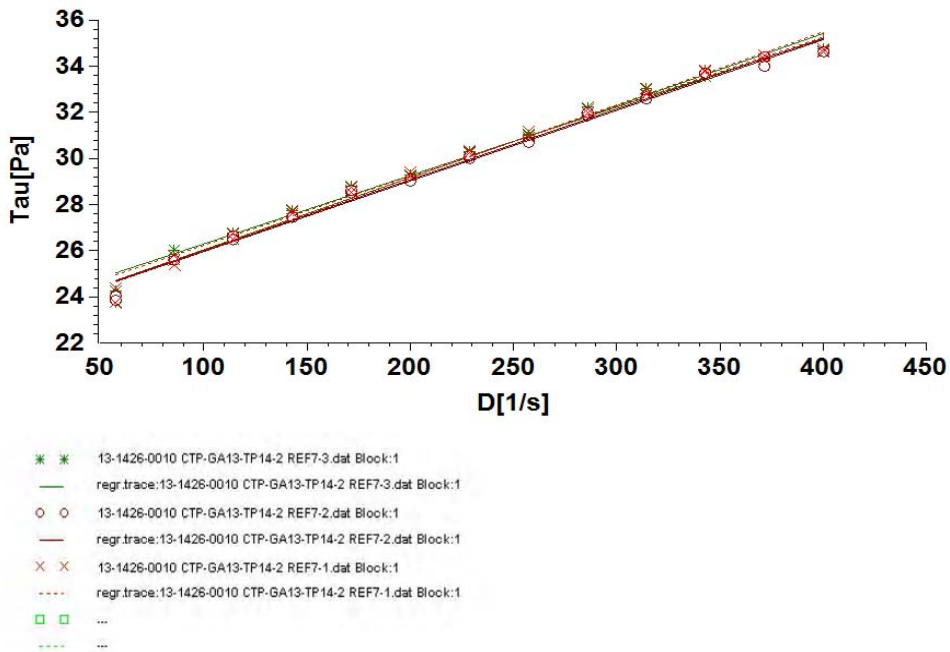
Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF6-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=55.444+0.067694*X ;B=0.97827; S=1.17
step1: Bingham yieldstress[Pa]=55.4439
step1: Bingham viscosity[Pas]=0.0677
step2: Bingham: Y=54.313+0.070432*X ;B=0.97964; S=1.18
step2: Bingham yieldstress[Pa]=54.3127
step2: Bingham viscosity[Pas]=0.0704

filter activated: D[1/s]>40
step1: Bingham: Y=55.12+0.06726*X ;B=0.98114; S=1.08
step1: Bingham yieldstress[Pa]=55.1196
step1: Bingham viscosity[Pas]=0.0673
step2: Bingham: Y=54.184+0.069746*X ;B=0.98064; S=1.14
step2: Bingham yieldstress[Pa]=54.1838
step2: Bingham viscosity[Pas]=0.0697

filter activated: D[1/s]>40
step1: Bingham: Y=54.825+0.06408*X ;B=0.97886; S=1.09
step1: Bingham yieldstress[Pa]=54.8252
step1: Bingham viscosity[Pas]=0.0641
step2: Bingham: Y=53.429+0.067362*X ;B=0.97791; S=1.18
step2: Bingham yieldstress[Pa]=53.4292
step2: Bingham viscosity[Pas]=0.0674
End of report

multiple data sources page 1

13:54 08/01/14
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 CTP-GA13-TP14-2 REF7-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=23.328+0.029607*X ;B=0.99201; S=0.309
step1: Bingham yieldstress[Pa]=23.3275
step1: Bingham viscosity[Pas]=0.0296
step2: Bingham: Y=22.917+0.031199*X ;B=0.98639; S=0.426
step2: Bingham yieldstress[Pa]=22.9169
step2: Bingham viscosity[Pas]=0.0312

filter activated: D[1/s]>40
step1: Bingham: Y=22.933+0.030658*X ;B=0.99305; S=0.298
step1: Bingham yieldstress[Pa]=22.933
step1: Bingham viscosity[Pas]=0.0307
step2: Bingham: Y=22.894+0.030591*X ;B=0.98943; S=0.368
step2: Bingham yieldstress[Pa]=22.8936
step2: Bingham viscosity[Pas]=0.0306

filter activated: D[1/s]>40
step1: Bingham: Y=23.217+0.030068*X ;B=0.9936; S=0.281
step1: Bingham yieldstress[Pa]=23.2173
step1: Bingham viscosity[Pas]=0.0301
step2: Bingham: Y=22.835+0.031581*X ;B=0.98554; S=0.445
step2: Bingham yieldstress[Pa]=22.8351
step2: Bingham viscosity[Pas]=0.0316
End of report

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	1/8/2014
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**1/9/2014**
Data Review	**1st Review**	**Complete**	**CA**	**1/9/2014**
	2nd Review	**Complete**	**ML**	**1/27/2014**

Sample ID:	13-1426-0010 STP - GA13-TP27
Sample Description:	dark grey material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.81

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	1.2549	1.3564	1.3432	1.318
2	0.7385	0.7538	0.7857	0.759
3	0.3242	0.3062	0.3153	0.315
4	0.1259	0.1322	0.1325	0.130
5	0.0324	0.0308	0.0330	0.032
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
1.4887	1.2684	1.4917	1.416
0.7483	0.7699	0.8026	0.774
0.3307	0.3213	0.3315	0.328
0.1320	0.1368	0.1356	0.135
0.0339	0.0340	0.0347	0.034

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	335.8220	302.8626	340.7784	326
2	177.1931	172.3880	181.5711	177
3	99.9674	101.2115	101.3564	101
4	53.3793	53.1099	52.7261	53
5	14.1437	14.4922	14.2799	14
6				
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
222.6610	279.9550	245.1108	249
153.3467	155.4334	162.2436	157
92.0638	90.1789	91.1446	91
49.9905	50.1587	50.0896	50
13.4895	13.3860	13.4326	13

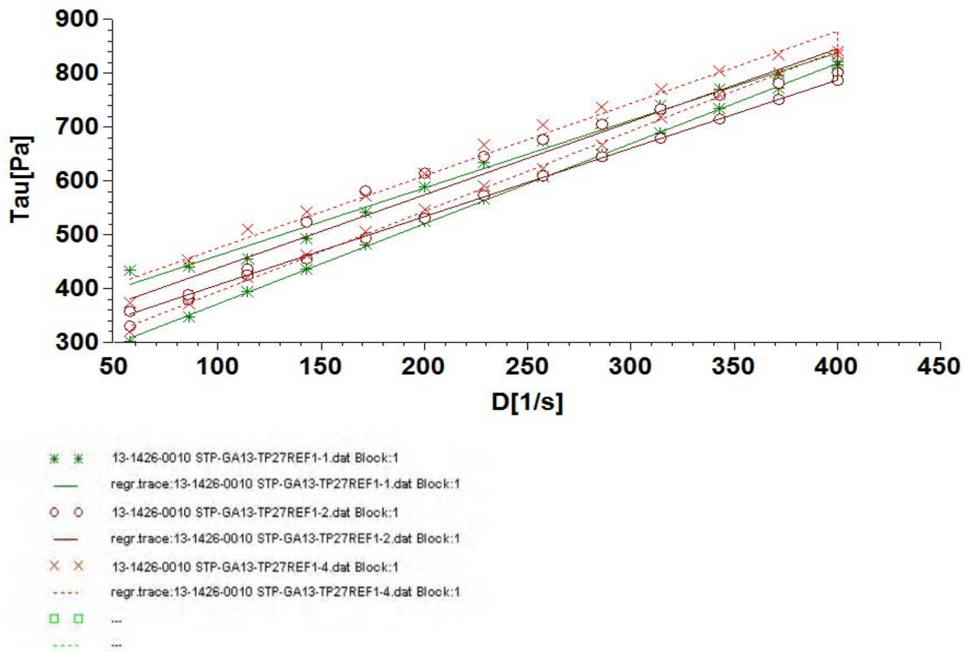
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	Z3	31.27	66.49	58.08	76.12%	0.53
2	46	30.55	59.49	52.18	74.74%	0.51
3	49	6.76	27.75	22.06	72.89%	0.49
4	15	30.30	58.26	50.16	71.03%	0.47
5	64	30.26	58.99	49.25	66.10%	0.41
6						
7						

Additional Notes:

multiple data sources

15:37 08/01/14
Manual Report Analysis/Regression

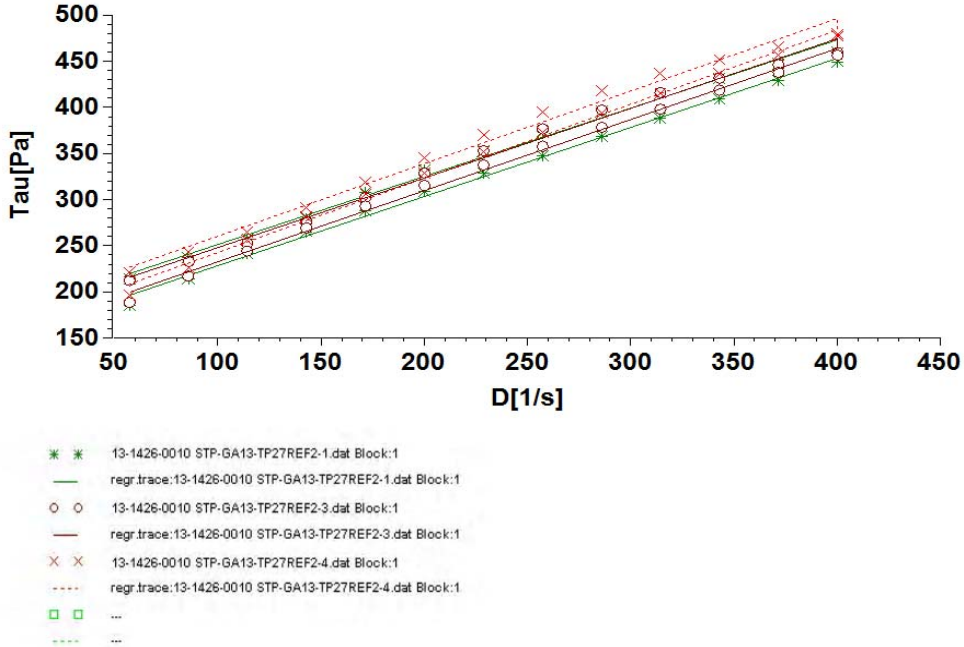


Analysis-results
Analysis data source: 13-1426-0010 STP-GA13-TP27REF1-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=335.82+1.2549*X ;B=0.98808; S=16
step1: Bingham yieldstress[Pa]=335.822
step1: Bingham viscosity[Pas]=1.2549
step2: Bingham: Y=222.66+1.4887*X ;B=0.99965; S=3.22
step2: Bingham yieldstress[Pa]=222.661
step2: Bingham viscosity[Pas]=1.4887

filter activated: D[1/s]>40
step1: Bingham: Y=302.86+1.3564*X ;B=0.9524; S=35.2
step1: Bingham yieldstress[Pa]=302.8626
step1: Bingham viscosity[Pas]=1.3564
step2: Bingham: Y=279.95+1.2684*X ;B=0.9995; S=3.29
step2: Bingham yieldstress[Pa]=279.955
step2: Bingham viscosity[Pas]=1.2684

filter activated: D[1/s]>40
step1: Bingham: Y=340.78+1.3432*X ;B=0.98296; S=20.6
step1: Bingham yieldstress[Pa]=340.7784
step1: Bingham viscosity[Pas]=1.3432
step2: Bingham: Y=245.11+1.4917*X ;B=0.999; S=5.49
step2: Bingham yieldstress[Pa]=245.1108
step2: Bingham viscosity[Pas]=1.4917
End of report

16:04 08/01/14
Manual Report Analysis/Regression



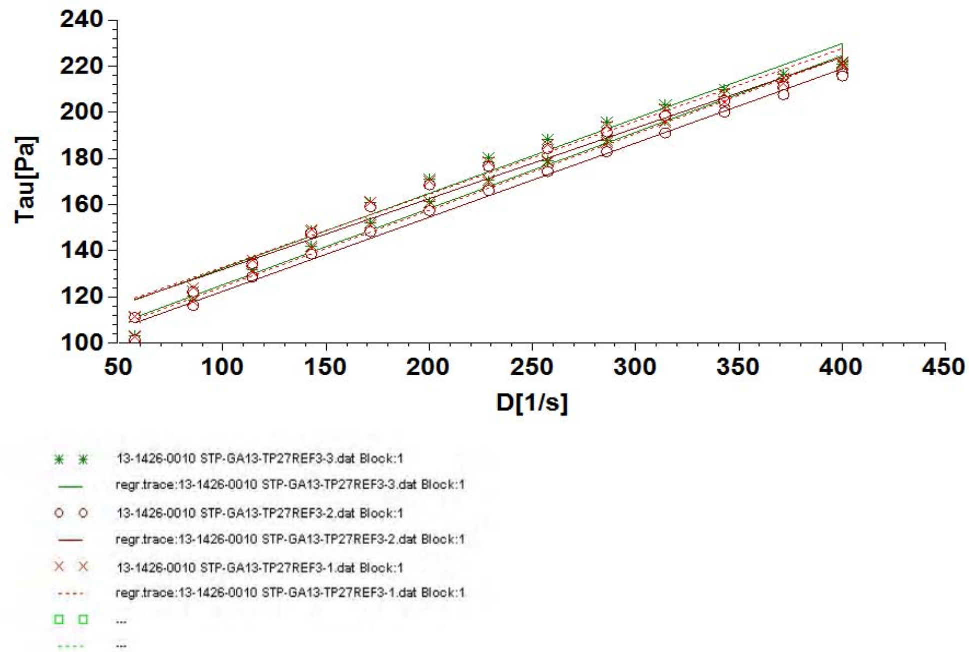
Analysis-results
Analysis data source: 13-1426-0010 STP-GA13-TP27REF2-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=177.19+0.73853*X ;B=0.99401; S=6.66
step1: Bingham yieldstress[Pa]=177.1931
step1: Bingham viscosity[Pas]=0.7385
step2: Bingham: Y=153.35+0.74825*X ;B=0.99689; S=4.85
step2: Bingham yieldstress[Pa]=153.3467
step2: Bingham viscosity[Pas]=0.7483

filter activated: D[1/s]>40
step1: Bingham: Y=172.39+0.75378*X ;B=0.99212; S=7.81
step1: Bingham yieldstress[Pa]=172.388
step1: Bingham viscosity[Pas]=0.7538
step2: Bingham: Y=155.43+0.7699*X ;B=0.99609; S=5.61
step2: Bingham yieldstress[Pa]=155.4334
step2: Bingham viscosity[Pas]=0.7699

filter activated: D[1/s]>40
step1: Bingham: Y=181.57+0.78566*X ;B=0.99036; S=9.01
step1: Bingham yieldstress[Pa]=181.5711
step1: Bingham viscosity[Pas]=0.7857
step2: Bingham: Y=162.24+0.80265*X ;B=0.99621; S=5.75
step2: Bingham yieldstress[Pa]=162.2436
step2: Bingham viscosity[Pas]=0.8026
End of report

multiple data sources page 1

16:26 08/01/14
Manual Report Analysis/Regression

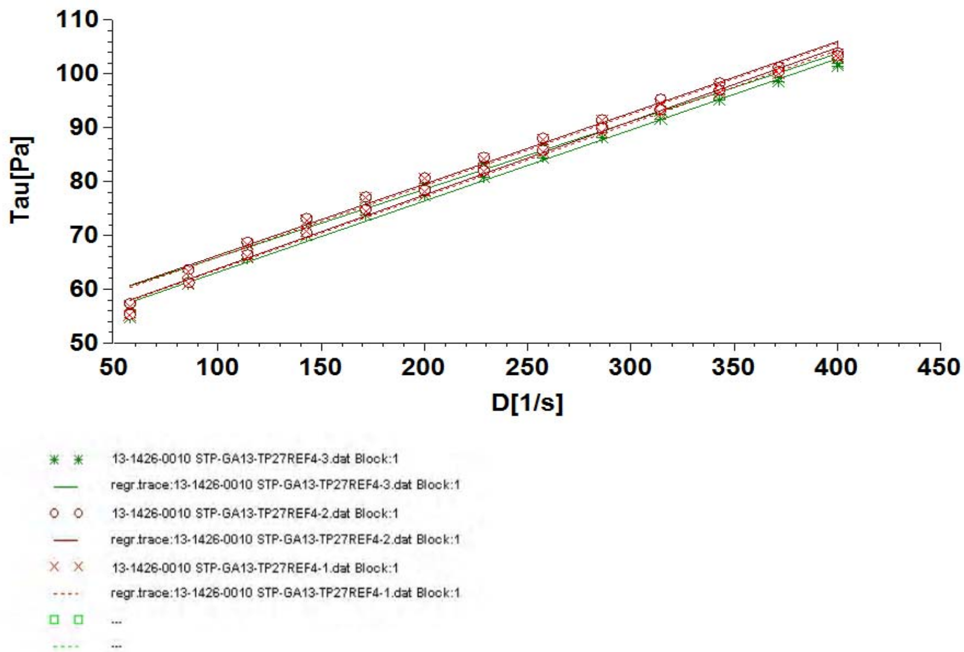


Analysis-results
Analysis data source: 13-1426-0010 STP-GA13-TP27REF3-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=99.967+0.32416*X ;B=0.98053; S=5.31
step1: Bingham yieldstress[Pa]=99.9674
step1: Bingham viscosity[Pas]=0.3242
step2: Bingham: Y=92.064+0.3307*X ;B=0.99225; S=3.4
step2: Bingham yieldstress[Pa]=92.0638
step2: Bingham viscosity[Pas]=0.3307

filter activated: D[1/s]>40
step1: Bingham: Y=101.21+0.3062*X ;B=0.9802; S=5.06
step1: Bingham yieldstress[Pa]=101.2115
step1: Bingham viscosity[Pas]=0.3062
step2: Bingham: Y=90.179+0.32133*X ;B=0.99343; S=3.04
step2: Bingham yieldstress[Pa]=90.1789
step2: Bingham viscosity[Pas]=0.3213

filter activated: D[1/s]>40
step1: Bingham: Y=101.36+0.31528*X ;B=0.98284; S=4.84
step1: Bingham yieldstress[Pa]=101.3564
step1: Bingham viscosity[Pas]=0.3153
step2: Bingham: Y=91.145+0.3315*X ;B=0.99312; S=3.21
step2: Bingham yieldstress[Pa]=91.1446
step2: Bingham viscosity[Pas]=0.3315
End of report

16:41 08/01/14
Manual Report Analysis/Regression



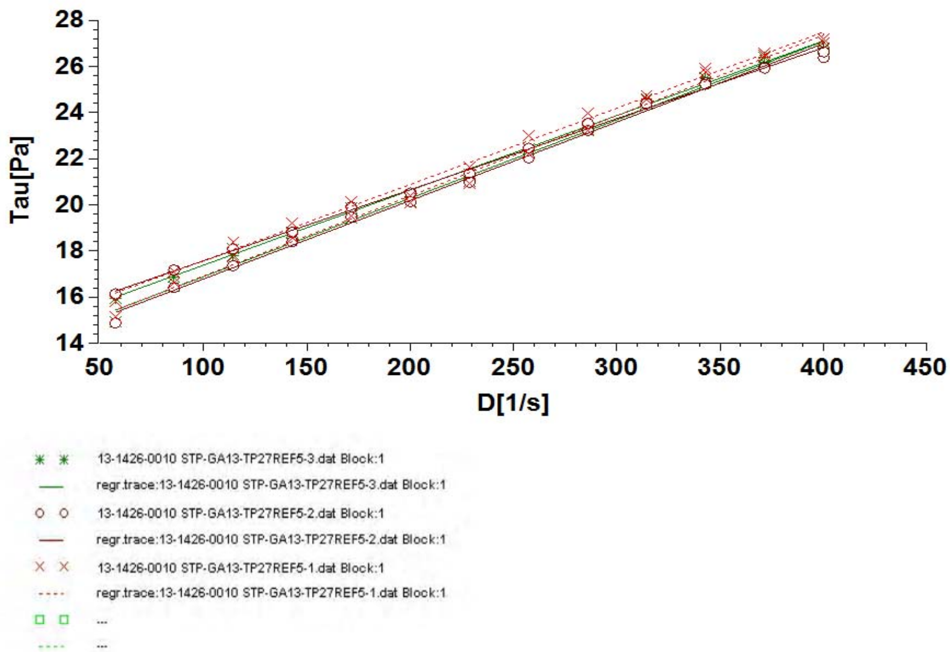
Analysis-results
Analysis data source: 13-1426-0010 STP-GA13-TP27REF4-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=53.379+0.12593*X ;B=0.98863; S=1.57
step1: Bingham yieldstress[Pa]=53.3793
step1: Bingham viscosity[Pas]=0.1259
step2: Bingham: Y=49.991+0.13199*X ;B=0.9943; S=1.16
step2: Bingham yieldstress[Pa]=49.9905
step2: Bingham viscosity[Pas]=0.132

filter activated: D[1/s]>40
step1: Bingham: Y=53.11+0.13219*X ;B=0.99067; S=1.49
step1: Bingham yieldstress[Pa]=53.1099
step1: Bingham viscosity[Pas]=0.1322
step2: Bingham: Y=50.159+0.13679*X ;B=0.9949; S=1.14
step2: Bingham yieldstress[Pa]=50.1587
step2: Bingham viscosity[Pas]=0.1368

filter activated: D[1/s]>40
step1: Bingham: Y=52.726+0.13245*X ;B=0.98978; S=1.56
step1: Bingham yieldstress[Pa]=52.7261
step1: Bingham viscosity[Pas]=0.1325
step2: Bingham: Y=50.09+0.13564*X ;B=0.99469; S=1.15
step2: Bingham yieldstress[Pa]=50.0896
step2: Bingham viscosity[Pas]=0.1356
End of report

multiple data sources

16:56 08/01/14
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 STP-GA13-TP27REF5-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=14.144+0.032367*X ;B=0.99658; S=0.22
step1: Bingham yieldstress[Pa]=14.1437
step1: Bingham viscosity[Pas]=0.0324
step2: Bingham: Y=13.49+0.033943*X ;B=0.99571; S=0.259
step2: Bingham yieldstress[Pa]=13.4895
step2: Bingham viscosity[Pas]=0.0339

filter activated: D[1/s]>40
step1: Bingham: Y=14.492+0.030759*X ;B=0.99689; S=0.2
step1: Bingham yieldstress[Pa]=14.4922
step1: Bingham viscosity[Pas]=0.0308
step2: Bingham: Y=13.386+0.033956*X ;B=0.99632; S=0.24
step2: Bingham yieldstress[Pa]=13.386
step2: Bingham viscosity[Pas]=0.034

filter activated: D[1/s]>40
step1: Bingham: Y=14.28+0.032974*X ;B=0.99377; S=0.303
step1: Bingham yieldstress[Pa]=14.2799
step1: Bingham viscosity[Pas]=0.033
step2: Bingham: Y=13.433+0.034748*X ;B=0.99529; S=0.278
step2: Bingham yieldstress[Pa]=13.4326
step2: Bingham viscosity[Pas]=0.0347
End of report

Golder Associates Ltd.

Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	12/6/2013
Technologist	CJC

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CJC**	**12/6/2013**
Data Review	**1st Review**	**Complete**	**CA**	**12/9/2013**
	2nd Review	**Complete**	**ML**	**1/27/2014**

Sample ID:	13-1426-0010 SCTP - BS - Mixed (Silt- Sand -Clay)
Sample Description:	coarse grey material
Water:	13-1426-0010 Water
pH Adjustment:	None
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.84

VISCOSITY DATA

	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	0.6557	0.6430	0.6408	0.647	0.6673	0.6614	0.6742	0.668
2	0.4873	0.4757	0.4874	0.483	0.4795	0.4863	0.4962	0.487
3	0.2340	0.2391	0.2208	0.231	0.2352	0.2416	0.2278	0.235
4	0.1303	0.1316	0.1309	0.131	0.1322	0.1360	0.1349	0.134
5	0.0647	0.0633	0.0646	0.064	0.0673	0.0666	0.0679	0.067
6	0.0290	0.0294	0.0292	0.029	0.0300	0.0312	0.0294	0.030
7								

YIELD STRESS DATA

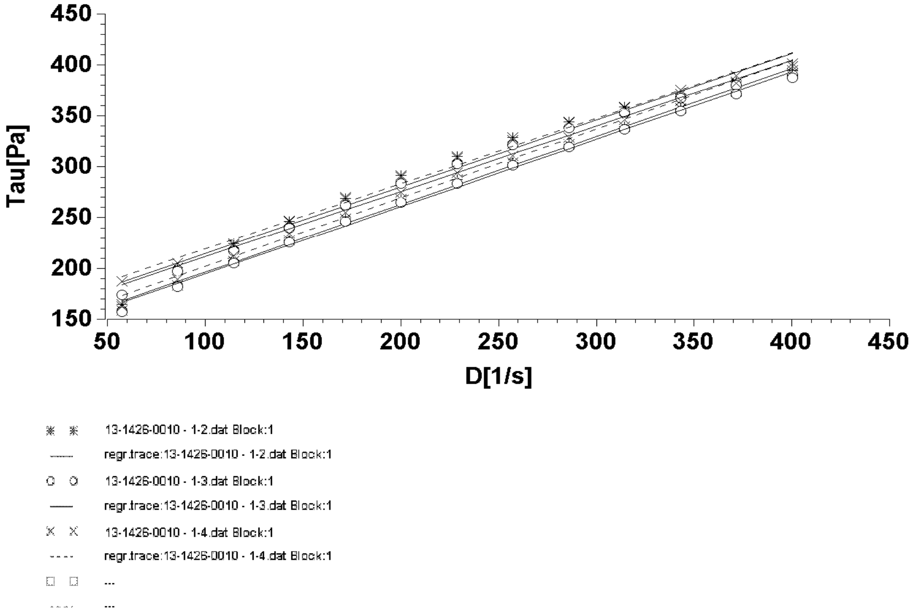
	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	148.9690	147.2086	155.2590	150	129.6029	128.4371	134.4695	131
2	117.6858	118.2698	119.9104	119	109.4912	105.3553	106.7777	107
3	71.1029	71.1412	71.3580	71	67.6556	67.6590	66.0430	67
4	46.5032	47.3369	46.5106	47	44.4739	44.2490	44.2473	44
5	25.3269	25.3096	25.8217	25	23.9223	23.7257	24.0186	24
6	9.2349	9.8064	8.7810	9	8.7451	8.8625	8.5863	9
7								

WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	x3	6.24	25.36	20.47	74.42%	0.51
2	45	6.79	18.70	15.60	73.97%	0.50
3	CA	6.16	24.71	19.58	72.35%	0.48
4	65	6.68	23.79	18.82	70.95%	0.46
5	x10	6.07	21.43	16.64	68.82%	0.44
6	x24	6.24	21.13	15.99	65.48%	0.40
7						

Additional Notes:

14:24 05/12/13
Manual Report Analysis/Regression

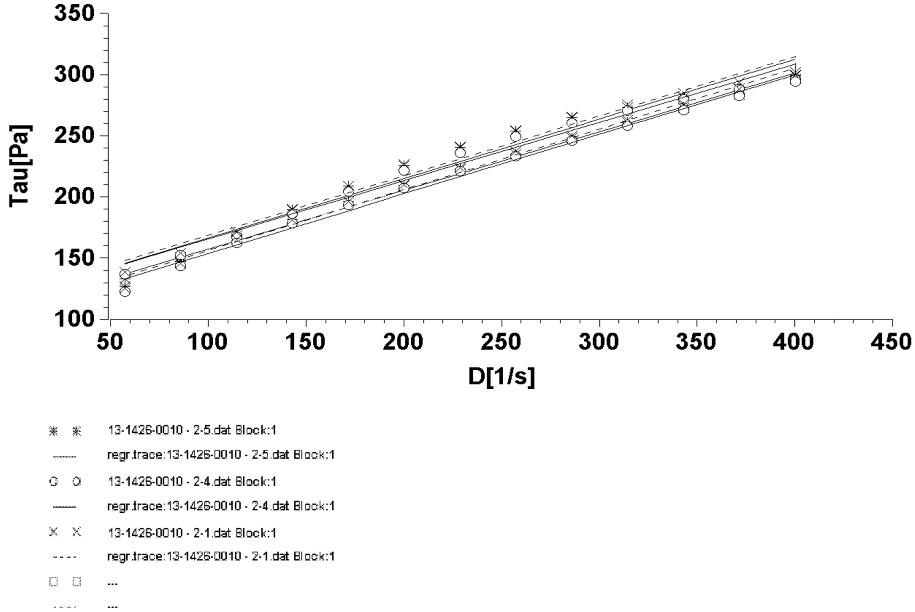


Analysis-results
Analysis data source: 13-1426-0010 - 1-2.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=148.97+0.65572*X ;B=0.97846; S=11.3
step1: Bingham yieldstress[Pa]=148.969
step1: Bingham viscosity[Pas]=0.6557
step2: Bingham: Y=129.6+0.66726*X ;B=0.99633; S=4.71
step2: Bingham yieldstress[Pa]=129.6029
step2: Bingham viscosity[Pas]=0.6673

filter activated: D[1/s]>40
step1: Bingham: Y=147.21+0.64299*X ;B=0.98895; S=7.9
step1: Bingham yieldstress[Pa]=147.2086
step1: Bingham viscosity[Pas]=0.643
step2: Bingham: Y=128.44+0.66142*X ;B=0.99692; S=4.27
step2: Bingham yieldstress[Pa]=128.4371
step2: Bingham viscosity[Pas]=0.6614

filter activated: D[1/s]>40
step1: Bingham: Y=155.26+0.64077*X ;B=0.99353; S=6.01
step1: Bingham yieldstress[Pa]=155.259
step1: Bingham viscosity[Pas]=0.6408
step2: Bingham: Y=134.47+0.67421*X ;B=0.99596; S=4.99
step2: Bingham yieldstress[Pa]=134.4695
step2: Bingham viscosity[Pas]=0.6742
End of report

15:07 05/12/13
Manual Report Analysis/Regression



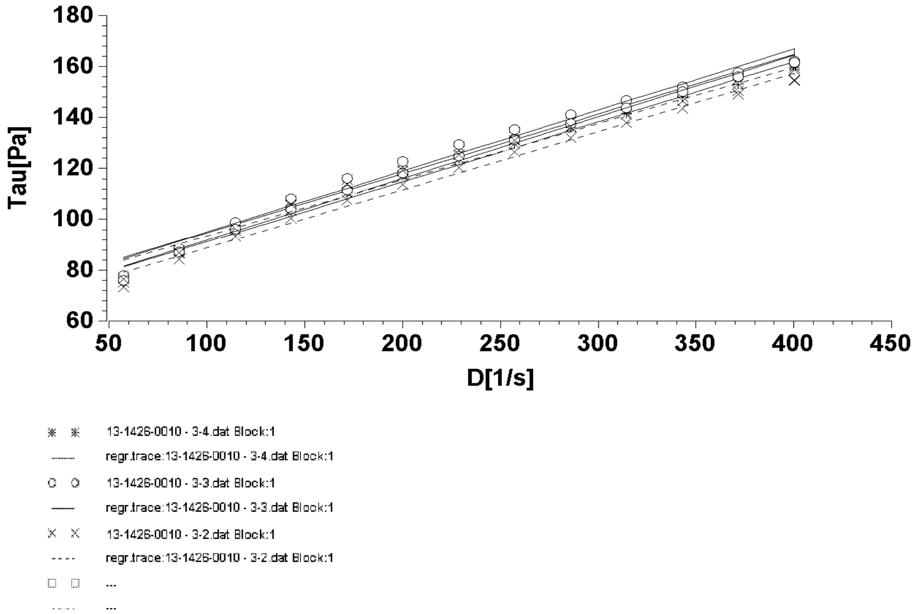
Analysis-results
Analysis data source: 13-1426-0010 - 2-5.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=117.69+0.48725*X ;B=0.97135; S=9.73
step1: Bingham yieldstress[Pa]=117.6858
step1: Bingham viscosity[Pas]=0.4873
step2: Bingham: Y=109.49+0.4795*X ;B=0.99362; S=4.46
step2: Bingham yieldstress[Pa]=109.4912
step2: Bingham viscosity[Pas]=0.4795

filter activated: D[1/s]>40
step1: Bingham: Y=118.27+0.47565*X ;B=0.98091; S=7.71
step1: Bingham yieldstress[Pa]=118.2698
step1: Bingham viscosity[Pas]=0.4757
step2: Bingham: Y=105.36+0.48634*X ;B=0.99273; S=4.84
step2: Bingham yieldstress[Pa]=105.3553
step2: Bingham viscosity[Pas]=0.4863

filter activated: D[1/s]>40
step1: Bingham: Y=119.91+0.4874*X ;B=0.98036; S=8.02
step1: Bingham yieldstress[Pa]=119.9104
step1: Bingham viscosity[Pas]=0.4874
step2: Bingham: Y=106.78+0.4962*X ;B=0.99383; S=4.54
step2: Bingham yieldstress[Pa]=106.7777
step2: Bingham viscosity[Pas]=0.4962
End of report

multiple data sources

09:11 06/12/13
Manual Report Analysis/Regression



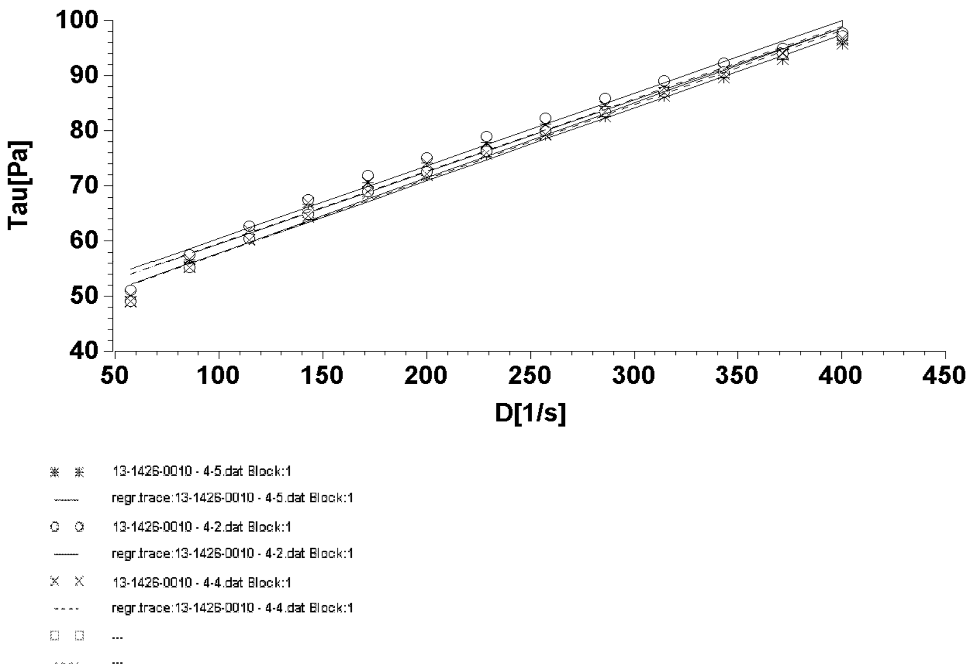
Analysis-results
Analysis data source: 13-1426-0010 - 3-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=71.103+0.23396*X ;B=0.97865; S=4.02
step1: Bingham yieldstress[Pa]=71.1029
step1: Bingham viscosity[Pas]=0.234
step2: Bingham: Y=67.656+0.23515*X ;B=0.99104; S=2.6
step2: Bingham yieldstress[Pa]=67.6556
step2: Bingham viscosity[Pas]=0.2352

filter activated: D[1/s]>40
step1: Bingham: Y=71.141+0.23906*X ;B=0.98244; S=3.71
step1: Bingham yieldstress[Pa]=71.1412
step1: Bingham viscosity[Pas]=0.2391
step2: Bingham: Y=67.659+0.24159*X ;B=0.99271; S=2.41
step2: Bingham yieldstress[Pa]=67.659
step2: Bingham viscosity[Pas]=0.2416

filter activated: D[1/s]>40
step1: Bingham: Y=71.358+0.22081*X ;B=0.97718; S=3.92
step1: Bingham yieldstress[Pa]=71.358
step1: Bingham viscosity[Pas]=0.2208
step2: Bingham: Y=66.043+0.22779*X ;B=0.99079; S=2.55
step2: Bingham yieldstress[Pa]=66.043
step2: Bingham viscosity[Pas]=0.2278
End of report

multiple data sources page 1

09:54 06/12/13
Manual Report Analysis/Regression



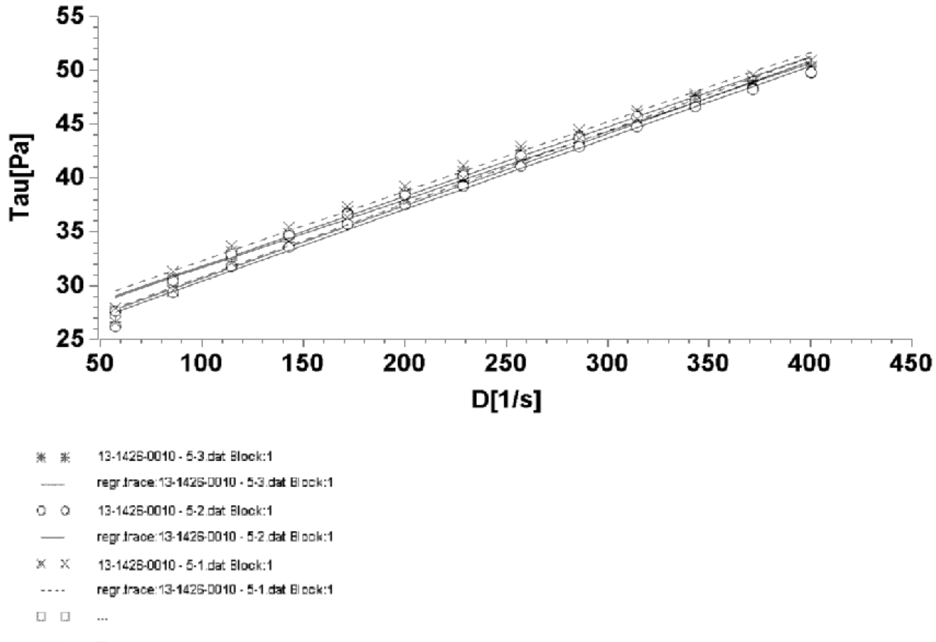
Analysis-results
Analysis data source: 13-1426-0010 - 4-5.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=46.503+0.13033*X ;B=0.98497; S=1.87
step1: Bingham yieldstress[Pa]=46.5032
step1: Bingham viscosity[Pas]=0.1303
step2: Bingham: Y=44.474+0.1322*X ;B=0.99241; S=1.34
step2: Bingham yieldstress[Pa]=44.4739
step2: Bingham viscosity[Pas]=0.1322

filter activated: D[1/s]>40
step1: Bingham: Y=47.337+0.13161*X ;B=0.98635; S=1.8
step1: Bingham yieldstress[Pa]=47.3369
step1: Bingham viscosity[Pas]=0.1316
step2: Bingham: Y=44.249+0.136*X ;B=0.99328; S=1.3
step2: Bingham yieldstress[Pa]=44.249
step2: Bingham viscosity[Pas]=0.136

filter activated: D[1/s]>40
step1: Bingham: Y=46.511+0.13086*X ;B=0.98663; S=1.77
step1: Bingham yieldstress[Pa]=46.5106
step1: Bingham viscosity[Pas]=0.1309
step2: Bingham: Y=44.247+0.13486*X ;B=0.99301; S=1.32
step2: Bingham yieldstress[Pa]=44.2473
step2: Bingham viscosity[Pas]=0.1349
End of report

multiple data sources

11:01 06/12/13
Manual Report Analysis/Regression



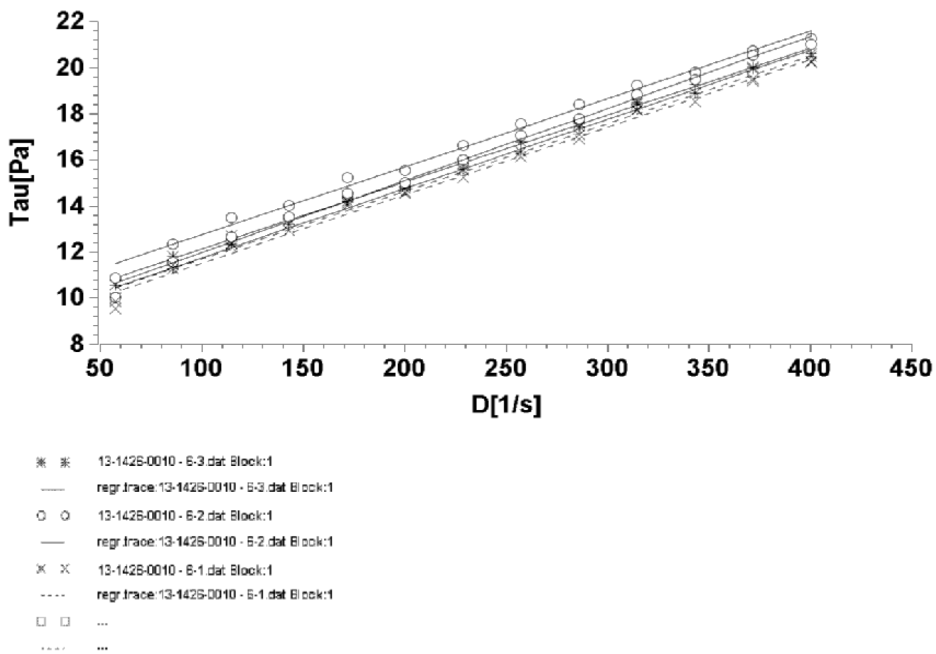
Analysis-results
Analysis data source: 13-1426-0010 - 5-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=25.327+0.064741*X ;B=0.99317; S=0.624
step1: Bingham yieldstress[Pa]=25.3269
step1: Bingham viscosity[Pas]=0.0647
step2: Bingham: Y=23.922+0.067338*X ;B=0.99575; S=0.511
step2: Bingham yieldstress[Pa]=23.9223
step2: Bingham viscosity[Pas]=0.0673

filter activated: D[1/s]>40
step1: Bingham: Y=25.31+0.063297*X ;B=0.99298; S=0.619
step1: Bingham yieldstress[Pa]=25.3096
step1: Bingham viscosity[Pas]=0.0633
step2: Bingham: Y=23.726+0.066628*X ;B=0.99509; S=0.544
step2: Bingham yieldstress[Pa]=23.7257
step2: Bingham viscosity[Pas]=0.0666

filter activated: D[1/s]>40
step1: Bingham: Y=25.822+0.064632*X ;B=0.99242; S=0.657
step1: Bingham yieldstress[Pa]=25.8217
step1: Bingham viscosity[Pas]=0.0646
step2: Bingham: Y=24.019+0.067873*X ;B=0.99461; S=0.581
step2: Bingham yieldstress[Pa]=24.0186
step2: Bingham viscosity[Pas]=0.0679
End of report

multiple data sources

11:30 06/12/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 - 6-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=9.2349+0.028976*X ;B=0.99788; S=0.155
step1: Bingham yieldstress[Pa]=9.2349
step1: Bingham viscosity[Pas]=0.029
step2: Bingham: Y=8.7451+0.030005*X ;B=0.99568; S=0.23
step2: Bingham yieldstress[Pa]=8.7451
step2: Bingham viscosity[Pas]=0.03

filter activated: D[1/s]>40
step1: Bingham: Y=9.8064+0.02943*X ;B=0.99355; S=0.276
step1: Bingham yieldstress[Pa]=9.8064
step1: Bingham viscosity[Pas]=0.0294
step2: Bingham: Y=8.8625+0.031194*X ;B=0.99474; S=0.264
step2: Bingham yieldstress[Pa]=8.8625
step2: Bingham viscosity[Pas]=0.0312

filter activated: D[1/s]>40
step1: Bingham: Y=8.781+0.029247*X ;B=0.99467; S=0.249
step1: Bingham yieldstress[Pa]=8.781
step1: Bingham viscosity[Pas]=0.0292
step2: Bingham: Y=8.5863+0.029398*X ;B=0.99254; S=0.296
step2: Bingham yieldstress[Pa]=8.5863
step2: Bingham viscosity[Pas]=0.0294
End of report

Golder Associates Ltd.
Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	12/4/2013
Technologist	CA

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**12/11/2013**
Data Review	**1st Review**	**Complete**	**CA**	**12/11/2013**
	2nd Review	**Complete**	**ML**	**1/27/2014**

Sample ID:	13-1426-0010 SCTP - BS - Silty Sand
Sample Description:	dark brown material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.81

VISCOSITY DATA

	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	0.7352	0.7094	0.7765	0.740	0.8545	0.8453	0.8776	0.859
2	0.5787	0.5399	0.5652	0.561	0.6306	0.6165	0.6382	0.628
3	0.2691	0.2705	0.2769	0.272	0.2910	0.2903	0.2984	0.293
4	0.1378	0.1334	0.1332	0.135	0.1527	0.1486	0.1461	0.149
5	0.0715	0.0729	0.0729	0.072	0.0775	0.0806	0.0812	0.080
6	0.0461	0.0439	0.0464	0.045	0.0497	0.0484	0.0499	0.049
7								

YIELD STRESS DATA

	Ramp Up				*Ramp Down*			
REF	Trial 1	Trial 2	Trial 3	AVG	Trial 1	Trial 2	Trial 3	AVG
1	161.3561	157.7334	150.4089	156	80.9777	85.3608	91.0097	86
2	109.7308	111.9380	114.0450	112	70.2783	66.4065	66.5790	68
3	54.9029	53.6947	55.2612	55	38.1892	37.4850	38.7782	38
4	34.0351	34.3865	32.0434	33	22.5851	22.1467	21.8092	22
5	17.5617	18.4719	18.1813	18	13.2631	13.3811	13.1021	13
6	10.4675	10.0376	10.3051	10	7.7950	7.6210	8.0191	8
7								

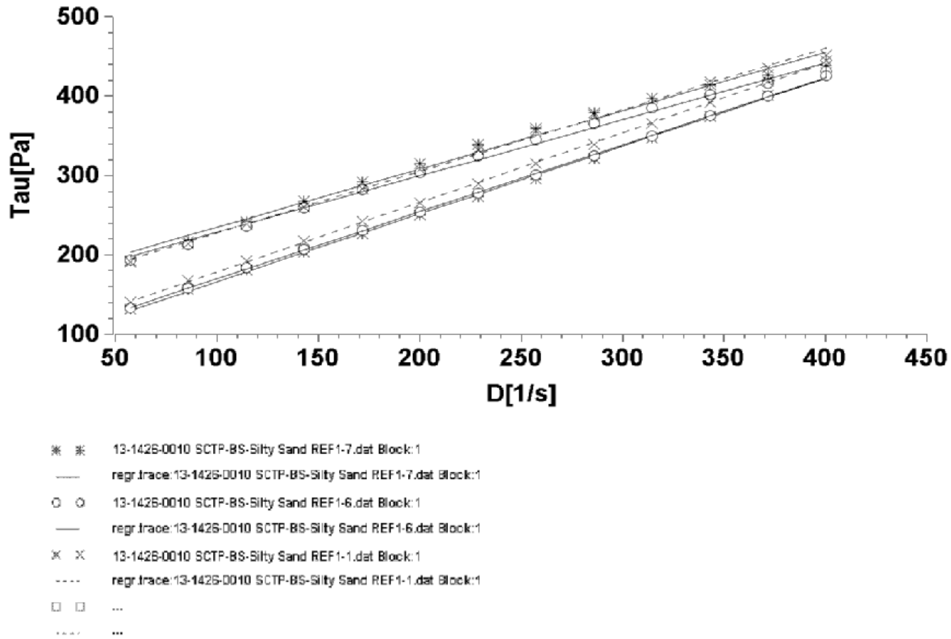
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	14	30.09	62.13	54.71	76.84%	0.54
2	68	30.41	69.02	59.90	76.38%	0.54
3	46	30.53	64.42	55.82	74.62%	0.51
4	54	30.46	62.72	54.01	73.00%	0.49
5	56	30.46	64.97	55.07	71.31%	0.47
6	12	29.77	68.77	56.87	69.49%	0.45
7						

Additional Notes:

multiple data sources

10:50 09/12/13
Manual Report Analysis/Regression



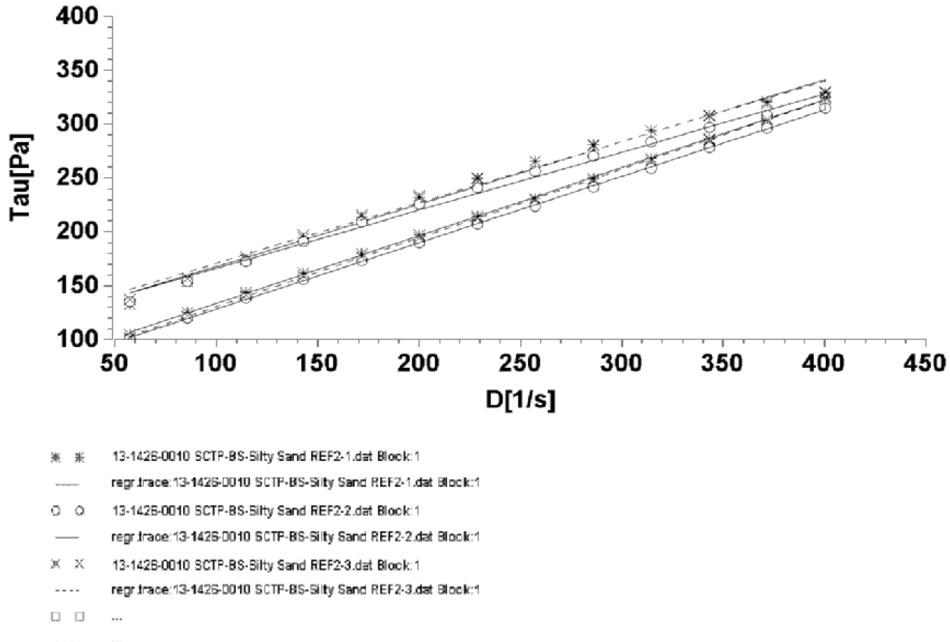
Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF1-7.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=161.36+0.73519*X ;B=0.98941; S=8.84
step1: Bingham yieldstress[Pa]=161.3561
step1: Bingham viscosity[Pas]=0.7352
step2: Bingham: Y=80.978+0.8545*X ;B=0.99887; S=3.35
step2: Bingham yieldstress[Pa]=80.9777
step2: Bingham viscosity[Pas]=0.8545

filter activated: D[1/s]>40
step1: Bingham: Y=157.73+0.70939*X ;B=0.99583; S=5.33
step1: Bingham yieldstress[Pa]=157.7334
step1: Bingham viscosity[Pas]=0.7094
step2: Bingham: Y=85.361+0.84528*X ;B=0.9998; S=1.39
step2: Bingham yieldstress[Pa]=85.3608
step2: Bingham viscosity[Pas]=0.8453

filter activated: D[1/s]>40
step1: Bingham: Y=150.41+0.77647*X ;B=0.99766; S=4.37
step1: Bingham yieldstress[Pa]=150.4089
step1: Bingham viscosity[Pas]=0.7765
step2: Bingham: Y=91.01+0.87761*X ;B=0.99969; S=1.79
step2: Bingham yieldstress[Pa]=91.0097
step2: Bingham viscosity[Pas]=0.8776
End of report

multiple data sources

14:42 09/12/13
Manual Report Analysis/Regression

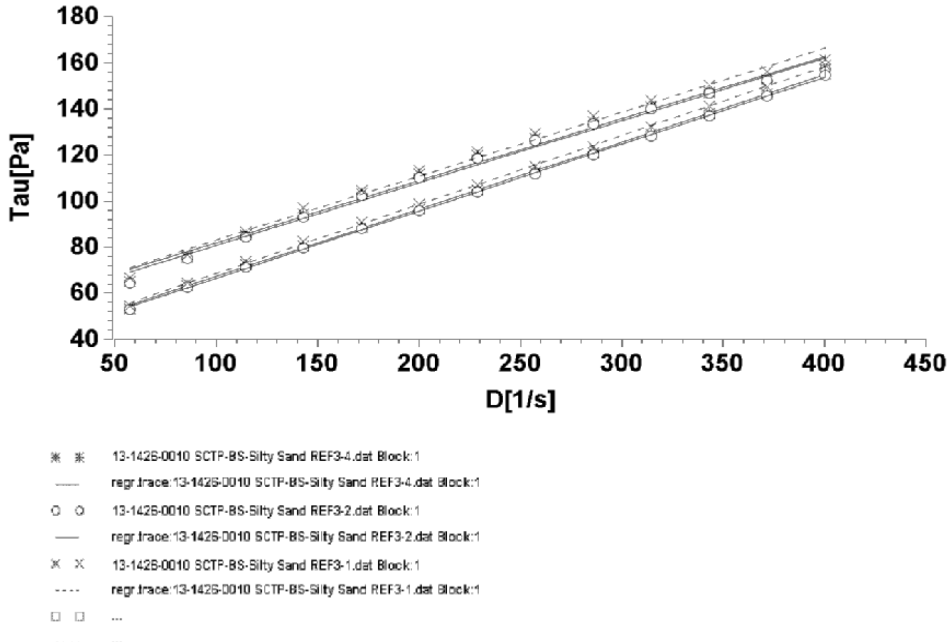


Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF2-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=109.73+0.57874*X ;B=0.9902; S=6.69
step1: Bingham yieldstress[Pa]=109.7308
step1: Bingham viscosity[Pas]=0.5787
step2: Bingham: Y=70.278+0.63065*X ;B=0.99971; S=1.25
step2: Bingham yieldstress[Pa]=70.2783
step2: Bingham viscosity[Pas]=0.6306

filter activated: D[1/s]>40
step1: Bingham: Y=111.94+0.53989*X ;B=0.99294; S=5.29
step1: Bingham yieldstress[Pa]=111.938
step1: Bingham viscosity[Pas]=0.5399
step2: Bingham: Y=66.406+0.61652*X ;B=0.99974; S=1.16
step2: Bingham yieldstress[Pa]=66.4065
step2: Bingham viscosity[Pas]=0.6165

filter activated: D[1/s]>40
step1: Bingham: Y=114.05+0.56519*X ;B=0.99091; S=6.29
step1: Bingham yieldstress[Pa]=114.045
step1: Bingham viscosity[Pas]=0.5652
step2: Bingham: Y=66.579+0.63817*X ;B=0.99971; S=1.26
step2: Bingham yieldstress[Pa]=66.579
step2: Bingham viscosity[Pas]=0.6382
End of report

15:00 09/12/13
Manual Report Analysis/Regression



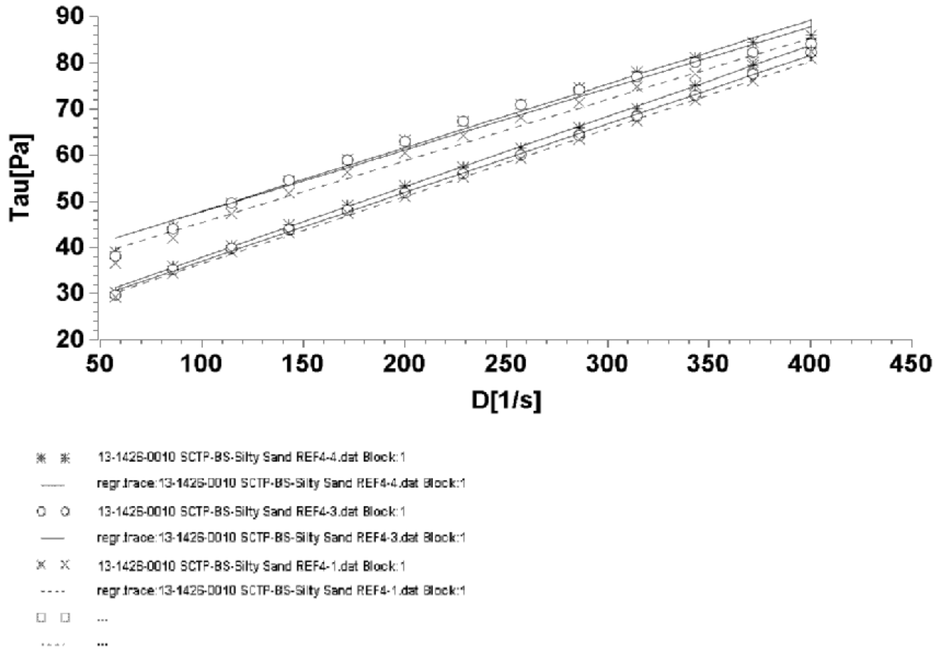
Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF3-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=54.903+0.26914*X ;B=0.99013; S=3.12
step1: Bingham yieldstress[Pa]=54.9029
step1: Bingham viscosity[Pas]=0.2691
step2: Bingham: Y=38.189+0.291*X ;B=0.9996; S=0.675
step2: Bingham yieldstress[Pa]=38.1892
step2: Bingham viscosity[Pas]=0.291

filter activated: D[1/s]>40
step1: Bingham: Y=53.695+0.27049*X ;B=0.99182; S=2.85
step1: Bingham yieldstress[Pa]=53.6947
step1: Bingham viscosity[Pas]=0.2705
step2: Bingham: Y=37.485+0.29032*X ;B=0.99966; S=0.619
step2: Bingham yieldstress[Pa]=37.485
step2: Bingham viscosity[Pas]=0.2903

filter activated: D[1/s]>40
step1: Bingham: Y=55.261+0.27693*X ;B=0.99224; S=2.85
step1: Bingham yieldstress[Pa]=55.2612
step1: Bingham viscosity[Pas]=0.2769
step2: Bingham: Y=38.778+0.29836*X ;B=0.99956; S=0.724
step2: Bingham yieldstress[Pa]=38.7782
step2: Bingham viscosity[Pas]=0.2984
End of report

multiple data sources

15:23 09/12/13
Manual Report Analysis/Regression



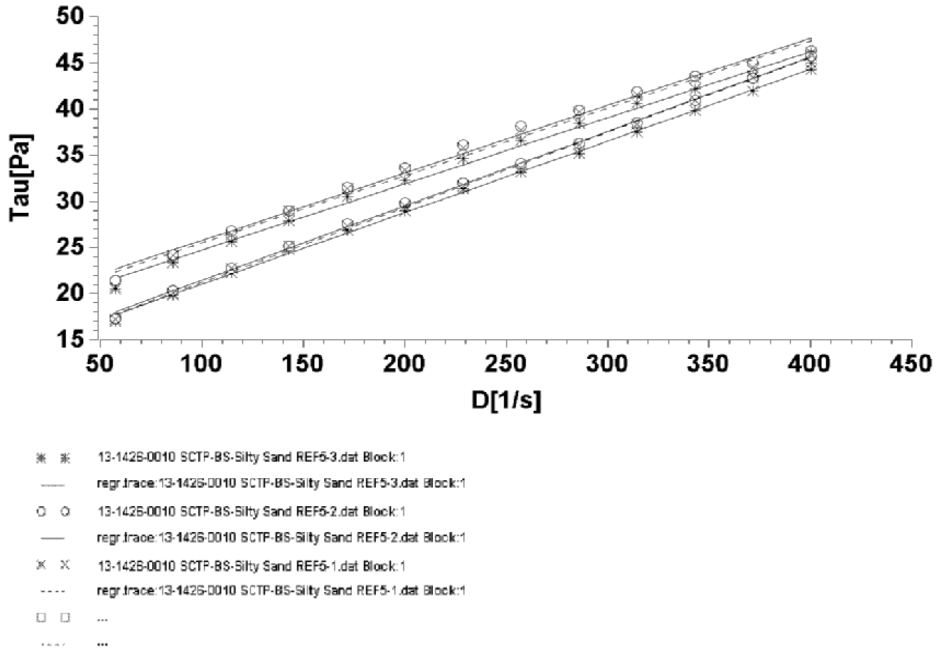
Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF4-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=34.035+0.13778*X ;B=0.98787; S=1.77
step1: Bingham yieldstress[Pa]=34.0351
step1: Bingham viscosity[Pas]=0.1378
step2: Bingham: Y=22.585+0.15273*X ;B=0.99926; S=0.483
step2: Bingham yieldstress[Pa]=22.5851
step2: Bingham viscosity[Pas]=0.1527

filter activated: D[1/s]>40
step1: Bingham: Y=34.386+0.1334*X ;B=0.97942; S=2.25
step1: Bingham yieldstress[Pa]=34.3865
step1: Bingham viscosity[Pas]=0.1334
step2: Bingham: Y=22.147+0.14858*X ;B=0.99911; S=0.514
step2: Bingham yieldstress[Pa]=22.1467
step2: Bingham viscosity[Pas]=0.1486

filter activated: D[1/s]>40
step1: Bingham: Y=32.043+0.13316*X ;B=0.98634; S=1.82
step1: Bingham yieldstress[Pa]=32.0434
step1: Bingham viscosity[Pas]=0.1332
step2: Bingham: Y=21.809+0.14609*X ;B=0.99933; S=0.44
step2: Bingham yieldstress[Pa]=21.8092
step2: Bingham viscosity[Pas]=0.1461
End of report

multiple data sources page 1

15:37 09/12/13
Manual Report Analysis/Regression

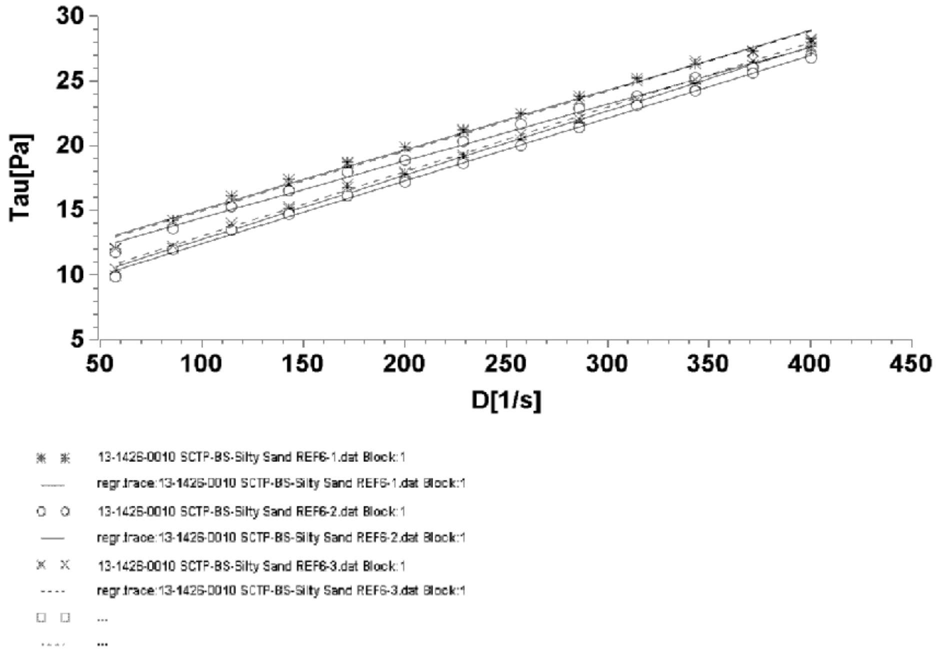


Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF5-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=17.562+0.07155*X ;B=0.99325; S=0.685
step1: Bingham yieldstress[Pa]=17.5617
step1: Bingham viscosity[Pas]=0.0715
step2: Bingham: Y=13.263+0.077489*X ;B=0.99887; S=0.303
step2: Bingham yieldstress[Pa]=13.2631
step2: Bingham viscosity[Pas]=0.0775

filter activated: D[1/s]>40
step1: Bingham: Y=18.472+0.072948*X ;B=0.99138; S=0.791
step1: Bingham yieldstress[Pa]=18.4719
step1: Bingham viscosity[Pas]=0.0729
step2: Bingham: Y=13.381+0.080607*X ;B=0.99903; S=0.292
step2: Bingham yieldstress[Pa]=13.3811
step2: Bingham viscosity[Pas]=0.0806

filter activated: D[1/s]>40
step1: Bingham: Y=18.181+0.072944*X ;B=0.98985; S=0.858
step1: Bingham yieldstress[Pa]=18.1813
step1: Bingham viscosity[Pas]=0.0729
step2: Bingham: Y=13.102+0.081176*X ;B=0.99892; S=0.31
step2: Bingham yieldstress[Pa]=13.1021
step2: Bingham viscosity[Pas]=0.0812
End of report

15:59 09/12/13
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 SCTP-BS-Silty Sand REF6-1.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=10.468+0.046081*X ;B=0.99287; S=0.454
step1: Bingham yieldstress[Pa]=10.4675
step1: Bingham viscosity[Pas]=0.0461
step2: Bingham: Y=7.795+0.049655*X ;B=0.99775; S=0.274
step2: Bingham yieldstress[Pa]=7.795
step2: Bingham viscosity[Pas]=0.0497

filter activated: D[1/s]>40
step1: Bingham: Y=10.038+0.043903*X ;B=0.99428; S=0.387
step1: Bingham yieldstress[Pa]=10.0376
step1: Bingham viscosity[Pas]=0.0439
step2: Bingham: Y=7.621+0.048375*X ;B=0.99821; S=0.238
step2: Bingham yieldstress[Pa]=7.621
step2: Bingham viscosity[Pas]=0.0484

filter activated: D[1/s]>40
step1: Bingham: Y=10.305+0.046369*X ;B=0.99418; S=0.412
step1: Bingham yieldstress[Pa]=10.3051
step1: Bingham viscosity[Pas]=0.0464
step2: Bingham: Y=8.0191+0.049857*X ;B=0.9986; S=0.217
step2: Bingham yieldstress[Pa]=8.0191
step2: Bingham viscosity[Pas]=0.0499
End of report

Golder Associates Ltd.
Viscosity / Flow Curve Testing R/S Plus Rheometer

Client:	Giant Mining Support Services
Project Number:	13-1426-0010
Date:	1/10/2014
Technologist	CJC

		Status	Reviewer	Date Complete
Data Entry		**Complete**	**CA**	**1/14/2014**
Data Review	**1st Review**	**Complete**	**CA**	**1/14/2014**
	2nd Review	**Complete**	**ML**	**1/27/2014**

Sample ID:	13-1426-0010 SCTP - BS - Clay - Silt
Sample Description:	Fine Grey Material
Water:	13-1426-0010 Water
pH Adjustment:	none
Bob:	CC25 Profiled Bob
Additional Info:	
Specific Gravity	2.82

VISCOSITY DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	1.2024	1.2450	1.2147	1.221
2	0.6866	0.6832	0.6738	0.681
3	0.3842	0.3698	0.3851	0.380
4	0.1532	0.1471	0.1525	0.151
5	0.0539	0.0522	0.0520	0.053
6	0.0324	0.0322	0.0332	0.033
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
1.3879	1.3868	1.3933	1.389
0.7160	0.6921	0.7342	0.714
0.3994	0.3905	0.3976	0.396
0.1601	0.1560	0.1568	0.158
0.0558	0.0551	0.0555	0.055
0.0332	0.0335	0.0334	0.033

YIELD STRESS DATA

Ramp Up

REF	Trial 1	Trial 2	Trial 3	AVG
1	447.9799	444.4236	455.2807	449
2	277.5498	269.1825	272.6703	273
3	177.8271	181.9153	177.4569	179
4	97.6812	95.9827	95.9051	97
5	42.8525	42.3300	42.6274	43
6	24.8330	24.4724	24.4095	25
7				

Ramp Down

Trial 1	Trial 2	Trial 3	AVG
391.0541	384.8612	389.1268	388
270.1349	265.9030	256.5575	264
180.9864	179.8639	180.0922	180
95.9650	92.9490	94.5235	94
42.3178	41.5142	41.6537	42
24.4971	24.1457	24.4079	24

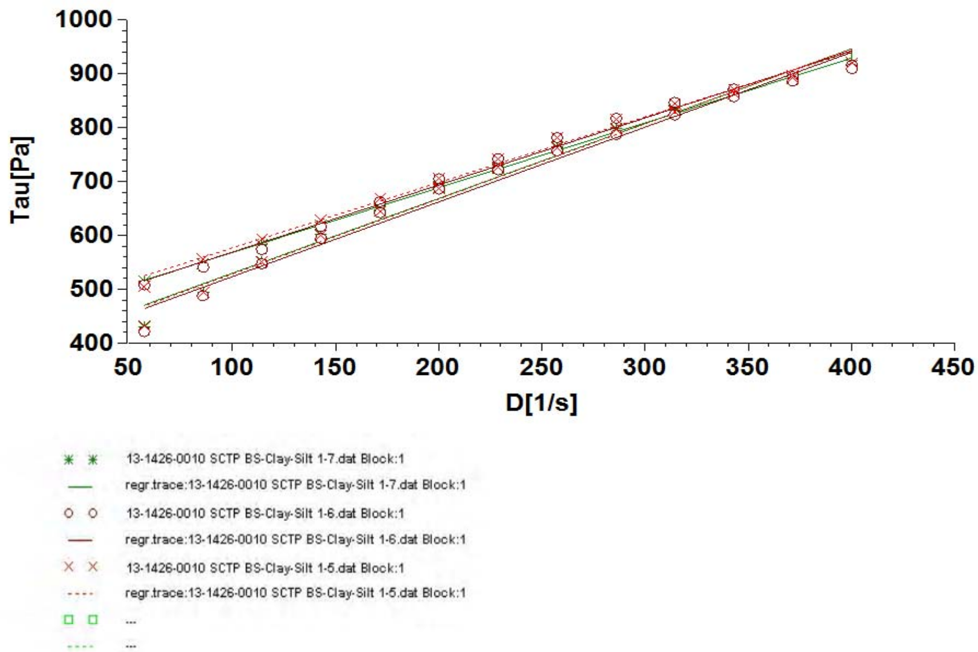
WEIGHT PERCENT SOLIDS

REF	Pan #	Pan Wt. (g)	Wet (g)	Dry (g)	Wt% Solids	SVF (Φ)
1	x33	6.10	28.72	22.18	71.09%	0.47
2	x13	6.01	27.01	20.66	69.76%	0.45
3	43	6.96	25.51	19.59	68.09%	0.43
4	x18	5.94	28.45	20.74	65.75%	0.41
5	x10	6.08	22.99	16.64	62.45%	0.37
6	x36	6.27	21.55	15.46	60.14%	0.35
7						

Additional Notes:

multiple data sources

15:39 10/01/14
Manual Report Analysis/Regression

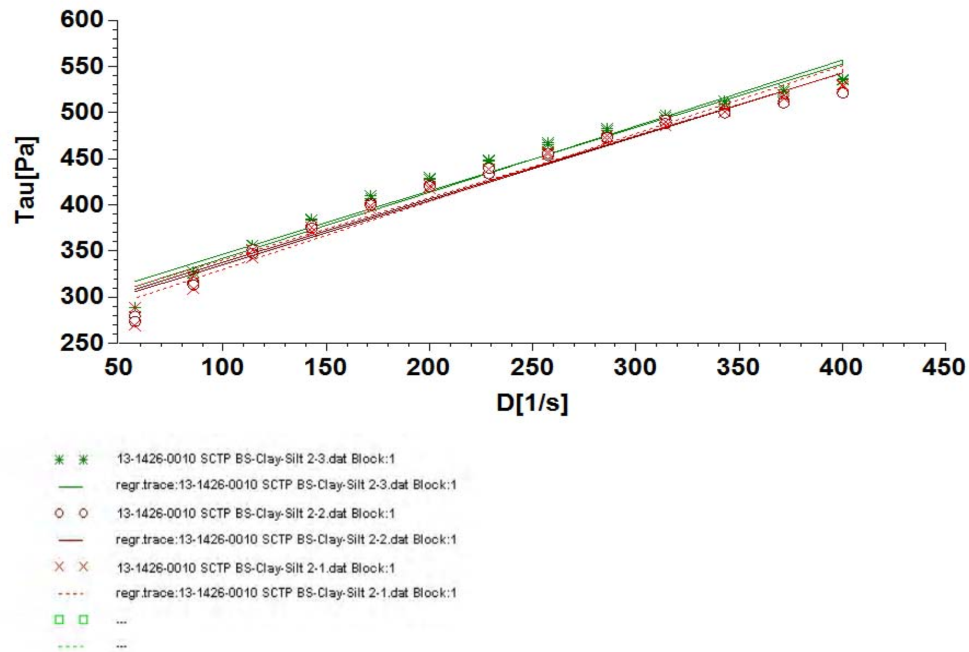


Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 1-7.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=447.98+1.2024*X ;B=0.99846; S=5.48
step1: Bingham yieldstress[Pa]=447.9799
step1: Bingham viscosity[Pas]=1.2024
step2: Bingham: Y=391.05+1.3879*X ;B=0.9837; S=20.8
step2: Bingham yieldstress[Pa]=391.0541
step2: Bingham viscosity[Pas]=1.3879

filter activated: D[1/s]>40
step1: Bingham: Y=444.42+1.245*X ;B=0.99032; S=14.3
step1: Bingham yieldstress[Pa]=444.4236
step1: Bingham viscosity[Pas]=1.245
step2: Bingham: Y=384.86+1.3868*X ;B=0.98312; S=21.1
step2: Bingham yieldstress[Pa]=384.8612
step2: Bingham viscosity[Pas]=1.3868

filter activated: D[1/s]>40
step1: Bingham: Y=455.28+1.2147*X ;B=0.99303; S=11.8
step1: Bingham yieldstress[Pa]=455.2807
step1: Bingham viscosity[Pas]=1.2147
step2: Bingham: Y=389.13+1.3933*X ;B=0.98651; S=18.9
step2: Bingham yieldstress[Pa]=389.1268
step2: Bingham viscosity[Pas]=1.3933
End of report

09:05 13/01/14
Manual Report Analysis/Regression



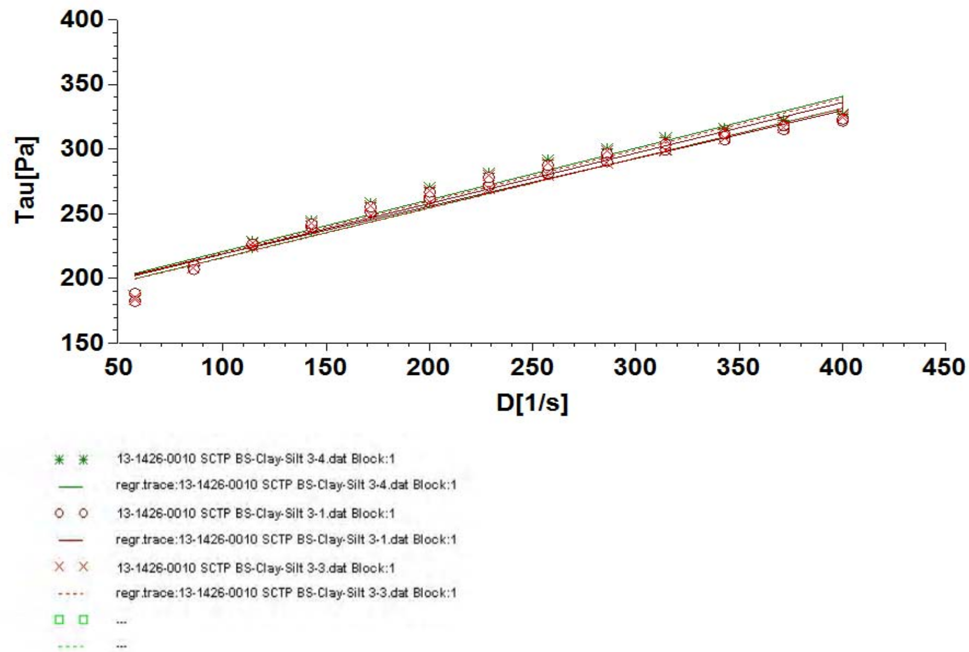
Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 2-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=277.55+0.6866*X ;B=0.971; S=13.8
step1: Bingham yieldstress[Pa]=277.5498
step1: Bingham viscosity[Pas]=0.6866
step2: Bingham: Y=270.13+0.71599*X ;B=0.96586; S=15.6
step2: Bingham yieldstress[Pa]=270.1349
step2: Bingham viscosity[Pas]=0.716

filter activated: D[1/s]>40
step1: Bingham: Y=269.18+0.68321*X ;B=0.96659; S=14.8
step1: Bingham yieldstress[Pa]=269.1825
step1: Bingham viscosity[Pas]=0.6832
step2: Bingham: Y=265.9+0.69208*X ;B=0.96138; S=16.1
step2: Bingham yieldstress[Pa]=265.903
step2: Bingham viscosity[Pas]=0.6921

filter activated: D[1/s]>40
step1: Bingham: Y=272.67+0.67378*X ;B=0.97942; S=11.4
step1: Bingham yieldstress[Pa]=272.6703
step1: Bingham viscosity[Pas]=0.6738
step2: Bingham: Y=256.56+0.73424*X ;B=0.97115; S=14.7
step2: Bingham yieldstress[Pa]=256.5575
step2: Bingham viscosity[Pas]=0.7342
End of report

multiple data sources

09:28 13/01/14
Manual Report Analysis/Regression

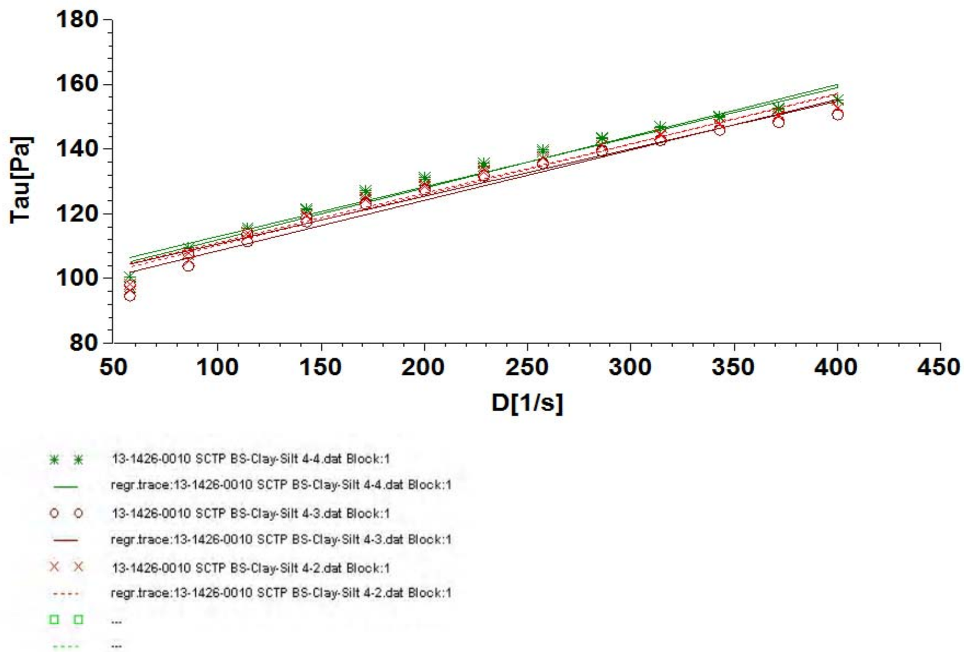


Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 3-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=177.83+0.38424*X ;B=0.9846; S=5.58
step1: Bingham yieldstress[Pa]=177.8271
step1: Bingham viscosity[Pas]=0.3842
step2: Bingham: Y=180.99+0.39936*X ;B=0.95612; S=9.94
step2: Bingham yieldstress[Pa]=180.9864
step2: Bingham viscosity[Pas]=0.3994

filter activated: D[1/s]>40
step1: Bingham: Y=181.92+0.36982*X ;B=0.97845; S=6.38
step1: Bingham yieldstress[Pa]=181.9153
step1: Bingham viscosity[Pas]=0.3698
step2: Bingham: Y=179.86+0.39051*X ;B=0.9574; S=9.57
step2: Bingham yieldstress[Pa]=179.8639
step2: Bingham viscosity[Pas]=0.3905

filter activated: D[1/s]>40
step1: Bingham: Y=177.46+0.38509*X ;B=0.98282; S=5.92
step1: Bingham yieldstress[Pa]=177.4569
step1: Bingham viscosity[Pas]=0.3851
step2: Bingham: Y=180.09+0.39765*X ;B=0.96239; S=9.14
step2: Bingham yieldstress[Pa]=180.0922
step2: Bingham viscosity[Pas]=0.3976
End of report

09:59 13/01/14
Manual Report Analysis/Regression

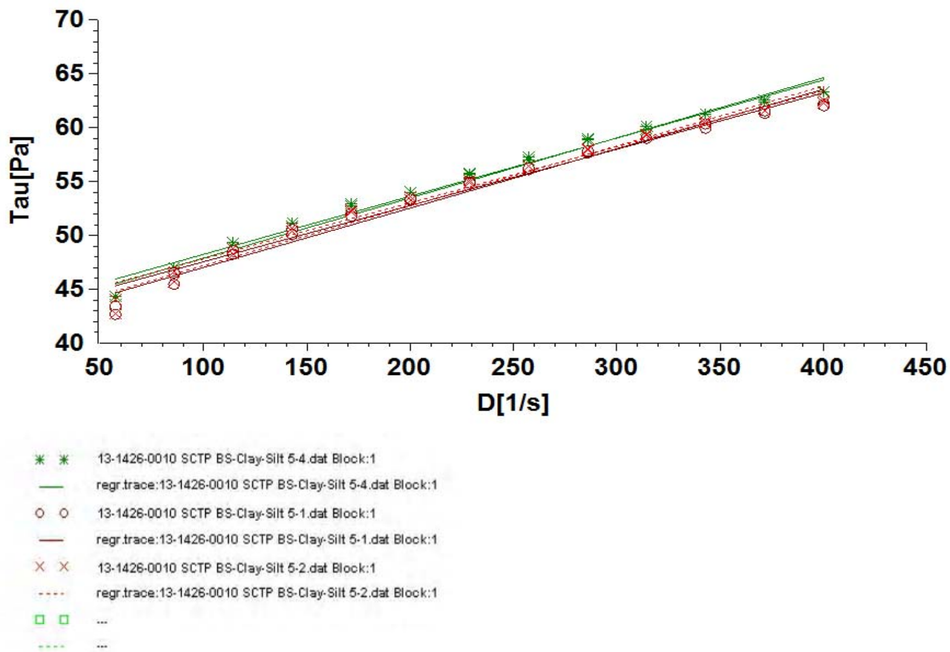


Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 4-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=97.681+0.15325*X ;B=0.9766; S=2.76
step1: Bingham yieldstress[Pa]=97.6812
step1: Bingham viscosity[Pas]=0.1532
step2: Bingham: Y=95.965+0.16009*X ;B=0.96341; S=3.63
step2: Bingham yieldstress[Pa]=95.965
step2: Bingham viscosity[Pas]=0.1601

filter activated: D[1/s]>40
step1: Bingham: Y=95.983+0.14713*X ;B=0.97291; S=2.85
step1: Bingham yieldstress[Pa]=95.9827
step1: Bingham viscosity[Pas]=0.1471
step2: Bingham: Y=92.949+0.15599*X ;B=0.9636; S=3.52
step2: Bingham yieldstress[Pa]=92.949
step2: Bingham viscosity[Pas]=0.156

filter activated: D[1/s]>40
step1: Bingham: Y=95.905+0.15247*X ;B=0.97567; S=2.8
step1: Bingham yieldstress[Pa]=95.9051
step1: Bingham viscosity[Pas]=0.1525
step2: Bingham: Y=94.523+0.15681*X ;B=0.96417; S=3.51
step2: Bingham yieldstress[Pa]=94.5235
step2: Bingham viscosity[Pas]=0.1568
End of report

10:37 13/01/14
Manual Report Analysis/Regression

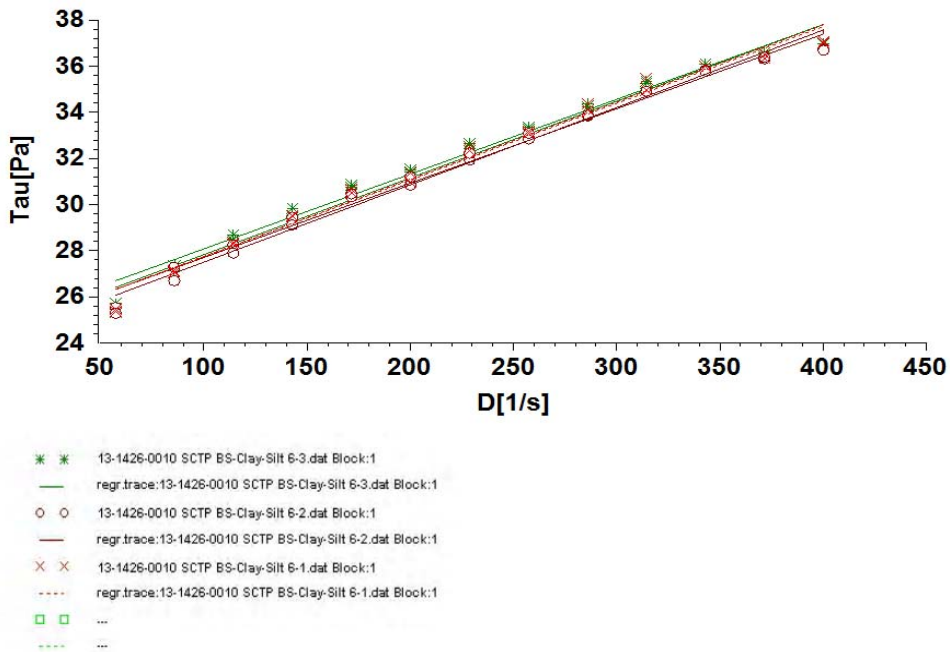


Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 5-4.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=42.852+0.053923*X ;B=0.98637; S=0.737
step1: Bingham yieldstress[Pa]=42.8525
step1: Bingham viscosity[Pas]=0.0539
step2: Bingham: Y=42.318+0.055774*X ;B=0.98116; S=0.898
step2: Bingham yieldstress[Pa]=42.3178
step2: Bingham viscosity[Pas]=0.0558

filter activated: D[1/s]>40
step1: Bingham: Y=42.33+0.052215*X ;B=0.98228; S=0.815
step1: Bingham yieldstress[Pa]=42.33
step1: Bingham viscosity[Pas]=0.0522
step2: Bingham: Y=41.514+0.055095*X ;B=0.97758; S=0.97
step2: Bingham yieldstress[Pa]=41.5142
step2: Bingham viscosity[Pas]=0.0551

filter activated: D[1/s]>40
step1: Bingham: Y=42.627+0.05197*X ;B=0.98627; S=0.713
step1: Bingham yieldstress[Pa]=42.6274
step1: Bingham viscosity[Pas]=0.052
step2: Bingham: Y=41.654+0.055479*X ;B=0.97763; S=0.975
step2: Bingham yieldstress[Pa]=41.6537
step2: Bingham viscosity[Pas]=0.0555
End of report

11:37 13/01/14
Manual Report Analysis/Regression



Analysis-results
Analysis data source: 13-1426-0010 SCTP BS-Clay-Silt 6-3.dat Block:1
filter activated: D[1/s]>40
step1: Bingham: Y=24.833+0.032386*X ;B=0.98347; S=0.488
step1: Bingham yieldstress[Pa]=24.833
step1: Bingham viscosity[Pas]=0.0324
step2: Bingham: Y=24.497+0.033231*X ;B=0.98244; S=0.516
step2: Bingham yieldstress[Pa]=24.4971
step2: Bingham viscosity[Pas]=0.0332

filter activated: D[1/s]>40
step1: Bingham: Y=24.472+0.032241*X ;B=0.99019; S=0.373
step1: Bingham yieldstress[Pa]=24.4724
step1: Bingham viscosity[Pas]=0.0322
step2: Bingham: Y=24.146+0.033502*X ;B=0.98625; S=0.46
step2: Bingham yieldstress[Pa]=24.1457
step2: Bingham viscosity[Pas]=0.0335

filter activated: D[1/s]>40
step1: Bingham: Y=24.409+0.03322*X ;B=0.98627; S=0.456
step1: Bingham yieldstress[Pa]=24.4095
step1: Bingham viscosity[Pas]=0.0332
step2: Bingham: Y=24.408+0.033407*X ;B=0.98587; S=0.465
step2: Bingham yieldstress[Pa]=24.4079
step2: Bingham viscosity[Pas]=0.0334
End of report

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

Golder Associates

TECHNICAL MEMORANDUM

DATE January 24, 2014 **REFERENCE No.** 1314260010-064-TM-Rev0-0000

TO Mr. Brad Thompson
Public Works and Government Services Canada (PWGSC)

FROM David Caughill **EMAIL** Dave_Caughill@golder.com

SUMMARY OF FIELD INVESTIGATION PROGRAMS ON THE NORTH/SOUTH/CENTRAL PONDS AT GIANT MINE, YELLOWKNIFE, NORTHWEST TERRITORIES

Public Works and Government Services Canada (PWGSC) requested Golder Associates Ltd. (Golder) to provide a summary of the field investigation programs carried out by Golder Associates on the North, Central and South Ponds at the Giant Mine Site, NWT. This technical memorandum was prepared to provide a factual field investigation record of the activities undertaken and observations recorded during the field programs and is intended to provide information to support production of paste from the tailings from these ponds.

The reader is referred to the Study Limitations section which follows the text and forms an integral part of this technical memorandum.

1.0 INTRODUCTION

Golder has completed four field investigation programs on the North, Central and South ponds between 2010 and 2013, consisting of three test pit site investigation programs and one auger borehole program. The test pit programs provide information on the upper 3 to 4 m of the tailings within the ponds. The borehole program provides more information on the tailings at deeper depths, at selected locations. Observations on consistency and composition of the tailings were recorded and samples were collected, to be used for laboratory testing to characterize and to evaluate the potential suitability of the tailings to produce paste for underground mine backfill. The information summarised in this memorandum is intended to provide information to support the planning of paste production programs in 2014 and 2015.

The paste produced with tailings from upper portions of the South Pond, the Central Pond and possibly the North Pond will be used to supply tailings for paste production in 2014 and 2015. For the purpose of this memorandum, the North Pond is considered as a backup location to source tailings, if insufficient tailings are available from the South and Central Ponds. Hence, the investigations completed to date for the North Pond are less extensive than that for the other two areas.

A brief summary of the typical tailings encountered in the upper portion of the ponds is provided in Section 4, with the ponds divided into sections according to typical soils description.

2.0 FIELD PROGRAMS

A total of 54 test pits have been excavated on the South Pond, 32 on the Central Pond and 2 on the North Pond. Two boreholes have been advanced on the South Pond, 2 on the Central Pond and 4 on the North Pond. Details on each program are provided in the individual reports, listed below:

- "Field Investigation for Tailings Excavation Planning at Giant Mine, Yellowknife, Northwest Territories – July 2013", (Golder 2013A).
- "Field Investigation for Paste Production Planning at Giant Mine, Yellowknife, Northwest Territories – October 2013", (Golder 2013B).
- "Phase 1 – Tailings Investigation Giant Mine Remediation Project" (Golder 2011).
- "Tailings Investigation, Giant Mine, Yellowknife, NWT" (Golder 2012).

Additional information on the tailings can also be found in an investigation report prepared by SRK in 2007. The information in this report is not included in this summary memorandum. The reference for the report is:

- "Tailings and Settling Pond Field Investigations, Giant Mine, Yellowknife, NWT, Canada" (SRK 2007b).

The descriptions of the tailings in the tables below were based on particle size distribution test where available and field assessments at locations where the tailings was not sampled. Field assessment techniques were limited to visual inspection and handling with gloved hands.

In general the tailings encountered during the investigation in the south and central tailings ponds can be classified as silty sand, sandy silt or clayey silt, as described below:

- Silty sand, fine grained, grey to brown, no cementation, non-cohesive, dry to moist, very loose to loose. This unit often contains lenses of blocky/friable sandy silt up to about 0.5 m thick.
- Sandy silt, various shades of brown and grey 1 to 10 mm thick interlaminations, very weakly cemented, blocky/friable, dry to moist, soft. This unit often contained lenses of silty sand up to about 0.5 m thick.
- Clayey silt, low plasticity, some sand to sandy, light grey to brown, cohesive, wet of plastic limit, very soft. This unit retained its water (no seepage/free water observed at time of excavation).

With few variations the material encountered during the investigation programs can be classified in one of these three categories. For the purposes of this report, the classification took into consideration the behavior of the material from the standpoint of paste production. The material described as silty sand is generally loose material that crumbles easily with light finger pressure. The material described as sandy silt is generally blocky or friable and requires moderate to strong finger pressure to crumble. The material described as clayey silt is plastic in nature and can be moulded or squeezed rather than crumbled with light to moderate finger pressure.

Observations during the 2013 paste production activities were that each type of material required different processing in order to be used for paste production (using Reimer trucks in this case). Silty sand was generally suitable to be used as excavated, except to possibly screen for debris within the tailings. Sandy silt required screening or mechanical conditioning, to break up the lumps in the tailings. Without conditioning, the tailings tended to cause blockages in the paste production (mixing process) operation. Clayey silt material, due to the plasticity, would need to be blended with coarser material, in order to not cause blockages in the paste piping system.

Based on field observations made during tailings excavation at the north end of the South Pond for the 2013 paste production trial, it should be noted that water conditions in the tailings can change due to the excavation activity itself. For example repeated passes by heavy equipment made over the same spot can have a "pumping" effect, apparently bringing water closer to the surface than it was during the initial investigation.

3.0 SUMMARY OF INVESTIGATION PROGRAMS

The location of the test pits and boreholes at the South and Central Pond are shown on Figure 1 and those for the North Pond are shown on Figure 2. Some key observations from the investigation for each pond are noted below and tailings descriptions and observations are noted in Tables 1 to 4, for each program. Borehole and test pit records from the 2010, 2011 and 2013 investigation programs are provided in the individual reports referenced in Section 2.0.

3.1 South Pond

A key note related to the South Pond investigation programs is that all of the boreholes and test pits were completed prior to tailings being excavated in the north and north-west portions of the pond. The tailings were excavated in the fall of 2013 for paste production, to depths up to approximately 2 m. The reviewer will need to compare pre- and post-excavation contours in order to remove the upper portions of the test pit records in this area (the plans with these contours provided under separate cover).

In general, the grain size of the tailings varies both laterally and vertically in the South Pond, presumably as a result of multiple discharge locations. Boreholes and test pits could not be advanced near or on the pond in the north east corner of the pond, as the bearing capacity was too soft for the equipment in this area.

3.2 Central Pond

Features to note for the Central Pond is a channel along the western side of pond and a storage pad on the north east corner of the pond. Tailings cannot be excavated at the location of the pad. There are also anecdotal records of debris that may be buried in the pond.

Frozen tailings (suspected permafrost) were encountered within the tailings in test pits and boreholes on the Central Pond. The excavators were unable to dig through the frozen layers.

3.3 North Pond

There is a significant pond in the southern section of the pond; the potential tailings for paste production are located north of this pond.

3.4 Summary Tables of Investigation Programs

Summary tables for each investigation program are listed below.

Table 1: North, Central and South Pond Test Pit Summary 2010

Test Pit	Depth (m)	Sample ID	Visual Description	Sand Content (%)	Fines Content (%)
GA10-06 (North Pond)	0-0.8	SA1	Sandy Silt	27	73
	0.8-1.9	SA2	Silt	1	99
	1.9-3.0	SA3	Clayey Silt	0	100
GA10-07 (North Pond)	0-3.1	SA2	Silty Sand	85	15
GA10-08 (Central Pond)	0-2.9	SA1	Silty Sand	56	44
	2.9-3.6	SA4	Silt	0	100
GA10-09 (South Pond)	0-3.0	SA2	Silty Sand	77	23
GA10-10 (South Pond)	0-0.8	SA1	Sandy Silt	44	64
	0.8-1.1		Clayey Silt		
	1.1-1.3		Silty Sand		
	1.3-1.9	SA2	Silt	0	100
GA10-11 (South Pond)	0-1.8	SA1	Silt, some sand	6	94
		Sa2	Silt, some sand	15	85
	1.8-2.2		Silt		
	2.2-3.1		Silty Sand		

Table 2: North, Central and South Pond Borehole Summary 2011

Borehole	Depth (m)	Sample ID	Visual Description	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-08 (North Pond)	0.3-0.6	SA1	Silt	21.0					
	4.5-5.5	SA2	Silt	23.7					
	7.5-9.0	SA3	Silt	27.1					
	3.0-3.4	SA4	Silt	20.6					
	3.8-4.3	SA5	Silt	22.4					NP
	4.6-4.9	SA6	Silt	20.1					
	5.3-5.8	SA7	Silt	21.5					NP
	6.1-6.4	SA8	Silt	20.2					
	6.9-7.2	SA9A	Silt	29.1				23	18
	7.2-7.3	SA9B	Sand and Gravel	14.6					
	7.6-7.9	SA10	Silty Clay	17.6					NP
GA11-T-09 (North Pond)	0.3-0.6	SA1	Silt	27.9					
	1.2-1.5	SA2	Sand		74.0	20.5	5.5		NP
	1.8-2.1	SA3	Silt	21.2					NP
	3.0-3.4	SA5	Silt	26.8				24	23
	4.6-4.9	SA7	Silt	32.0					
	5.2-5.5	SA8	Sand and Gravel	11.2					
	6.2-6.6	SA9	Clayey Silt	20.9				25	24
	7.3-7.6	SA10	Clayey Silt	23.0					
	8.4-8.8	SA11	Clayey Silt	33.0					
	9.0-9.3	SA12	Peat	26.7					
	9.6-9.9	SA13	Silty Clay	40.9					
GA11-T-10 (North Pond)	0.3-0.6	SA1	Silt and Sand	24.0					
	1.5-1.8	SA2	Silt and Sand	22.2					NP
	2.3-2.7	SA3	Silt and Sand	31.6					
	3.0-3.4	SA4	Clayey Silt	29.4					NP
	4.6-4.9	SA6	Clayey Silt	26.4					NP
	5.3-5.8	SA7	Clayey Silt	30.6					
	6.1-6.4	SA8	Clayey Silt	25.6					
	6.9-7.3	SA9	Clayey Silt	29.6					
	7.6-7.9	SA10	Clayey Silt	38.9				32	27
	8.4-8.8	SA11	Silty Clay	11.3					

Borehole	Depth (m)	Sample ID	Visual Description	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-11 (North Pond)	0.3-0.6	SA1	Clayey Silt	42.3					
	1.2-1.5	SA2	Clayey Silt	32.3					
	1.5-2.3	SA3	Sandy - Silt		19.8	68.9	11.3		NP
	3.2-3.5	SA4	Sandy Silt	8.4					
	3.8-4.3	SA5	Clayey Silt	34.5	1.2	81.5	17.3		
	4.6-4.9	SA6	Clayey Silt	39.2					
	5.3-5.8	SA7	Clayey Silt	40.3	0.5	85.2	14.2		NP
	6.1-6.4	SA8	Clayey Silt	36.5					
	6.9-7.3	SA9	Clayey Silt	34.5	0.6	86.4	13.0	26	24
	7.6-7.9	SA10	Clayey Silt	39.2					
	8.4-8.8	SA11	Clayey Silt	41.0	0.6	85.6	13.9		NP
	10.4-10.7	SA12	Clayey Silt	34.6					
	11.4-11.9	SA13	Clayey Silt	35.8	0.3	82.6	17.1		NP
	12.5-12.8	SA14	Peat	63.9					
	13.4-13.7	SA15	Silty Clay	33.8					
	14.0-14.3	SA16	Silty Sand	31.5					
GA11-T-04 (Central Pond)	0.3-0.6	SA1	Silt and Sand	28.2					
	0.8-1.2	SA2	Silt and Sand	20.0					
	1.5-1.8	SA3	Silt and Sand	15.2					
	2.3-2.7	SA4	Silt and Sand	9.7					
	3.0-3.4	SA5	Sandy, Clayey - Silt	27.5	18.9	66.0	15.0		NP
	4.0-4.3	SA6	Sandy, Clayey - Silt		15.4	71.6	13.0		NP
	4.6-5.2	SA7	Silt	19.7				26	23
	5.3-5.8	SA8	Clayey, Sand and Silt	24.8	51.8	35.9	12.2		NP
	6.1-6.4	SA9	Silt	20.0					
	6.9-7.3	SA10	Sandy Silt	19.1	32.1	60.6	7.3		NP
	7.6-7.9	SA11	Silt	27.6					
	8.4-8.5	SA12	Sandy Silt	23.7	28.7	63.6	7.7		NP
	10.7-11.0	SA13	Silt	28.5					
	11.4-11.9	SA14	Silt	30.9					
	13.7-14.0	SA15	Sandy Silt	22.8	28.1	60.0	11.9		NP
	14.5-14.9	SA16	Silt	30.5					
	16.5-16.8	SA17	Silt	23.6					
	18.6-19.2	SA18	Silt	32.5					NP
	20.0-20.4	SA19	Peat	116.2					

Borehole	Depth (m)	Sample ID	Visual Description	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-06 (Central Pond)	4.6-4.9	SA6	Clayey Silt	38.2					
	5.3-5.8	SA7	Sandy Silt	24.0	38.1	55.0	6.9		
	6.1-6.4	SA8	Clayey Silt	29.9					
	7.6-7.9	SA9	Silt	25.1	11.1	85.7	3.2		NP
	8.4-8.8	SA10	Clayey Silt	34.7					
	10.4-10.7	SA11	Sandy Silt	23.6	27.2	71.5	1.3		NP
	13.4-13.7	SA12	Sandy Silt	29.3	14.2	74.9	10.9		NP
	14.5-14.9	SA14	Clayey Silt	16.8					
	16.6-16.9	SA15	Silty Sand	24.3	67.3	26.9	5.8		NP
	19.5-19.8	SA16	Clayey Silt	22.8					
	19.5-19.8	SA17	Peat	25.1					
	20.0-20.3	SA18	Sand	18.4					
GA11-T-01 (South Pond)	0.3-0.6	SA1	Silty Sand	9.9	61.1	32.3	6.6		NP
	0.8-1.2	SA2	Clayey Silt	24.2					
	1.5-1.8	SA3	Clayey Silt	27.4	2.1	82.8	15.2	25	22
	2.3-2.7	SA4	Clayey Silt	27.6	0.2	83.9	15.9		NP
	3.2-3.5	SA5	Sandy-Silt	31.2	29.7	58.4	11.9		NP
	3.8-4.3	SA6	Clayey Silt	25.8					
	4.6-4.7	SA7	Clayey Silt	41.7	0.5	79.6	19.9	32	25
	5.3-5.8	SA8	Clayey Silt	33.7					
	6.1-6.4	SA9	Sandy Silt	23.4	15.5	73.8	10.7		NP
	6.9-7.3	SA10	Clayey Silt	29.2					
	7.6-7.9	SA11	Sandy Silt	23.7	13.8	75.5	10.7		NP
	8.5-9.4	SA12	Clayey Silt	24.2					
	10.7-11.0	SA13	Clayey Silt	29.0	2.4	79.2	18.4	27	23
	11.4-11.9	SA15	Clayey Silt	29.9				23	17
	12.5-12.8	SA16	Clayey Silt	27.9					
	14.5-14.9	SA17	Clayey Silt	27.5					
	15.1-15.2	SA18	Peat	45.7					
	16.0-16.5	SA19	Silty Clay	24.9					
	16.6-17.1	SA20	Silty Clay	27.5					

Borehole	Depth (m)	Sample ID	Visual Description	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-02 (South Pond)	0.3-0.6	SA1	Silt	44.3					
	0.9-1.5	SA2	Sand and Silt		55.5	39.1	5.4		NP
	3.0-3.4	SA5	Clayey Silt	22.5	11.5	75.0	13.5		NP
	4.6-4.9	SA7	Clayey - Silt	34.6	3.8	79.0	17.2	24	20
	5.3-5.8	SA8	Silt	35.4					
	6.1-6.4	SA9	Sandy, Clayey Silt	26.6	16.7	69.5	13.8		NP
	6.9-7.3	SA10	Silt	24.8					
	7.6-7.9	SA11	Sand and Silt	23.2	46.9	42.1	11.0		NP
	8.8-9.1	SA13	Silt	30.8					
	9.1-9.4	SA14	Bedrock	17.9					

Note: NP = Non Plastic

Table 3: Central and South Pond Test Pit Summary July 2013

Area	Test Pit ID	Depth (m)	Visual Description / Relative Moisture Content	Sand Content (%)	Silt Content (%)	Clay Content (%)
Central Pond	CP-TP-01	0-3.7	Sandy Silt to Silt with trace sand and trace clay. Material varied from dry (shallow depths) to moist (deeper)	42	53	5
	CP-TP-02	0-3.4	Sandy Silt to Silt with trace sand and trace clay. Material varied from dry (shallow depths) to moist (deeper)	40	55	5
	CP-TP-03	0-3.6	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)			
	CP-TP-04	0-3.5	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)			
	CP-TP-05	0-3.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
	CP-TP-06	0-2.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.0-3.6	Clayey Silt			
	CP-TP-07	0-2.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.5-3.7	Clayey Silt			
	CP-TP-08	0-2.5	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.5-3.7	Clayey Silt			
South Pond	SP-TP-01	0-3.0	Sandy Silt with trace clay. Material varied from dry to moist (shallow depths) to moderately wet (deeper)	39	57	4
		3.0-4.0	Clayey Silt with sand. TP collapsed at 4.0m depth			
	SP-TP-02	0-2.9	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)	43	54	3
	SP-TP-03	0-3.4	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)	42	54	4
	SP-TP-04	0-2.4	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)	15	79	6
	SP-TP-05	0-3.4	Sandy Silt with trace clay. Material varied from dry (shallow depths) to moist (deeper)	45	51	4

Area	Test Pit ID	Depth (m)	Visual Description / Relative Moisture Content	Sand Content (%)	Silt Content (%)	Clay Content (%)
	SP-TP-06	0-3.0	Sandy Silt intermixed with clayey silt. Material varied from dry (shallow depths) to moist (deeper)	37	58	5
		3.0-4.0	Clayey Silt with trace sand			
	SP-TP-07	0-3.5	Sandy Silt with clay. Material varied from dry (shallow depths) to moist (deeper)			
		3.5-4.0	Clayey Silt with trace sand			
	SP-TP-08	0-2.0	Silty Sand. Material varied from dry to moist (shallow depths) to moderately wet (deeper)			
		2.0-3.0	Clayey Silt. Collapse at 3.3 m. Water at 3 m, accumulated overnight			
	SP-TP-09	0-2.0	Sandy Silt. Material varied from dry to moist (shallow depths) to moderately wet (deeper)			
		2.0-4.0	Clayey sandy Silt. Collapse at 3.0 m. Water at 2.4 m, accumulated overnight			
	SP-TP-10	0-2.5	Sandy Silt with clay. Material varied from dry (shallow depths) to moist (deeper)			
		2.5-3.5	Clayey Sandy Silt			
	SP-TP-11	0-1.9	Sandy Silt with clay. Material varied from dry (shallow depths) to moist (deeper)			
		1.9-3.7	Clayey Sandy Silt			
	SP-TP-12	0-1.0	Sandy Silt with clay. Material varied from dry (shallow depths) to moist (deeper)			
		1.0-3.7	Clayey Silt with sand			
	SP-TP-13	0-2.4	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.4-3.4	Clayey Silt			
	SP-TP-14	0-4.0	Clayey Silt (small sinkhole observed nearby test pit afterwards, probably existing sinkhole, ~45 cm diameter, 20-30 cm deep). Material varied from dry (shallow depths) to moist (deeper)			
	SP-TP-15	0-3.5	Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)			
	SP-TP-16	0-3.7	Clayey Silt with sand. Material varied from dry (shallow depths) to moist (deeper)			

Area	Test Pit ID	Depth (m)	Visual Description / Relative Moisture Content	Sand Content (%)	Silt Content (%)	Clay Content (%)
	SP-TP-17	0-3.4	Clayey Silt with sand. Material varied from dry (shallow depths) to moist (deeper)			
	SP-TP-18	0-1	Sandy Clayey Silt. Material varied from dry (shallow depths) to moist (deeper)			
		1.0-3.5	Clayey Silt			
	SP-TP-19	0-1.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		1.0-3.8	Clayey Silt			
	SP-TP-20	0-1.2	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		1.2-3.5	Clayey Silt			
	SP-TP-21	0-1.3	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		1.3-3.8	Clayey Silt			
	SP-TP-22	0-2.3	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.3-3.7	Clayey Silt			
	SP-TP-23	0-2.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		2.0-3.7	Clayey Silt			
	SP-TP-24	0-1.0	Sandy Silt. Material varied from dry (shallow depths) to moist (deeper)			
		1.0-3.7	Sandy Silt			
	SP-TP-25	0-1.5	Sandy Silt. Material varied from dry to moist (shallow depths) to moderately wet (deeper)			
		1.5-3.6	Clayey Silt. Collapse at 3.6 m			

Table 4: Central and South Pond Test Pit Summary October 2013

Location	Test Pit ID	Depth (m)	Visual Description/Comments	Sand Content (%)	Silt Content (%)	Clay Content (%)
Central Pond	CP-TP-09	0-1.25	Silty Sand			
		1.25-2.5	Sandy Silt	23	70	7
		2.5-4.5	Clayey Silt. Sloughing in Clayey Silt			
	CP-TP-10	0-1.25	Silty Sand			
		1.25-1.75	Sandy Silt			
		1.75-4.5	Clayey Silt. Sloughing in Clayey Silt	4	87	9
	CP-TP-11	0-1.0	Silty Sand			
		1.0-4.0	Sandy Silt (moist to wet). Sloughing in sandy Silt layer, rock (suspected bedrock) at 4.0 m	28	66	6
	CP-TP-12	0-3.5	Sandy Silt (dry to moist. Clayey Silt lens from 2.0 to 2.5 m			
	CP-TP-13	0-2.0	Sandy Silt			
		2.0-5.0	Silty Sand. Clayey Silt lens from 4.0 to 4.5 m			
	CP-TP-14	0-2.5	Sandy Silt	42	54	4
		2.5-4.5	Clayey Silt	2	89	9
	CP-TP-15	0-4.0	Silty Sand, containing lenses/laminations of blocky and clayey material	64	33	3
		4.0-5.5	Sandy Silt			
	CP-TP-16	0-4.5	Silty Sand	48	48	4
	CP-TP-17	0-1.0	Sandy Silt			
		1.0-4.5	Silty Sand. Dry to moist, containing wet clayey lenses at 3.0 m			
	CP-TP-18	0-3.75	Sandy Silt	32	63	5
		3.75-5.0	Clayey Silt			
	CP-TP-19	0-4.0	Sand and Silt, laminated			
		4.0-4.5	Sandy Silt	35	61	4
	CP-TP-20	0-4.0	Sandy Silt with sand lenses			
		4.0-4.5	Clayey Silt. Clayey lenses at 2.5 m. Sloughing off side walls observed	12	81	7

Location	Test Pit ID	Depth (m)	Visual Description/Comments	Sand Content (%)	Silt Content (%)	Clay Content (%)
	CP-TP-21	0-3.75	Silty Sand to Sandy Silt. Frozen from 3.5 to 3.75 m. Unable to excavate through the frozen tailings			
	CP-TP-22	0-4.0	Sandy Silt. Frozen, containing ice with 1 to 2 mm ice lenses from 3.0 to 4.0 m. Unable to dig further			
	CP-TP-23	0-4.0	Sandy Silt			
		4.0-5.0	Clayey Silt. Sloughing off side walls observed			
	CP-TP-24	0-2.5	Sandy Silt. Rock below 2.5 m. Topsoil and tree roots encountered from 2.25 to 2.5 m			
	CP-TP-25	0-3.5	Silty Sand with Silt lenses. Rock below 3.5 m. Soft clayey lenses at 2.25 m			
	CP-TP-26	0-2.25	Sandy Silt			
		2.25-3.0	Clayey Silt. Rock (suspected bedrock) below 3.0 m. Roots encountered from 2.5 to 3.0 m	12	80	8
	CP-TP-27	0-4.25	Silty Sand. Containing sandy Silt lenses up to 0.5 m thick. Clayey Silt lenses below 3.5 m			
	CP-TP-28	0-5.0	Silty Sand. Containing sandy Silt lenses up to 0.5 m thick. Clayey Silt lens from 3.0 to 3.5 m			
	CP-TP-29	0-2.0	Silty Sand containing Sandy Silt lenses			
		2.0-5.0	Sandy Silt. Clayey Silt lenses from 2.5 to 5.0 m			
	CP-TP-30	0-1.0	Sandy Silt			
		1.0-4.0	Silt and Sand			
		4.0-5.5	Sandy Silt. Clayey Silt lenses from 4.0 to 5.5 m			
	CP-TP-31	0-5.0	Silty Sand			
		5.0-6.5	Sandy Silt. Wet Clayey Silt lenses at 4.75 m			
South Pond	SP-TP-26	0-0.75	Sandy Silt to Silty Sand			
		0.75-2.75	Silty Sand			
		2.75-3.75	Clayey Silt			
		3.75-4.25	Silty Sand			
	SP-TP-27	0-1.5	Sandy Silt	24	70	6
		1.5-4.0	Silty Sand			

Location	Test Pit ID	Depth (m)	Visual Description/Comments	Sand Content (%)	Silt Content (%)	Clay Content (%)
	SP-TP-28	0-1.0	Sandy Silt			
		1.0-4.0	Silty Sand containing sandy Silt lenses			
	SP-TP-29	0-0.5	Sandy Silt			
		0.5-3.75	Silty Sand. Clayey Silt lens from 1.75 to 2.5 m			
		3.75-4.0	Clayey Silt			
	SP-TP-30	0-4.0	Silty Sand. Sandy Silt lenses from 2.5 to 4.0 m			
	SP-TP-31	0-2.0	Sandy Silt to Silty Sand. Rock (suspected bedrock) below 2.0 m			
	SP-TP-32	0-4.0	Silty Sand. Moist to wet silt lenses from 3.5 to 4.0 m			
	SP-TP-33	0-1.25	Sandy Silt			
		1.25-2.25	Clayey Silt			
		2.25-4.0	Silty Sand			
	SP-TP-34	0-3.0	Sandy Silt. Wet Clayey Silt lens at 1.75 m			
		3.0-4.0	Clayey Silt.			
	SP-TP-35	0-1.25	Sandy Silt	38	57	5
		1.25-2.0	Silty Sand			
		2.0-4.0	Clayey Silt			
	SP-TP-36	0-3.0	Silty Sand			
		3.0-4.0	Clayey Silt	0	90	10
	SP-TP-37	0-0.75	Silty Sand			
		0.75-4.0	Clayey Silt			
	SP-TP-38	0-2.5	Sandy Silt to Silty Sand containing Clayey Silt lenses			
		2.5-4.0	Clayey Silt. Sloughing off side walls noted	0	88	12
	SP-TP-39	0-2.25	Sandy Silt to silty Sand			
		2.25-3.75	Clayey Silt. Rock (suspected bedrock) below 3.75 m. Roots and topsoil encountered from 3.5 to 3.75 m			
	SP-TP-40	0-0.5	Sandy Silt			
		0.5-3.0	Clayey Silt. Rock (suspected bedrock) below 3.0 m			
	SP-TP-41	0-3.0	Clayey Silt. Possible Silty Clay from 2.0 to 3.0 m. Side walls collapsed	0	89	11

Location	Test Pit ID	Depth (m)	Visual Description/Comments	Sand Content (%)	Silt Content (%)	Clay Content (%)
	SP-TP-44	0-2.75	Silty Sand. Rock (suspected bedrock) below 2.75 m. Tree roots and boulders encountered from 2.5 to 2.75 m			
	SP-TP-45	0-1.0	Sandy Silt			
		1.0-3.0	Silty Sand. Rock below 3.0 m (suspected bedrock). A PVC pipe was encountered in this test pit			
	SP-TP-46	0-1.75	Silty Sand containing sandy Silt lenses			
		1.75-2.75	Clayey Silt. Sloughing noted in Clayey Silt layer			
		2.75-4.0	Silty Sand			
	SP-TP-47	0-1.0	Clayey Silt			
		1.0-2.0	Sandy Silt			
		2.0-4.0	Silty Sand			
	SP-TP-48	0-0.5	Clayey Silt			
		0.5-3.0	Silty Sand containing Sandy Silt lenses. Rock below 3.0 m (suspected bedrock)			
	SP-TP-49	0-3.5	Silty Sand containing Sandy Silt lenses			
		3.5-4.25	Sandy Silt			
	SP-TP-50	0-2.0	Sandy Silt containing Silty Sand			
		2.0-4.0	Silty Sand containing Sandy Silt lenses. Moist to wet from 0 to 4.0 m			
	SP-TP-51	0-1.0	Sandy Silt			
		1.0-3.25	Silty Sand containing Sandy Silt			
		3.25-4.0	Sandy Silt containing some clay. Moist to wet from 1.5 to 4.0 m			
	SP-TP-52	0-3.5	Sandy Silt. Clayey lenses from 1.5 to 3.5 m. Moist to wet	10	83	7
		3.5-4.0	Silty Sand. Moist			
	SP-TP-53	0-1.25	Sandy Silt			
		1.25-2.5	Silty Sand			
		2.5-4.0	Clayey Silt			

4.0 POTENTIAL EXCAVATION AREAS

This section provides a summary of potential excavation areas in the South, Central and North Ponds. The ponds have been divided into areas based on soil classification, as described in Section 2, to help provide guidance as to the amount of processing that is likely to be required to use the tailings from each area. The areas are outlined on Figure 3. This section applies to the upper 4 m of tailings, as most of the investigation effort to date has been from test pits, which are limited to depths of 3 to 4 m. Insufficient information is available to divide the ponds by material type at greater depths. Some guidance on material characteristics below 4 m can be found on the record of borehole sheets for the boreholes drilled in the ponds in 2007 and 2011 (Golder 2012, SRK 2007b).

In general, the tailings in the upper portion of the Central Pond are slightly coarser than in the South Pond (higher sand, lower clay content), and thus may require somewhat less processing than for the South Pond tailings. It is anticipated that some processing will be required for all the tailings, at least to screen for potential small debris in the tailings. Frozen tailings at depth (suspected permafrost) were also encountered at some locations in the Central Pond, which is noted on the relevant test pit and borehole records in the referenced reports.

This section is intended for planning and guidance purposes only and is not intended to replace detailed review of the information provided in this report and the other tailings investigation reports referenced in Section 2.

4.1 South Pond

- **Area 1** – Typically silty sand to sandy silt material. The tailings in this area are generally suitable for paste production with minimal processing, except to screen for potential debris.
- **Area 2** – Typically sandy silt at surface, with thicknesses of 0 to 3 m thick, underlain by clayey silt. The upper tailings will likely require conditioning to break up lumps and the clayey silt tailings will require blending with coarser material.
- **Area 3** – Typically silty sand to sandy silt underlain by clayey silt. Silty sand to sandy silt varies from 0.5 to 3 m thick. The upper tailings will likely require conditioning to break up lumps and the clayey silt tailings will require blending with coarser material.
- **Area 4** – Not suitable for paste production at this time – generally consists of clayey silt and a significant portion of the area covered by ponded water.
- **Area 5** – Typically sandy silt from surface to depths of 2.0 to 3.5 m, clayey silt below this level. The upper tailings will likely require conditioning to break up lumps and the clayey silt tailings will require blending with coarser material. **Note** – some of the surface material from this area was excavated in 2013, the depths referred to here and in the test pit records are relative to the tailings surface prior to excavation.
- **Area 6** – Typically silty sand to depths up to 4 m, with shallow bedrock in some areas. The tailings in this area are generally suitable for paste production with minimal processing, except to screen for potential debris.

4.2 Central Pond

- **Area 7** – Typically silty sand to sandy silt material. Some mechanical conditioning may be required as well as screening for potential debris. Note there is a buried water pipe in this area that drains water from the pond in the South Pond to the channel on the west side of the Central pond. This approximate location of this pipe is shown on Figure 4.
- **Area 8** – Typically silty sand to sandy silt from surface to 2 to 2.5 m depth, underlying clayey silt. The upper tailings will likely require conditioning to break up lumps and the clayey silt tailings will require blending with coarser material.
- **Area 9** – Typically silty sand to sandy silt material, with shallow bedrock in some areas. Some mechanical conditioning may be required as well as screening for potential debris. Note that anecdotal evidence from the mine site indicates that there is likely waste debris buried in the tailings in this area (anecdotal evidence that this area was a boneyard – no records are available).

4.3 North Pond

- **Area 10** – The limited investigation in this area indicates that the material grades from silty sand along the dams to the north east edge of the pond to sandy silt and then to clayey silt with distance towards the water pond in the centre of the North Pond. (The material becomes less suitable, or will require more processing, at greater distances from the dams).

5.0 CLOSURE

We trust that the information provided in this technical memorandum meets your present needs. Should you have any questions or require additional information, please feel free to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED AND SEALED

Dave Caughill, P.Eng.
Associate, Senior Geotechnical Engineer

ORIGINAL SIGNED

John Hull, P.Eng.
Principal, Mining Division

DC/JAH/jlj

Attachments: Figures 1, 2 and 3

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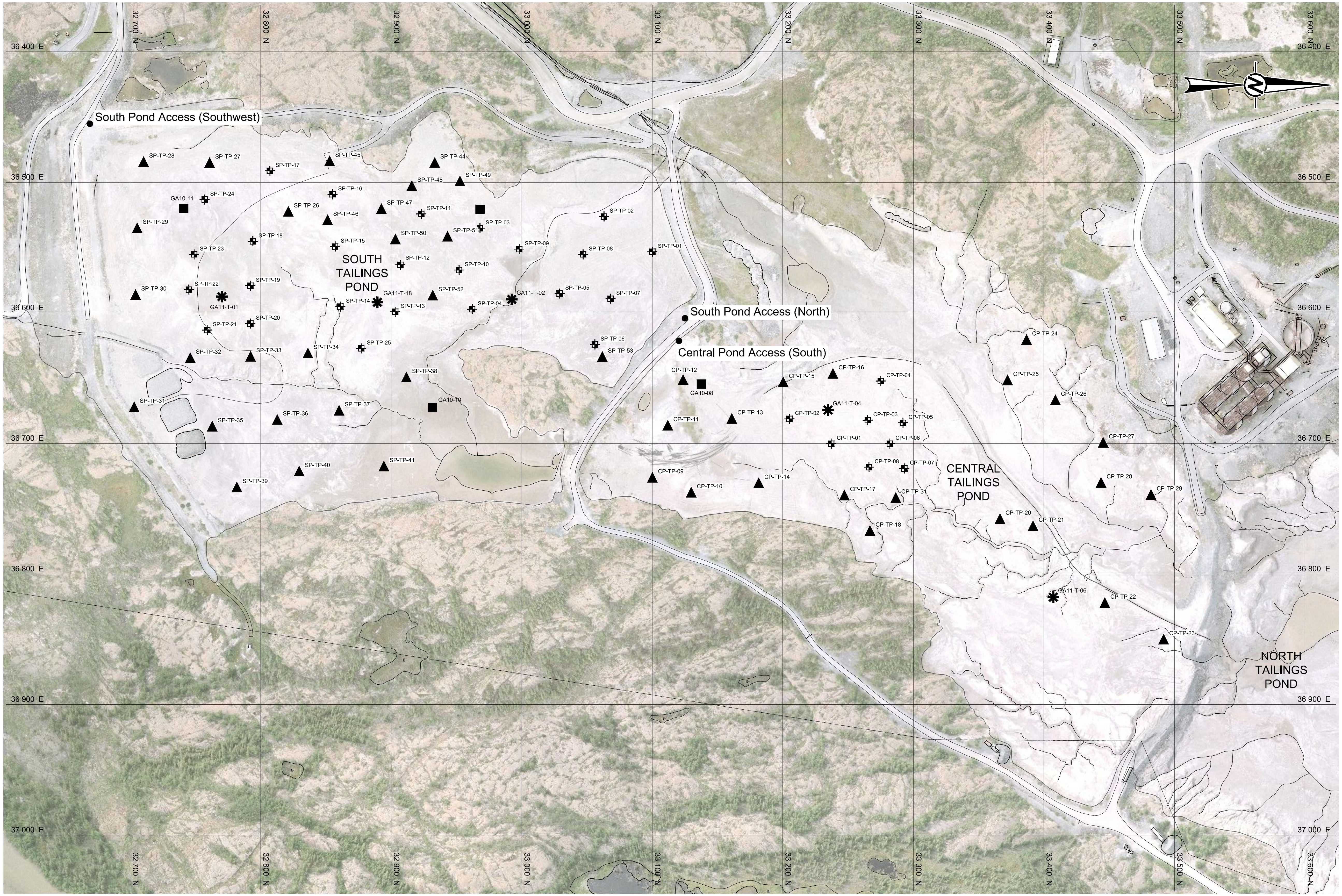

PLAN VIEW
SCALE A

LEGEND
- ▲ TEST PIT LOCATION (GOLDER 2013B)
- ● ACCESS POINT
- ✚ TEST PIT LOCATION (GOLDER 2013A)
- ✱ AUGER HOLE LOCATION (GOLDER 2011)
- ■ TEST PIT LOCATION (GOLDER 2010)

NOTES
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REFERENCES
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0	ISSUED WITH DOC. #064 REVA	2013-12-03

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PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuvé par: DC
Designed by/Concept par: DC
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
INVESTIGATION LOCATIONS ON THE SOUTH AND CENTRAL PONDS GOLDER 2010 TO 2013

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010 DOC. #064	FIGURE 1 OF 3	1

PWGSC – A1 – 841X594

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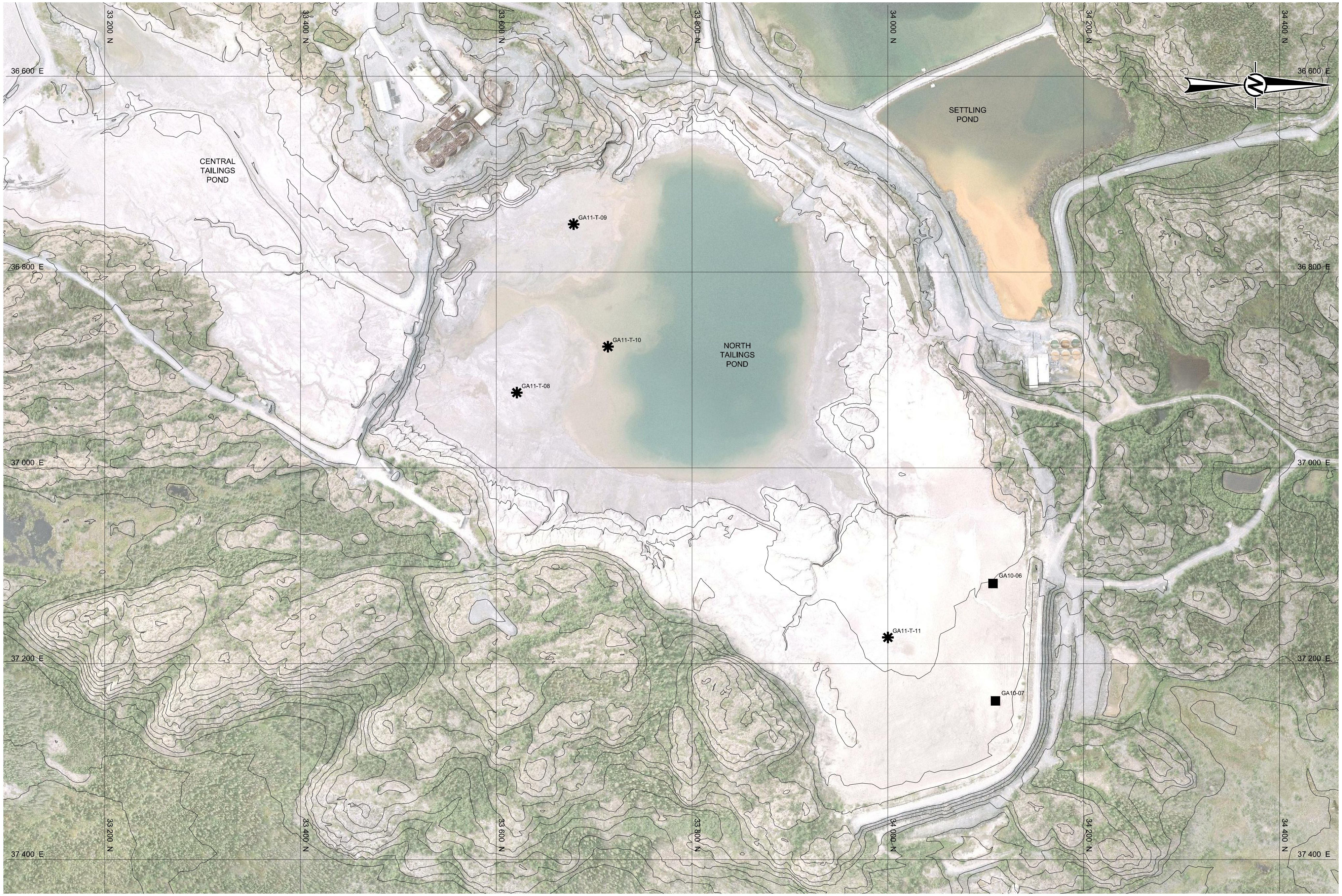

PLAN VIEW

SCALE A

LEGEND

✱ AUGER HOLE LOCATION (GOLDER 2011)

■ TEST PIT LOCATION (GOLDER 2010)

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REFERENCES

1. AERIAL PHOTO DATED 2009, PROVIDED BY PUBLIC WORKS GOVERNMENT SERVICES CANADA
2. TOPOGRAPHIC CONTOURS PROVIDED BY PUBLIC WORKS GOVERNMENT SERVICES CANADA, RECEIVED JANUARY 10, 2011

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0	ISSUED WITH DOC #064 RevA	2013-12-03

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GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuve par: CD
Designed by/Concept par: CD
Drawn by/Dessine 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
INVESTIGATION LOCATIONS ON THE NORTH POND GOLDER 2010 AND 2011

Project No./No. du projet: 13-1426-0010 DOC. #064
Sheet/Feuille: FIGURE 2 OF 3
Revision no./La Révision no.: 1

PWGSC – A1 – 841X594

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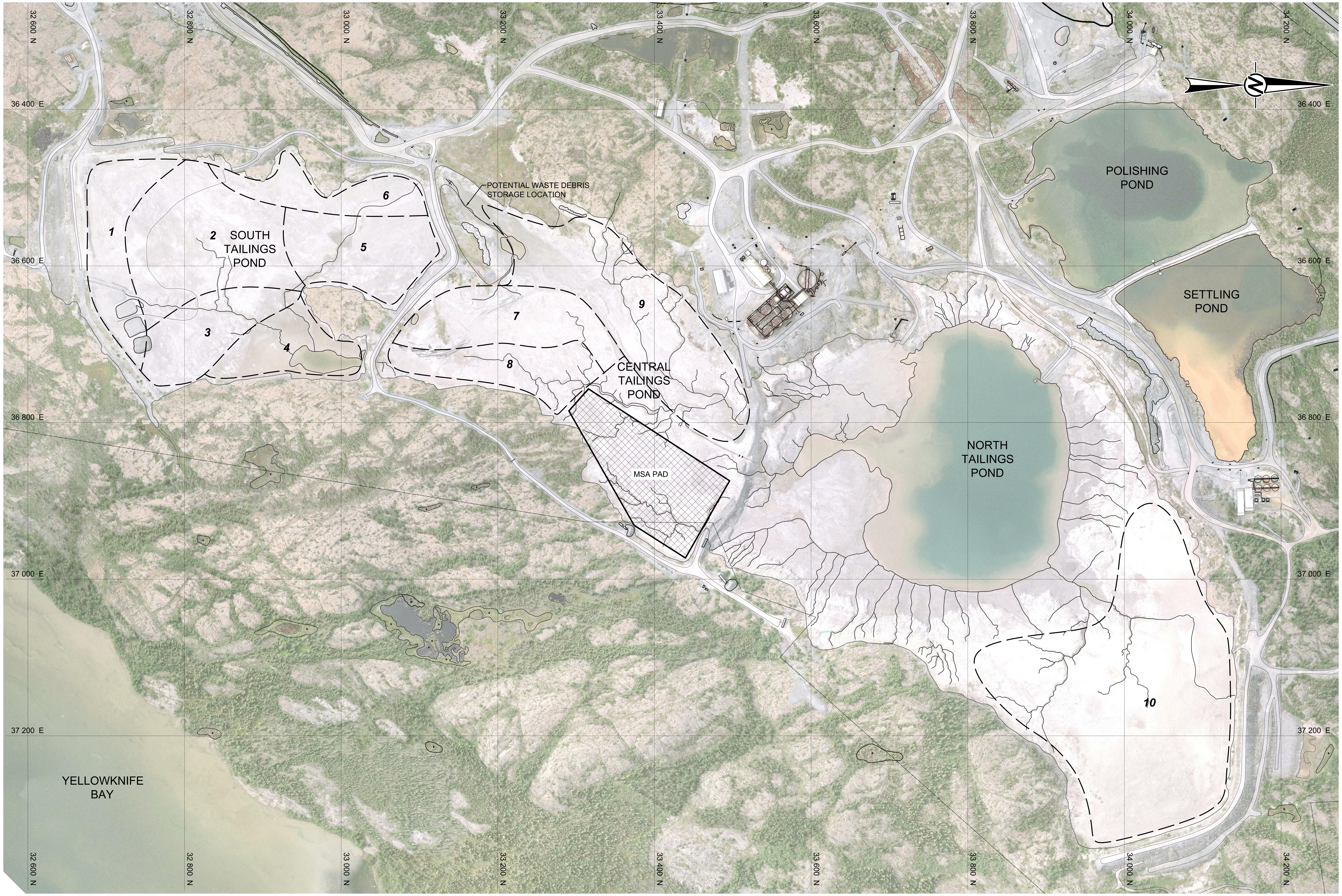

PLAN VIEW

SCALE A

LEGEND

MSA PAD
NO TAILINGS EXCAVATION HERE

TAILINGS EXCAVATION AREAS

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Project title/Titre du projet

GIANT MINE
REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

Approved by/Approuvé par
DC

Designed by/Concept par
DC

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

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TAILINGS EXCAVATION AREAS,
SOUTH, CENTRAL
AND NORTH PONDS

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010 DOC. #064	FIGURE 3 OF 3	A

PWGSC – A1 – 841X594

13-1426-0010-1000-1608_10

January 18, 2011

REPORT ON

Phase 1 - Tailings Investigation Giant Mine Remediation Project

Submitted to:
Northern Contaminated Sites, Western Region
Public Works and Government Services Canada
4th Floor Greenstone Building, 5101 – 50th Ave
P.O. Box 518
Yellowknife, NT   X1A 2N4

REPORT

Project Number:	09-1427-0006/2100
AECOM Doc. No.:	7-R.014204.307-RPT-0001-Rev0_20110118
GAL Doc. No.:	034

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Table of Contents

FIGURES

APPENDICES

1.0 INTRODUCTION

As part of the Giant Mine Remediation, Golder Associates Ltd. (Golder) undertook an investigation to supplement previous studies of the tailings pond facilities. The purpose of the investigation was to confirm conditions and further characterize the upper surface of the tailings ponds to assist in the Giant Mine Remediation Project.

This study, as well as previous investigation programs of the tailings ponds, is limited to the upper 6 m of the tailings, in areas that are accessible for mobile equipment. Thus, the areas of the ponds with permanently ponded water and the deeper areas of the ponds have not been investigated to date. It has been proposed to complete these investigations using auger drilling techniques in the winter of 2011.

The investigation included the advancement of test pits and collection of samples for laboratory testing. The following factual report details the findings of the investigation.

2.0 PREVIOUS INVESTIGATIONS

2.1 Tailings and Settling Pond Field Investigations, Giant Mine Yellowknife, NWT, Canada (SRK 2007)

A field investigation program of the tailings and settling ponds incorporating test pits, penetration and shear vane and Guelph permeameter testing, and drilling (within the settling pond) was completed. Laboratory testing included grain size, standard Proctor testing, specific gravity, constant head permeability, Atterberg limits, as well as triaxial, consolidation and geochemical testing of the sludge from the settling pond. For the tailings ponds, the investigation was limited to the upper surface of the tailings (generally 2 to 6 m depth), due to equipment restrictions and in areas accessible for the excavator.

3.0 FIELD PROGRAM

The geotechnical field investigation was completed in the Fall of 2010. The investigation consisted of a series of test pits advanced in the Northwest, North, Central and South tailings ponds to identify and characterize the materials present. A total of 11 test pits were advanced using a rubber-tired SK100W excavator provided and operated by Weatherby Trucking Ltd. The test pits were completed as follows:

- In the Northwest Tailings Pond, four test pits were advanced to depths ranging from 3.1 m to 3.5 m below ground level (m bgl);
- In the North Tailings Pond, two test pits were advanced to depths of 3.0 m and 3.1 m bgl;
- In the Central Tailings Pond, one test pit was advanced to a depth of 3.1 m bgl; and
- In the South Tailings Pond, three test pits were advanced to depths ranging from 1.9 m to 3.6 m bgl.

Test pits were generally advanced to the practical reach of the excavator which was limited by the soft tailings surface. Samples were collected for grain size testing at regular intervals and as necessary to distinguish stratigraphy. Select photographs of test pits are provided in Appendix B.

Prior to mobilization, the preferred locations of the test pits were identified based on the availability of information from previous investigations. Due to access restrictions at the time of the investigation and the limitations of the excavator equipment, several locations could not be investigated. The locations of each test pit are provided in Figures 1, 2, and 3.

4.0 RESULTS

Detailed descriptions of the subsurface conditions encountered in each of the test pits are presented in the Record of Test Pit sheets provided in Appendix A.

The stratigraphic boundaries shown on the Record of Test Pit sheets represent transitions between soil types rather than distinct lithological boundaries. It should be recognized that subsurface conditions often vary both with depth and laterally between individual test pit locations.

Laboratory testing consisted of wash sieves, to determine sand size and percent silt/clay sizes, primarily to confirm that the upper tailings material in areas not previously investigated was of similar grain size to that previously investigated.

Previous investigations within the tailings ponds indicated that the upper tailings materials were predominantly fine grained sands and silts. The distribution of sand sized particles ranged from 0% to 74% and silt sized particles ranged from 24% to 99% (SRK 2007). The particle size distribution testing completed on 16 samples collected during the supplemental investigation indicated sand sized particles from 0% to 86% and silt/clay sized particles from 14% to 100%. The results of the particle size distribution tests are provided in Appendix C and shown on the Record of Test Pit sheets.

Comparisons of visual descriptions for the SRK investigation and this investigation program are generally similar for each of the tailings ponds. There are minor variations in the visual descriptions provided for secondary and minor constituents. This may be attributed to the variability of the material or the methods of classification.

Frozen materials were not encountered in any of the test pits during this investigation. Comparison with findings of previous investigations indicates that the depth to frozen material likely exceeded the reach of the available excavator.

As discussed above, the flooded zones and the intermediate zones were not accessible with the available equipment or the equipment used during the previous investigations. As a result, limited information is available for the tailings in these areas.

5.0 DISCUSSION

Additional investigations will be required to adequately characterize and delineate the materials in the tailings ponds. Future investigations should be completed with equipment capable of reaching the base of the tailings deposits in the ponds. The use of amphibious capable equipment for accessing and working in soft, saturated and/or fully flooded areas may be worth consideration. Alternatively, investigations may be completed when the thickness of ice cover in the winter is capable of supporting heavy equipment.

6.0 CLOSURE

We trust the information presented in this report meets your present requirements. Should you have any questions or need further assistance regarding foundation design, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Dave Caughill, P.Eng.
Associate, Senior Engineer

ORIGINAL SIGNED

John Hull, P.Eng.
Principal, Senior Engineer

JPH/DC/JAH/rs

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LEGEND

TEST PIT LOCATIONS (2010)

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.□m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE: GIANT MINE - CONTOURS (0.□m) - 2009 - GMRP.dwg, DATE RECEIVED: JANUARY 10, 2011
2. PWGSC, CAD FILE: GiantMine_GRP.sid, DATE RECEIVED: JANUARY 10, 2011

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GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

TAILINGS REHAB TASK NO. 7

Approved by/Approuvé par

Designed by/Concept par
D.C.

Drawn by/Dessiné par
M.R.

PWGSC Project Manager/Administrateur de Projets TPSGC

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

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TEST PIT LOCATIONS AT THE NORTHWEST POND

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204	FIGURE 1 OF 3	0

A0 – PWGSC – ANSI B-L1 – 11X17

60162□26-R-014204-30□-RPT-0001-CF01-R0

LEGEND

TEST PIT LOCATIONS □2010□

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.□m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE□GIANT MINE - CONTOURS □0.□m□- 2009 - GMRP.d□g, DATE RECEIVED□□ANUARY 10, 2011
2. PWGSC, CAD FILE□GiantMine_GRP.sid, DATE RECEIVED□□ANUARY 10, 2011

0 40 80 120 160 200

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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Revision/Révision	Description/Description	Date/Date
0	DESIGN COMPLETION	

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE
REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

TAILINGS REHAB
TASK NO. 7

Approved by/Approuvé par

Designed by/Concept par
D.C.

Drawn by/Dessiné par
M.R.

PWGSC Project Manager/Administrateur de Projets TPSGC

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

Client/client
PWGSC

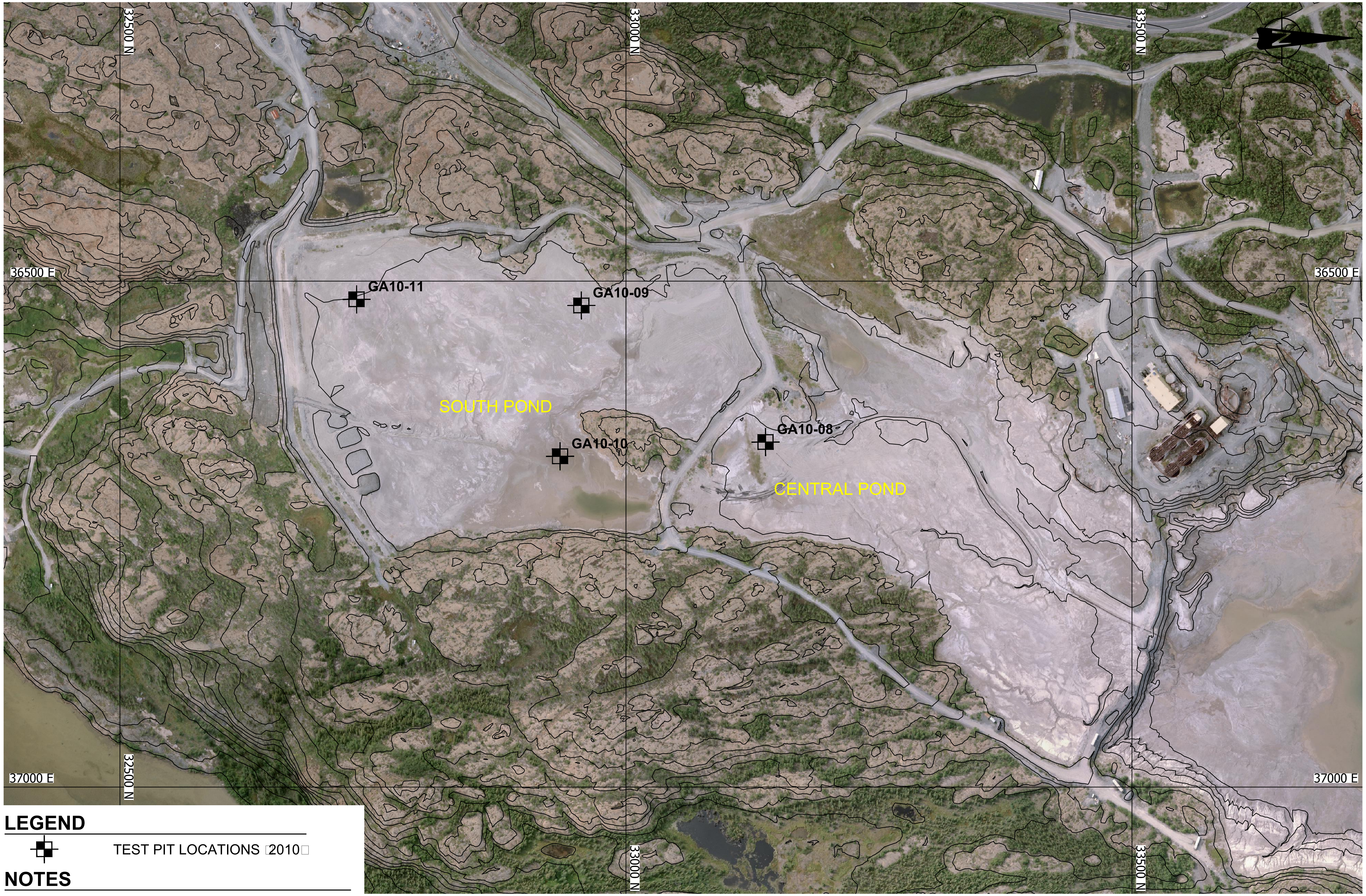
Drawing title/Titre du dessin

TEST PIT LOCATIONS
AT THE NORTH POND

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204	FIGURE 2 OF 3	0

A0 – PWGSC – ANSI B-L1 – 11X17

60162□26-R-014204-30□-RPT-0001-CF02-R0



LEGEND

TEST PIT LOCATIONS □2010□

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.□m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE□GIANT MINE - CONTOURS □0.□m□- 2009 - GMRP.d□g, DATE RECEIVED□□ANUARY 10, 2011
2. PWGSC, CAD FILE□GiantMine_GRP.sid, DATE RECEIVED□□ANUARY 10, 2011

0 40 80 120 160 200

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

Golder Associates

DO NOT SCALE DRAWINGS

Revision/Révision	Description/Description	Date/Date
0	DESIGN COMPLETION	

Client/client

PUBLIC WORKS
GOVERNMENT SERVICES
CANADA

Project title/Titre du projet

GIANT MINE
REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

TAILINGS REHAB
TASK NO. 7

Approved by/Approuvé par

Designed by/Concept par
D.C.

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M.R.

PWGSC Project Manager/Administrateur de Projets TPSGC

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

Client/client
PWGSC

Drawing title/Titre du dessin

TEST PIT LOCATIONS
AT SOUTH AND CENTRAL PONDS

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204	FIGURE 3 OF 3	0

A0 – PWGSC – ANSI B-L1 – 11X17

60162□26-R-014204-30□-RPT-0001-CF03-R0

APPENDIX A

Record of Test Pit Sheets

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-01

LOCATION: See Location Plan

N: 6935365 E: 636121

EXCAVATION DATE: October 26, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Loose, moist, grey, silty SAND (TAILINGS)		0.00	1	GS					
1		Loose to compact, wet, grey, SILT, little sand, trace clay (TAILINGS)		0.80	2	GS				9% Sand 91% Silt/Clay	
2					3	GS					
3		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.10							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

DATA ENTRY: JPH

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-02

LOCATION: See Location Plan

N: 6934950 E: 635864

EXCAVATION DATE: October 26, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Loose, moist, grey, silty SAND (TAILINGS)		0.00							
					1	GS					
1											
					2	GS					
2											
		Loose to compact, wet, grey, SILT and SAND, trace clay (TAILINGS)		2.30							
					3	GS					
3											
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.10							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-03

LOCATION: See Location Plan

N: 6934516 E: 635839

EXCAVATION DATE: October 26, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Loose, moist, brown to grey, SILT and SAND (TAILINGS)		0.00							
					1	GS					
1											
					2	GS				45% Sand 55% Silt/Clay	
2											
		--- pockets of light grey silty SAND, trace to little clay from 2.4 m bgl			3	GS					
3											
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.20							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

DATA ENTRY: JPH

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-04

SHEET 1 OF 1

LOCATION: See Location Plan

N: 6934503 E: 636083

EXCAVATION DATE: October 26, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W, Weatherby Trucking Ltd.	Cemented, dry, light grey, silty SAND (SOIL CEMENT)		0.00	1A	GS					
		Loose to compact, moist, brown to grey, silty SAND, contains layers of brown SILT (TAILINGS)		0.50	1B	GS				1% Sand 99% Silt/Clay	
1											
		Compact, dry to moist, light brown to brown, SILT, trace sand (TAILINGS)		1.70							
2					2	GS					
3					3	GS				2% Sand 98% Silt/Clay	
		End of TEST PIT.		3.20							
4											
5											

NOTES:
EOH at practical extent of excavator reach.
No ponded water observed upon completion.

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-05

LOCATION: See Location Plan

N: 6934716 E: 636288

EXCAVATION DATE: October 27, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —O^W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W / Weatherby Trucking Ltd.	Loose to compact, moist, brown to grey, silty SAND to SAND some silt, contains layers of brown SILT (TAILINGS)		0.00							
					1	GS					
1											
					2	GS				86% Sand 14% Silt/Clay	
2											
					3	GS					
3		Compact, moist, brown, sandy SILT (TAILINGS)		3.10							
					4	GS					
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.50							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

DATA ENTRY: JPH

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-06

SHEET 1 OF 1

LOCATION: See Location Plan

N: 6934110 E: 637118

EXCAVATION DATE: October 27, 2010

DATUM: UTM Zone 11 (Nad 83)

Column headings: DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa, nat V. + Q - ●, rem V. ⊕ U - ○ (10, 20, 30, 40) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT, Wp —○W— Wl (20, 40, 60, 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: SK100W, Weatherby Trucking Ltd.

Depth Scale (m)	Description	Elev. Depth (m)	Sample Number	Type	Additional Lab. Testing
	Ground Surface				
0	Loose, moist, brown to grey, sandy SILT to SILT some sand, contains layers of brown SILT (TAILINGS)	0.00			
			1	GS	27% Sand 73% Silt/Clay
	Compact, moist, brown and grey, SILT, trace sand, trace clay (TAILINGS)	0.80			
1					
			2	GS	1% Sand 99% Silt/Clay
2	Compact, moist to wet, brown and grey, SILT, trace sand, little clay (TAILINGS)	1.90			
			3	GS	100% Silt/Clay
3	End of TEST PIT.	3.00			

NOTES:
EOH at practical extent of excavator reach.
No ponded water observed upon completion.

Depth scale marks: 4, 5

DEPTH SCALE
1 : 25

Golder Associates

LOGGED: JPH
CHECKED: DC

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-07

LOCATION: See Location Plan

N: 6934108 E: 637239

EXCAVATION DATE: October 27, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Loose to compact, moist, brown to grey, SAND, some silt, contains layers of brown SILT (TAILINGS)		0.00							
					1	GS					
1											
					2	GS				85% Sand 15% Silt/Clay	
2											
					3	GS					
3											
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.10							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

DATA ENTRY: JPH

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-08

SHEET 1 OF 1

LOCATION: See Location Plan

N: 6933138 E: 636659

EXCAVATION DATE: October 27, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W, Weatherby Trucking Ltd.	Compact, moist, brown to grey, silty SAND to SAND and SILT, contains layers of brown SILT (TAILINGS)		0.00							
					1	GS				56% Sand 44% Silt/Clay	
1											
					2	GS					
2											
					3	GS					
		Compact, wet, brown to grey, SILT, trace sand, trace clay (TAILINGS)		2.90							
3											
					4	GS				100% Silt/Clay	
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.60							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-09

LOCATION: See Location Plan

N: 6932956 E: 636524

EXCAVATION DATE: October 28, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Loose to compact, moist, brown to grey, silty SAND, contains layers of brown SILT (TAILINGS)		0.00							
					1	GS					
1											
					2	GS				77% Sand 23% Silt/Clay	
2											
		--- increased moisture content									
					3	GS					
3		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.00							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

RECORD OF TEST PIT: GA10-10

PROJECT No.: 09-1427-0006

LOCATION: See Location Plan

N: 6932935 E: 636673

EXCAVATION DATE: October 28, 2010

SHEET 1 OF 1

DATUM: UTM Zone 11 (Nad 83)

BORING METHOD: SK100W, Weatherby Trucking Ltd.

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface						
0	Loose to compact, moist, brown to grey, SILT, some sand (TAILINGS)	0.00					
			1	GS		44% Sand 64% Silt/Clay	
	Soft, brown, CLAYEY SILT (TAILINGS)	0.80					
1							
	Loose to compact, moist, brown to grey, silty SAND, contains layers of brown SILT (TAILINGS)	1.10					
	Loose, wet, brown and grey, SILT, trace sand, trace clay (TAILINGS)	1.30					
			2	GS		100% Silt/Clay	
	End of TEST PIT. NOTES: EOH due to extremely soft conditions under excavator.	1.90					
2							
3							
4							
5							

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (20, 40, 60, 80)

DEPTH SCALE 1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

PROJECT No.: 09-1427-0006

RECORD OF TEST PIT: GA10-11

LOCATION: See Location Plan

N: 6932734 E: 636518

EXCAVATION DATE: October 28, 2010

DATUM: UTM Zone 11 (Nad 83)

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp W Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	SK100W Weatherby Trucking Ltd.	Compact, moist, brown and grey, SILT, trace sand, contains layers of grey silty SAND (TAILINGS)		0.00							
					1	GS				6% Sand 94% Silt/Clay	
1											
					2	GS				15% Sand 85% Silt/Clay	
		Compact, moist, light brown, SILT, some sand (TAILINGS)		1.80							
2					3	GS					
		--- becoming silty SAND		2.20							
					4	GS					
3											
		End of TEST PIT. NOTES: EOH at practical extent of excavator reach. No ponded water observed upon completion.		3.10							
4											
5											

DEPTH SCALE

1 : 25

Golder Associates

LOGGED: JPH

CHECKED: DC

APPENDIX B

Test Pit Photos

Photograph 1:

Test pit excavation pile from Northwest Tailings Pond.

Photograph 2:

Test pit excavation pile from North Tailings Pond.

Photograph 3:

Test pit excavation pile from Central Tailings Pond.

Photograph 4:

Test pit excavation pile from South Tailings Pond.

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APPENDIX C

Laboratory Test Results

Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Golder Associates

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

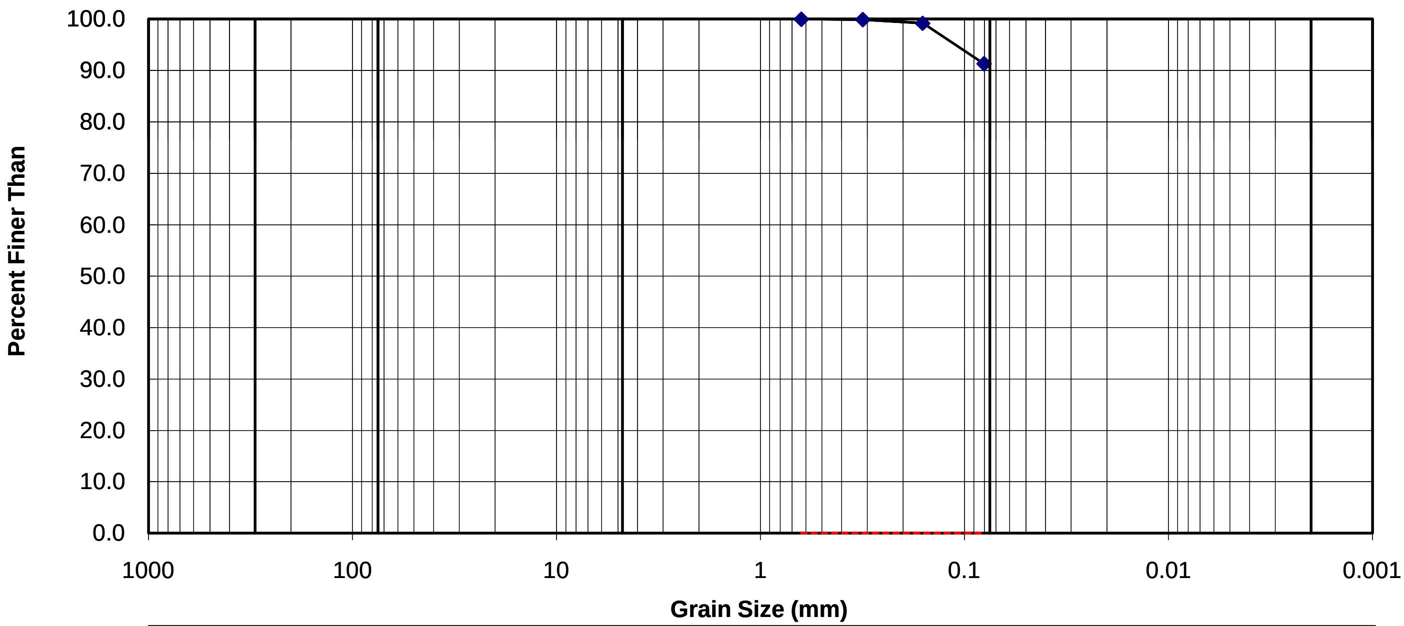
Sample Location: GA10-01 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	99.9	
0.16	99.2	
0.08	91.3	



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<tr><td rowspan="2">Boulder</td><td rowspan="2">Cobbles</td><td colspan="2">Gravel</td><td colspan="3">Sand</td><td rowspan="2">Silt</td><td rowspan="2">Clay</td></tr>
<tr><td>Coarse</td><td>Fin</td><td>Coarse</td><td>Medium</td><td>Fine</td></tr>
</table>

Gravel % 0.0 | Sand % 8.7 | Silt/Clay % 91.3

Reviewed By: ______________________

Golder Associates Ltd
#300 10525 170th Street, Edmonton Alberta T5P 4W2
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 Phase: Report Number: A2590
Short Title:
Sampled by: JH Date Sampled:

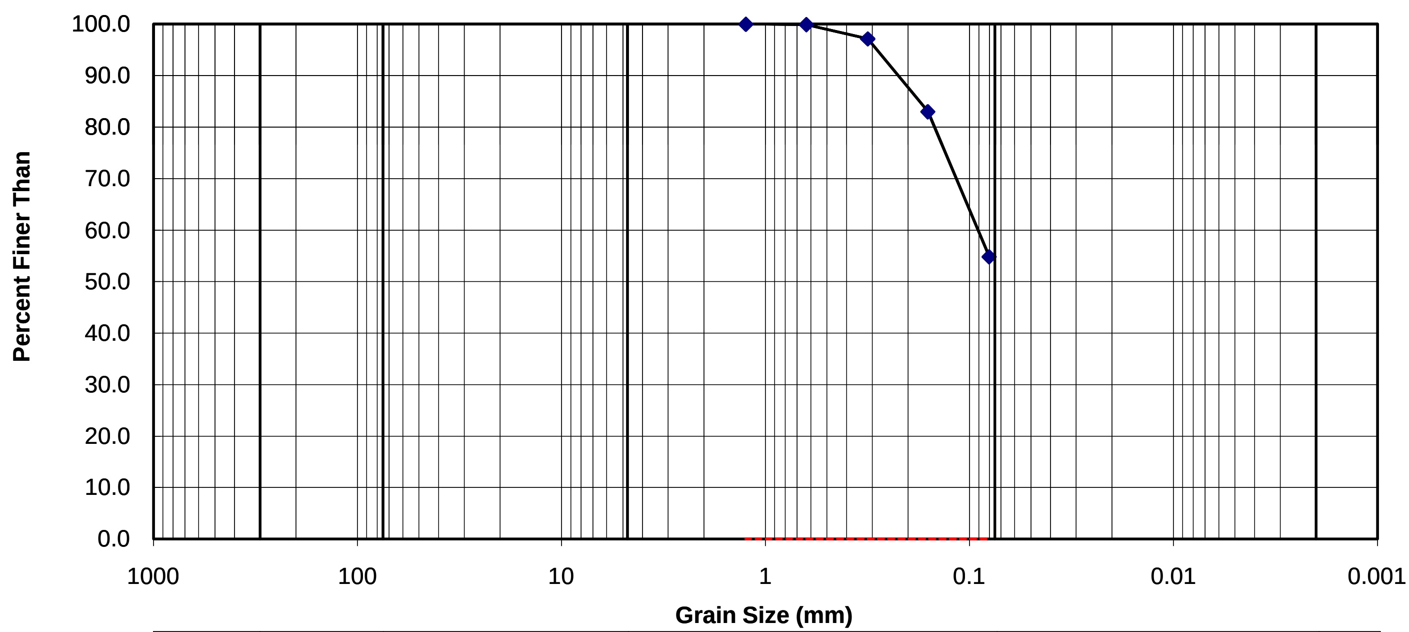
Sample Location: GA10-03 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
1.25	100.0	
0.63	99.9	
0.315	97.2	
0.16	83.0	
0.08	54.8	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 45.2 Silt/Clay % 54.8

Reviewed By: ____________

Golder Associates Ltd
#300 10525 170th Street, Edmonton Alberta T5P 4W2
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

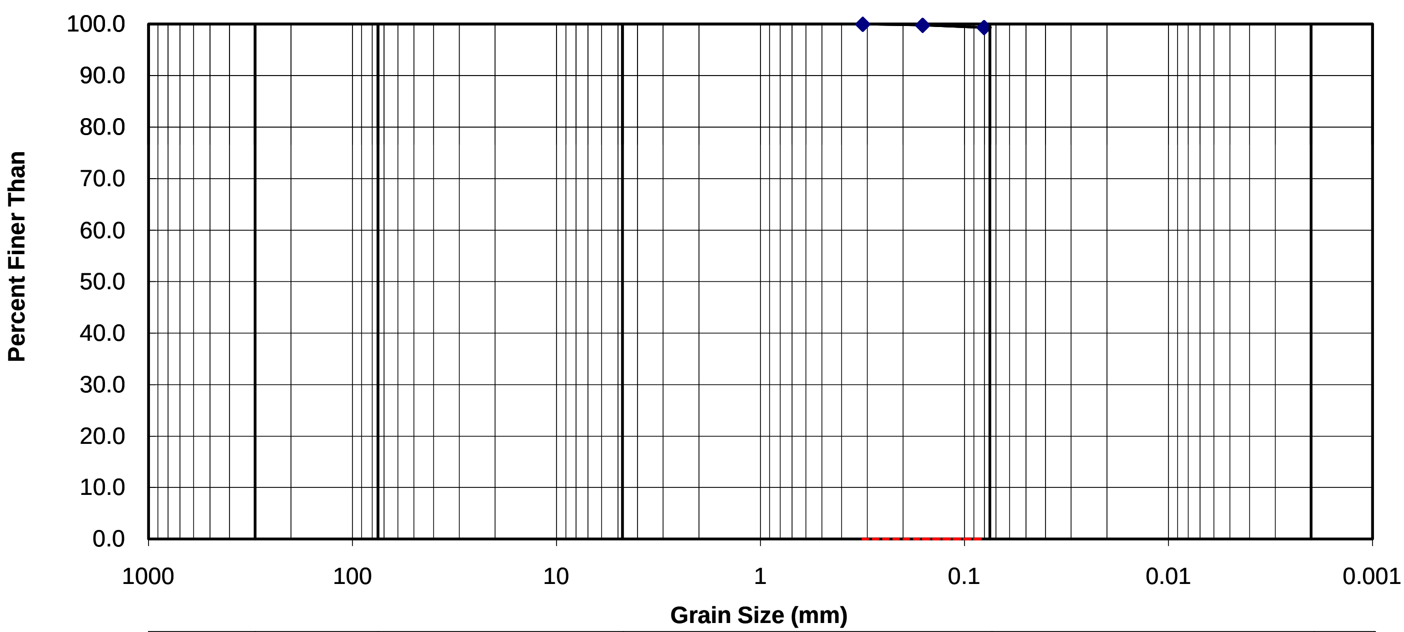
Sample Location: GA10-04 GS 1B @1.0m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.315	100.0	
0.16	99.8	
0.08	99.4	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 | Sand % 0.6 | Silt/Clay % 99.4

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Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 Phase: Report Number: A2590
Short Title:
Sampled by: JH Date Sampled:

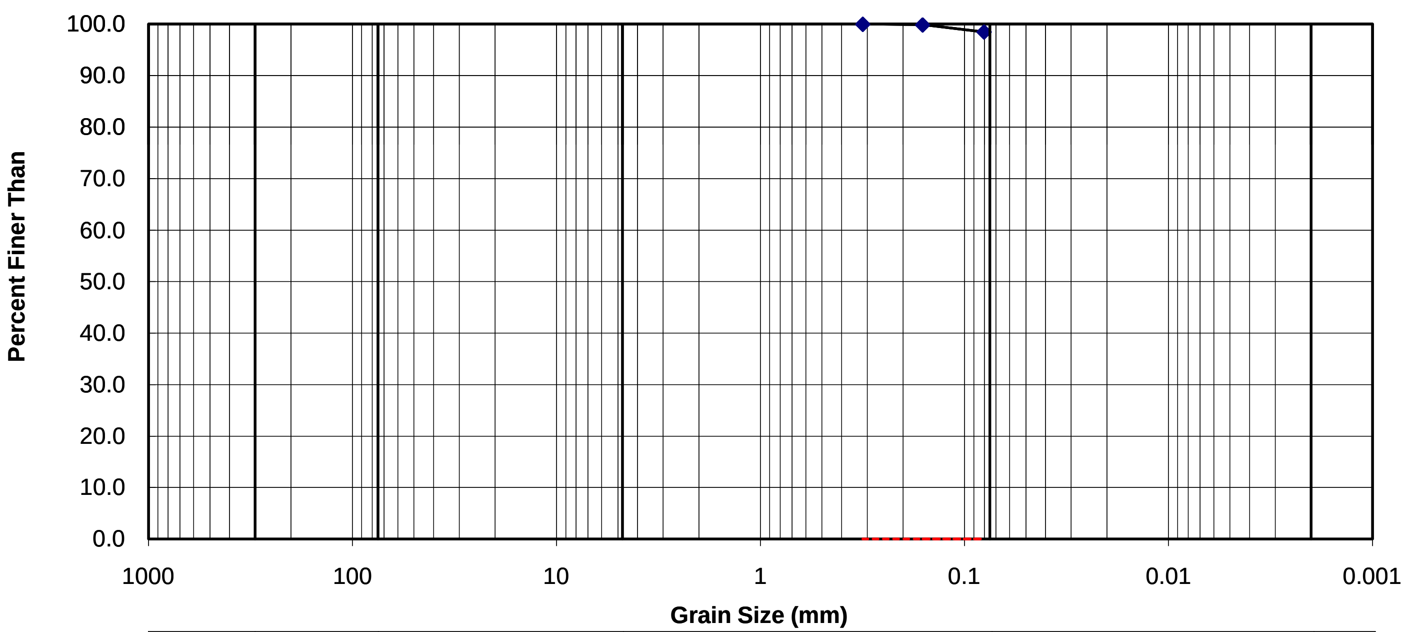
Sample Location GA10-04 GS03 @3.0m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested November 29, 2010
Tested By IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.315	100.0	
0.16	99.9	
0.08	98.5	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 1.5 Silt/Clay % 98.5

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ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

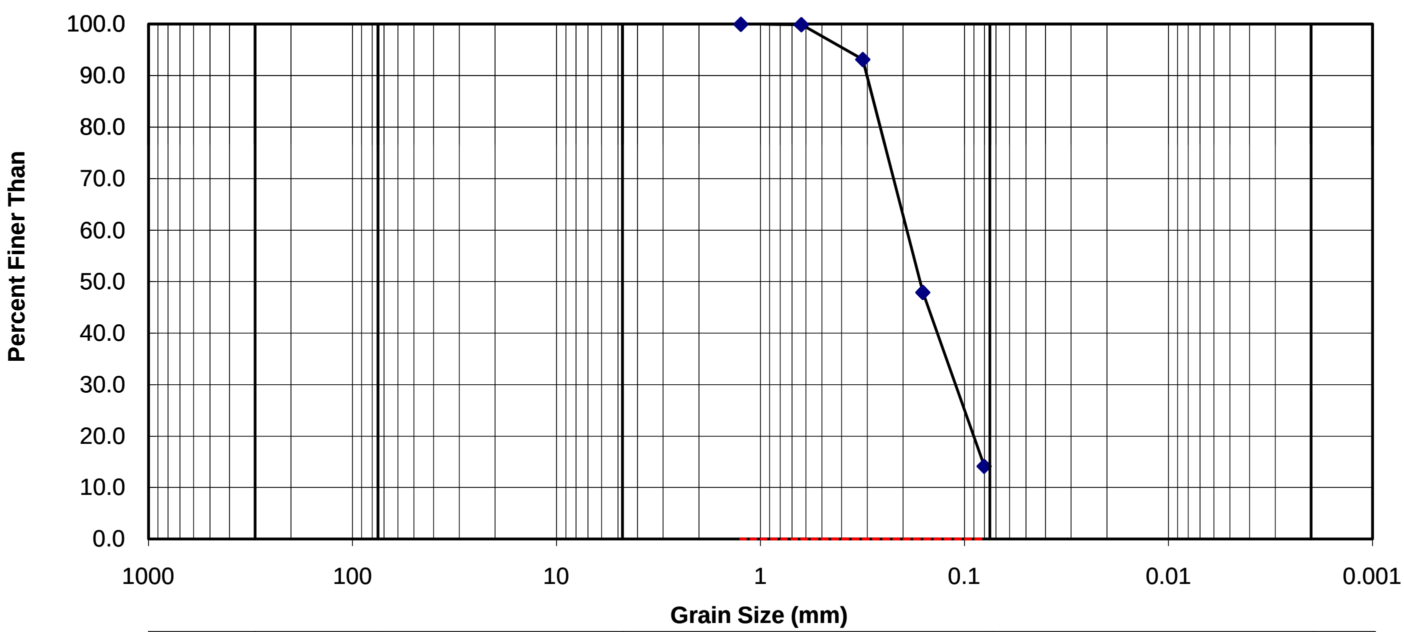
Sample Location: GA10-05 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
1.25	100.0	
0.63	99.9	
0.315	93.1	
0.16	47.9	
0.08	14.1	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 | Sand % 85.9 | Silt/Clay % 14.1

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ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

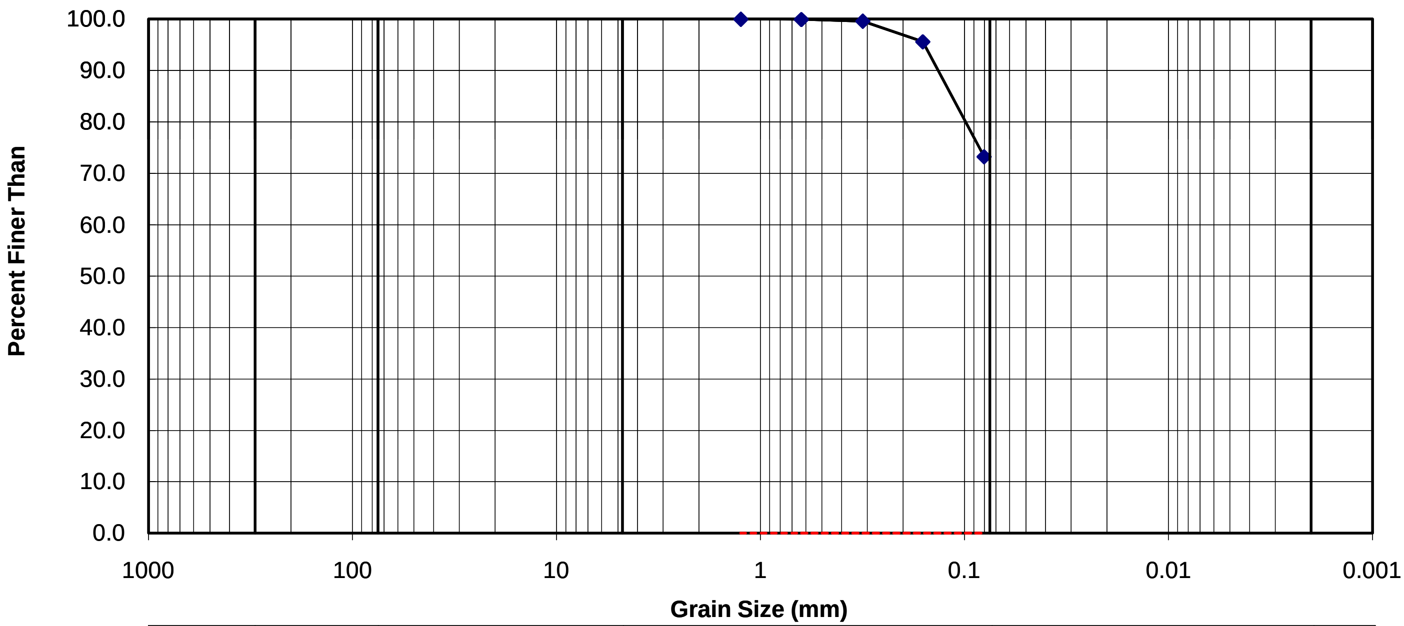
Sample Location: GA10-06 GS01 @0.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
1.25	100.0	
0.63	99.9	
0.315	99.6	
0.16	95.6	
0.08	73.2	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 | Sand % 26.8 | Silt/Clay % 73.2

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Project #: 09-1427-0006 | Phase: | Report Number: A2590

Short Title:

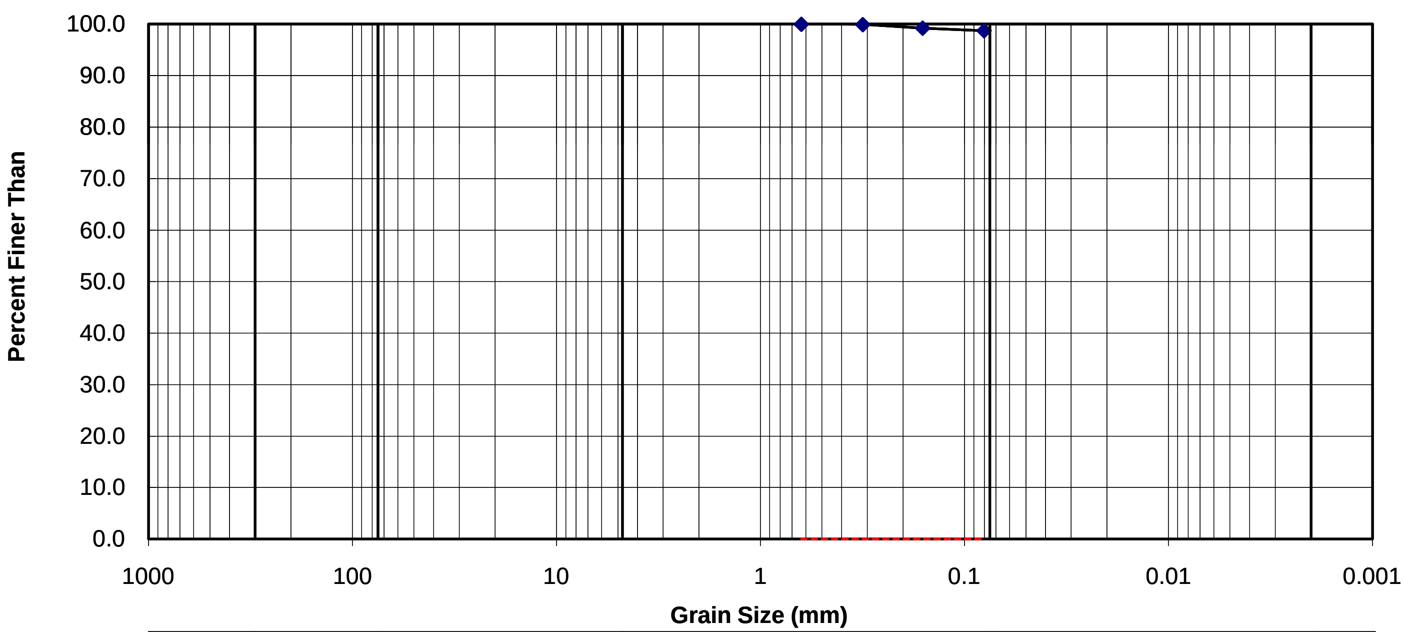
Sampled by: JH | Date Sampled:

Sample Location	GA10-06 GS 2 @1.5m
Source	
Sample Description	
Fractured Face	
In situ Water Content	
Date Tested	November 29, 2010
Tested By	IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	99.9	
0.16	99.2	
0.08	98.7	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 | Sand % 1.3 | Silt/Clay % 98.7

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ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

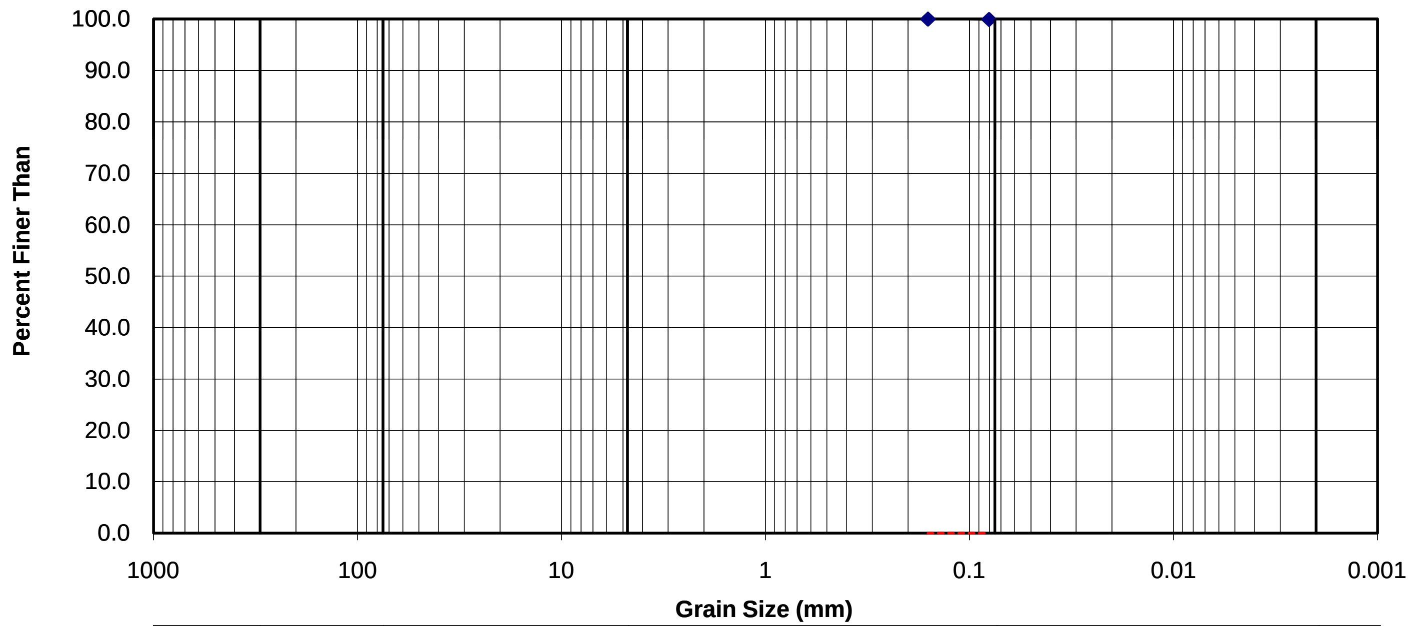
Sample Location: GA10-06 GS03 @2.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.16	100.0	
0.08	99.9	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.1 Silt/Clay % 99.9

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Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006 | Phase: | Report Number: A2590
Short Title:
Sampled by: JH | Date Sampled:

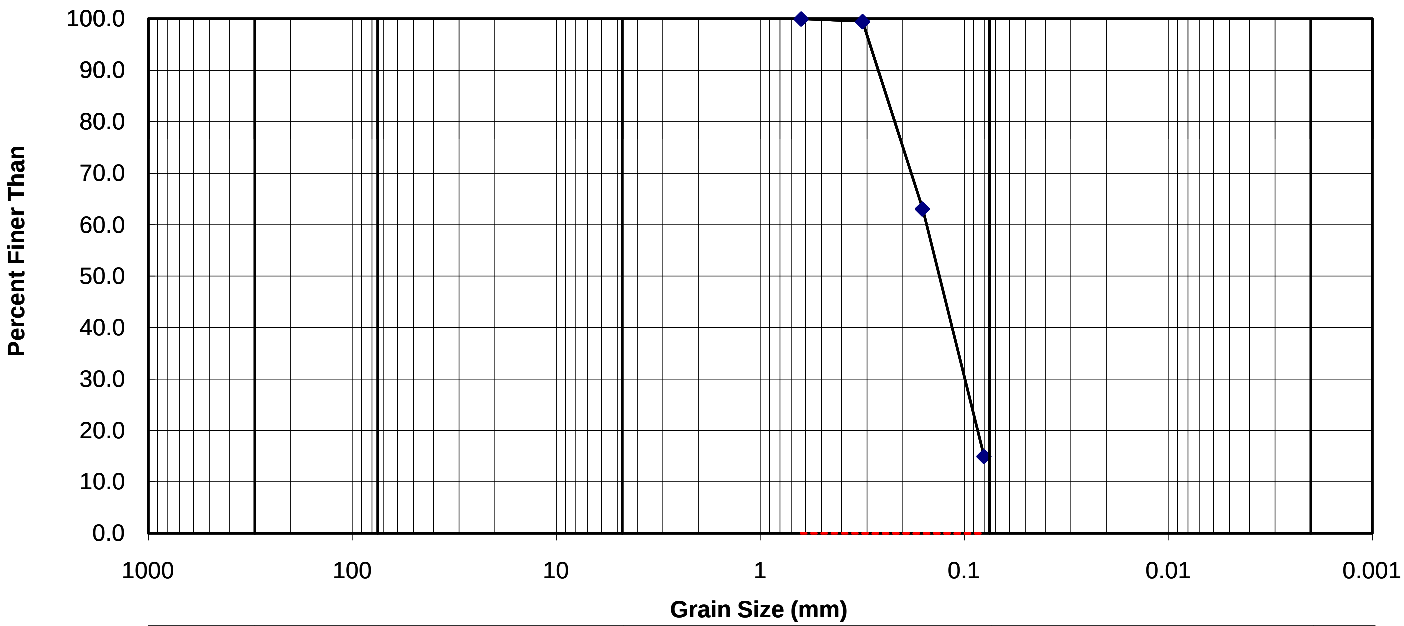
Sample Location: GA10-07 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	99.5	
0.16	63.1	
0.08	15.0	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 | Sand % 85.0 | Silt/Clay % 15.0

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ASTM C136 / CSA A23.2-2a

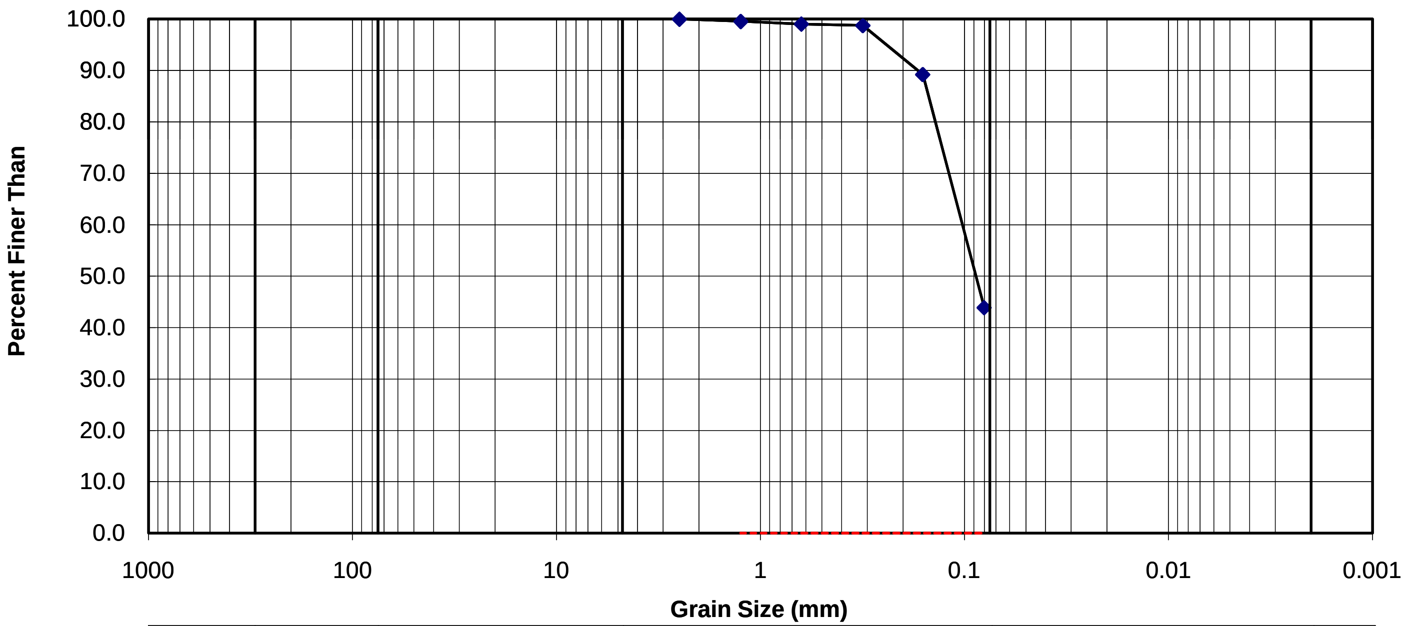
Project #:	09-1427-0006	Phase:	Report Number: A2590
Short Title:			
Sampled by:	JH	Date Sampled:	

Sample Location	GA10-08 GS01 @0.5m
Source	
Sample Description	
Fractured Face	
In situ Water Content	
Date Tested	November 29, 2010
Tested By	IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
2.5	100.0	
1.25	99.6	
0.63	99.0	
0.315	98.8	
0.16	89.2	
0.08	43.8	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	56.2	Silt/Clay %	43.8

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ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006		Phase:	Report Number: A2590
Short Title:			
Sampled by: JH		Date Sampled:	

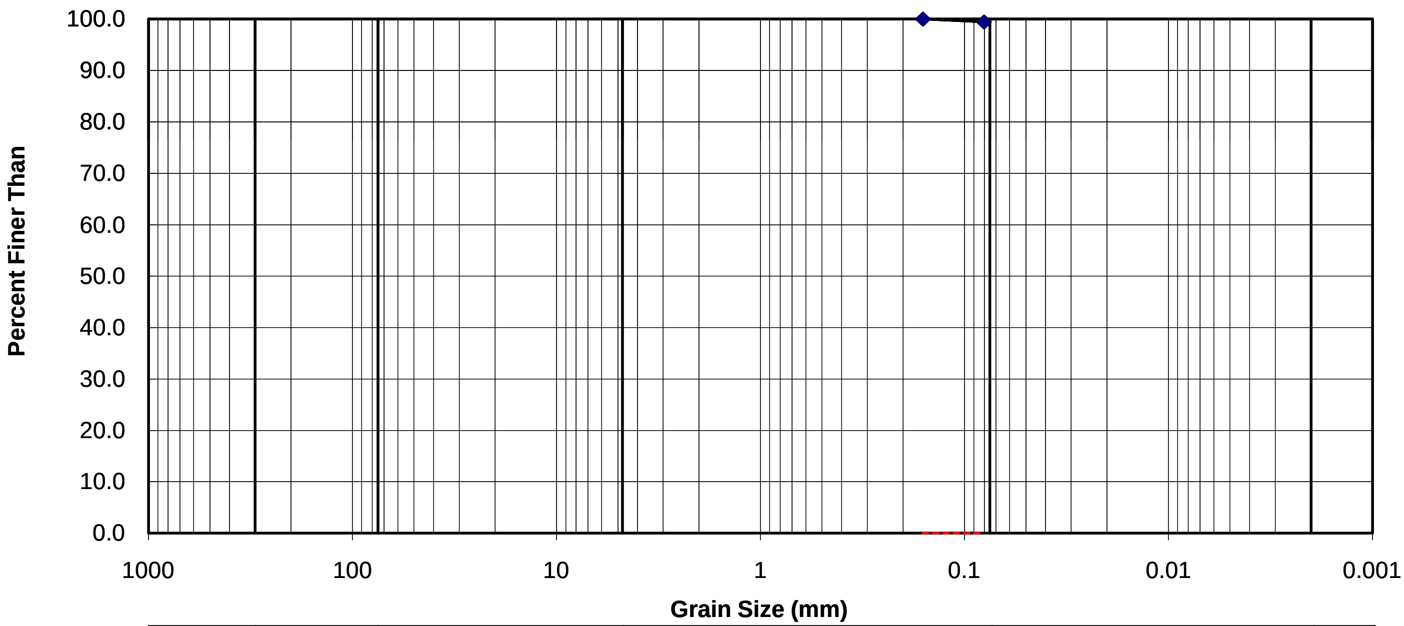
Sample Location: GA10-08 GS04 @3.0m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.16	100.0	
0.08	99.4	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.6	Silt/Clay %	99.4

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Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006   Phase: Report Number: A2590
Short Title:
Sampled by: JH   Date Sampled:

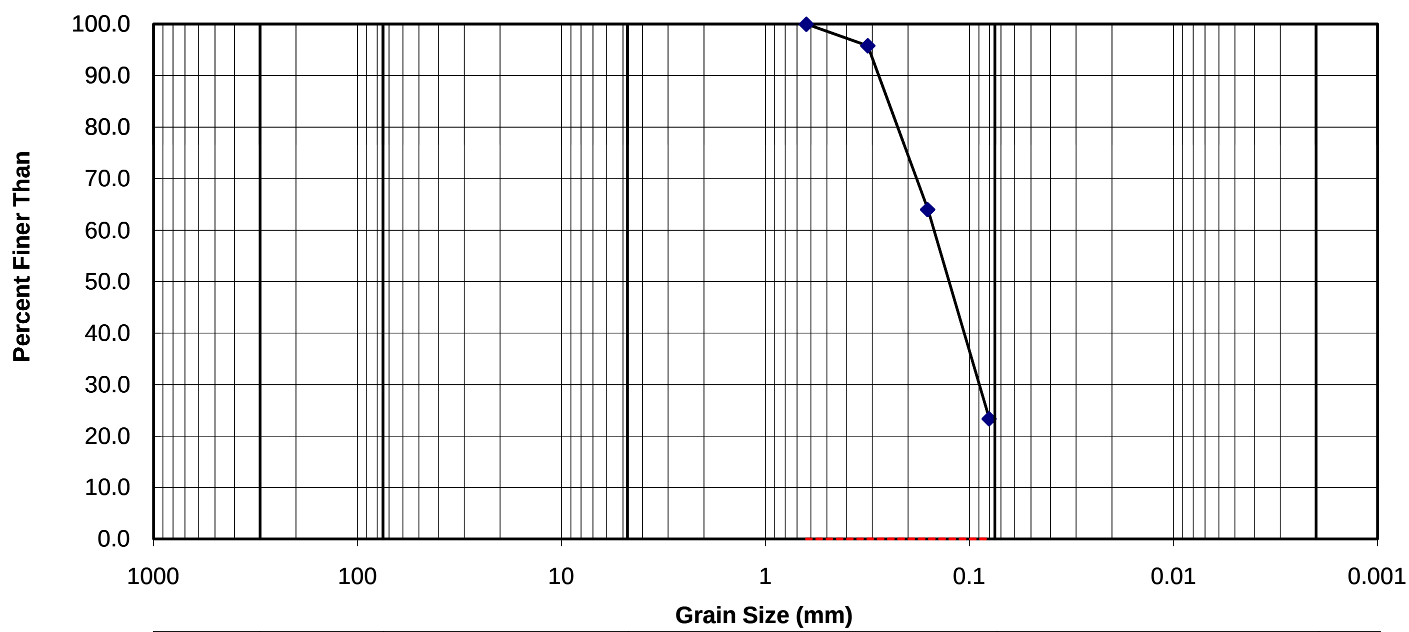
Sample Location: GA10-09 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	95.8	
0.16	64.0	
0.08	23.4	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0   Sand % 76.6   Silt/Clay % 23.4

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Project #: 09-1427-0006 Phase: Report Number: A2590
Short Title:
Sampled by: JH Date Sampled:

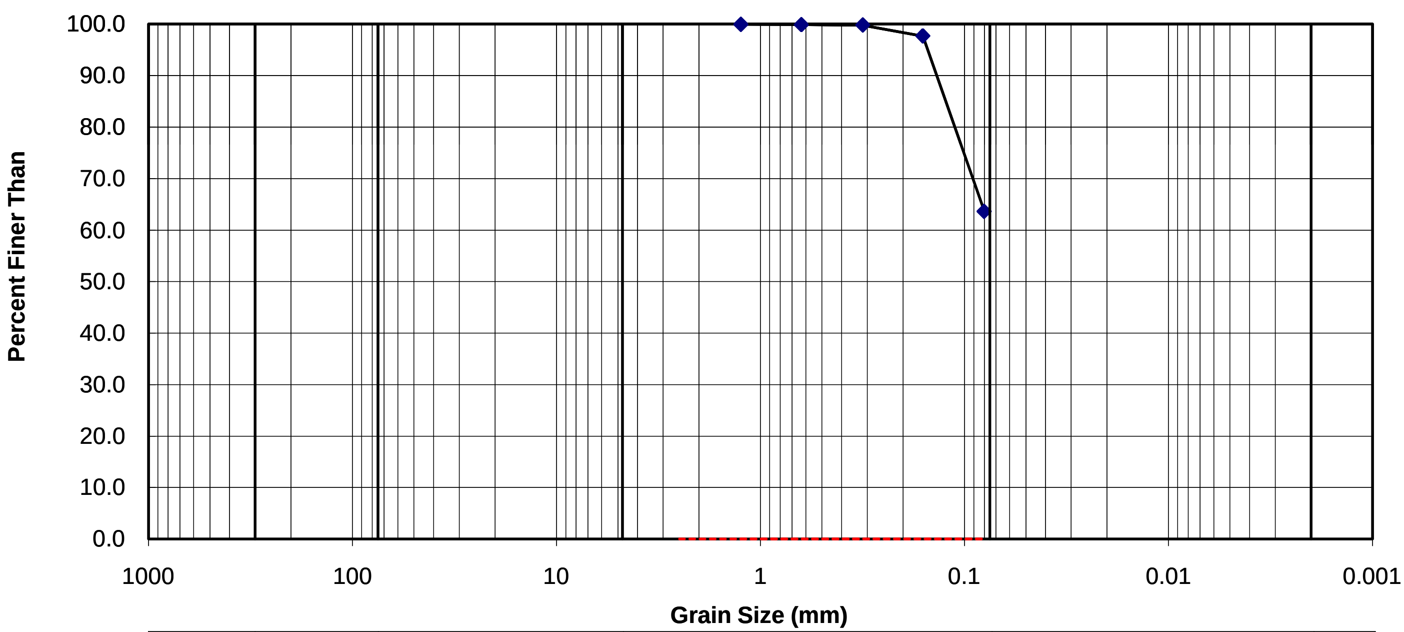
Sample Location GA10-10 GS 01 @ 0.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested November 29, 2010
Tested By IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
1.25	100.0	
0.63	99.9	
0.315	99.8	
0.16	97.7	
0.08	63.6	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 36.4 Silt/Clay % 63.6

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ASTM C136 / CSA A23.2-2a

Project #:	09-1427-0006	Phase:		Report Number:	A2590
Short Title:					
Sampled by:	JH	Date Sampled:			

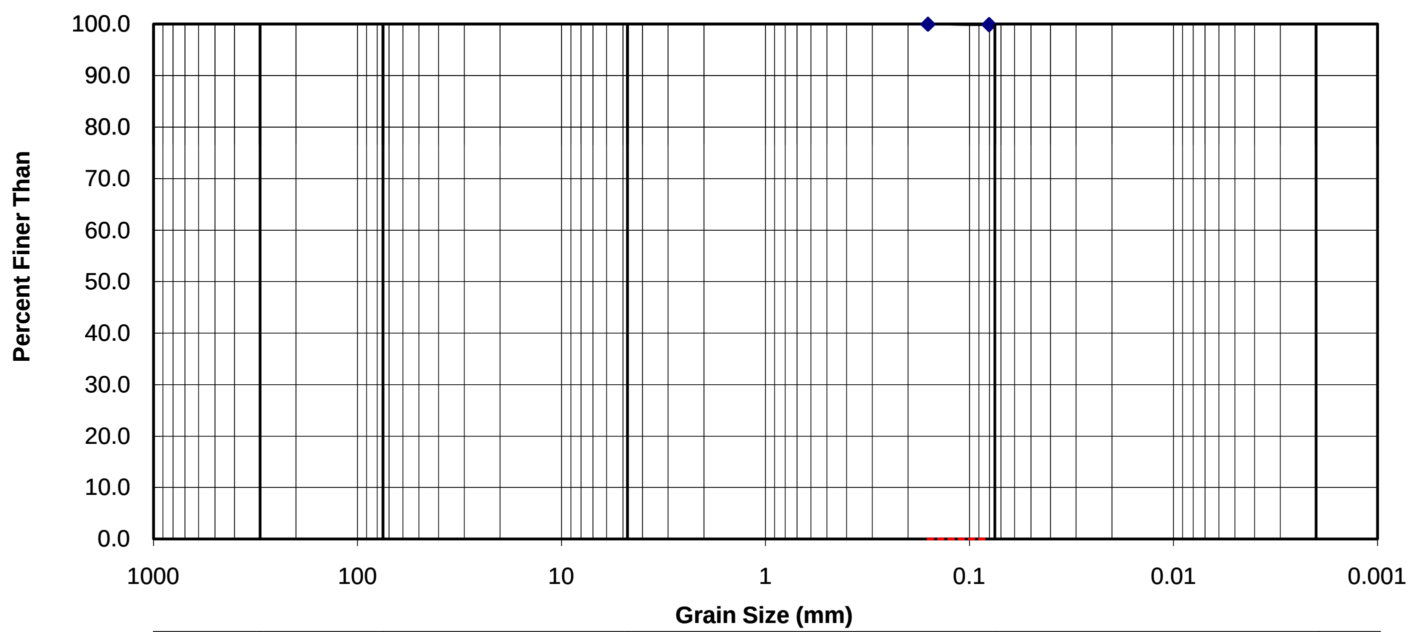
Sample Location: GA10-10 GS02 @1.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.16	100.0	
0.08	99.9	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.1	Silt/Clay %	99.9

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Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

Project #: 09-1427-0006
Phase:
Report Number: A2590
Short Title:
Sampled by: JH
Date Sampled:

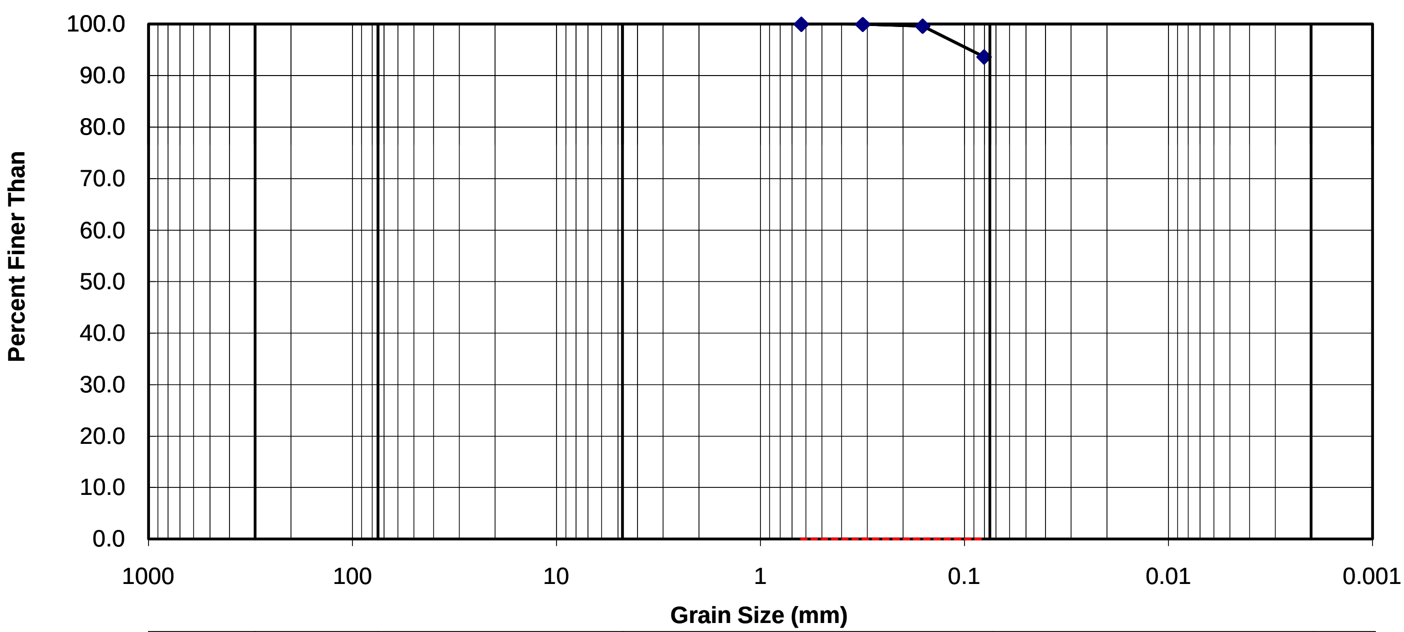
Sample Location: GA10-11 GS1 @0.5m
Source
Sample Description

Fractured Face
In situ Water Content
Date Tested: November 29, 2010
Tested By: IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	99.9	
0.16	99.6	
0.08	93.6	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 6.4 Silt/Clay % 93.6

Reviewed By: ____________________

Sieve Analysis of Fine and Coarse Aggregates
ASTM C136 / CSA A23.2-2a

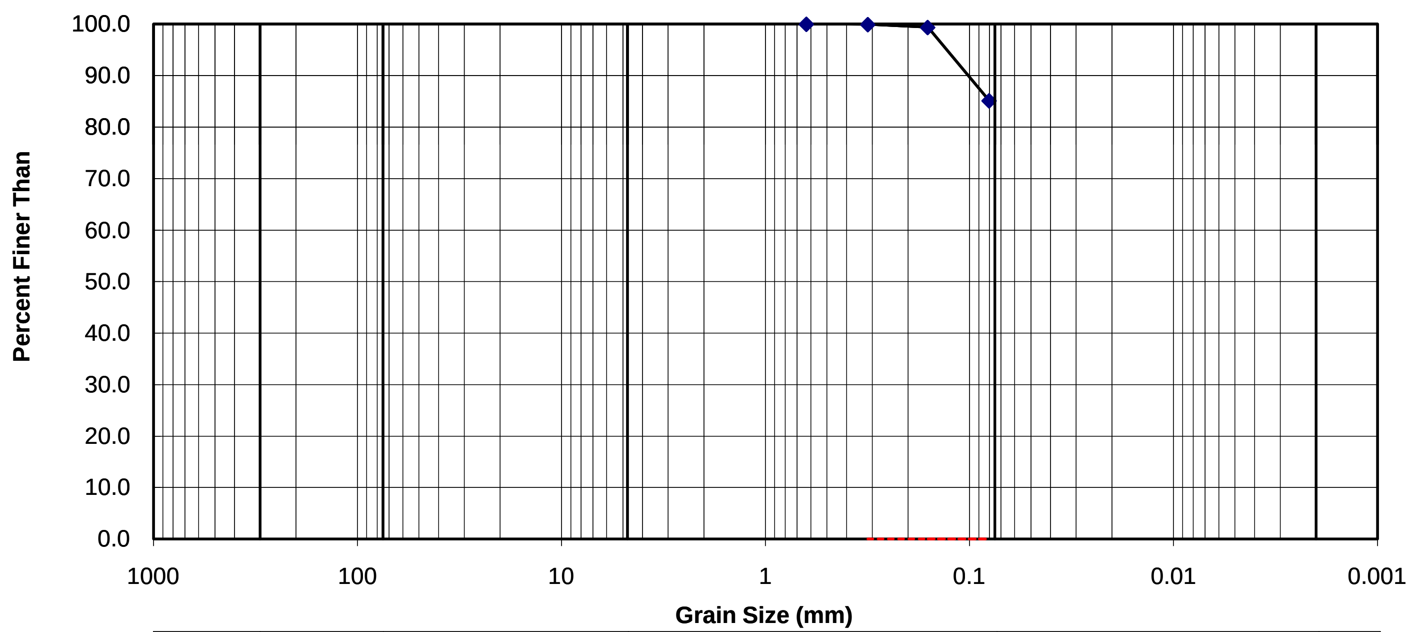
Project #:	09-1427-0006	Phase:	Report Number: A2590
Short Title:			
Sampled by:	JH	Date Sampled:	

Sample Location	GA10-11 GS02 @1.5m
Source	
Sample Description	
Fractured Face	
In situ Water Content	
Date Tested	November 29, 2010
Tested By	IK

Remarks:
Washed Sieve

Distribution

Sieve Size (mm)	Percent Passing	Specification Custom
0.63	100.0	
0.315	99.9	
0.16	99.4	
0.08	85.1	



Boulder	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fin	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	14.9	Silt/Clay %	85.1

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Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

June 29, 2012

GIANT MINE REMEDIATION PROJECT

Tailings Investigation, Giant Mine, Yellowknife, NWT

Submitted to:
Northern Contaminated Sites, Western Region
Public Works and Government Services Canada
4th Floor Greenstone Building, 5101 - 50th Ave.
P.O. Box 518 Yellowknife, NT
X1A 2N4

REPORT

Project Number:	09-1427-0006/2100
AECOM Doc. No.:	307-Tailings-7-RPT-0001-Rev1_20120629
GAL Doc. No.:	058

Distribution:

2 Copies - Public Works and Government Services Canada

1 Copy - AECOM

2 Copies - Golder Associates Ltd.

Golder Associates

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Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing in British Columbia, subject to the time limits and physical constraints applicable to this report. No other warranty, express or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use by any party of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Public Works and Government Services Canada to conduct an investigation for borrow materials within the Giant Mine site (Site), Yellowknife, Northwest Territories (NWT). The Site incorporates a large mine lease area (see Figure 1) upon which tailings ponds and dams were constructed. The tailings are impounded by a series of dams, designed to contain the tailings and minimize seepage. There are approximately 16 million tonnes of tailings stored in ponds, covering an area of about 95 hectares. There are an additional nine hectares covered by water treatment sludge stored in a settling and polishing pond. Both the tailings and sludge contain moderate amounts of arsenic, and are subject to wind erosion and direct contact by animals.

Tailings and sludge areas are to be covered with a layer of quarried rock and second layer of fine-grained soil. The layer of quarried rock prevents the upward migration of contamination from the tailings, and inhibits the downward penetration of plant roots. The upper layer will allow for re-vegetation and promote runoff and limit seepage into the tailings. The surface will be graded to limit erosion and allow water to run off of the cover without contacting the tailings.

In March 2011, Golder carried out an assessment of four tailings pond areas. The purpose of the investigation was to identify the existing material characteristics for input to the tailings ponds cover design as part of the Giant Mine Remediation Project. The information collected during this assessment is provided in the following sections.

This letter shall be read in conjunction with **"Important Information and Limitations of this Report"** which precedes this text. The reader's attention is specifically drawn to this information for the proper use and interpretation of this report.

2.0 PREVIOUS INVESTIGATIONS

Several investigations have been carried out previously to identify the site conditions in and around the tailings ponds at the Site. Those reports reviewed in this assessment have included the following:

- "Phase 1 – Tailings Investigation Giant Mine Remediation Project" (Golder 2011)
- "Giant Mine Remediation Implementation Plan" (Merit 2009)
- "As-built Report for the Tailings Cover Trails, Giant Mine, NWT" (SRK 2009)
- "Giant Mine Remediation Plan: 2008 Seismic Studies Related to Tailings Dam Safety – FINAL" (SRK 2008)
- "Giant Mine Remediation Plan" (SRK 2007a)
- "Tailings and Settling Pond Field Investigations, Giant Mine, Yellowknife, NWT, Canada" (SRK 2007b)
- "Giant Mine - Field Program Characterisation of Tailings" (SRK 2005a)"Giant Mine Remediation Plan: Tailings and Sludge Containment Areas" (SRK 2005b)
- "Characterization of Soil and Groundwater in the Calcine and Mill Areas, Giant Mine" (SRK 2004)"Tailings Retreatment Plant Information Brochure" (Giant 1990)

3.0 SCOPE OF WORK

The Giant Mine Remediation Plan specifies the closure objectives for the site. The objectives relevant to the closure of the tailings and sludge areas are:

- To remediate the surface of the site to the industrial standard guidelines under the NWT *Environmental Protection Act,* recognizing that portions of the site will be suitable for other land uses with appropriate restrictions; and
- To minimize the release of contaminants from the site to the surrounding environment.

Specifically related to the cover of the tailings and settling/polishing ponds, the objective is to design a cover that minimises contact between the tailings or tailings pore water and people or animals and to reduce infiltration to the groundwater. The cover design will be dependent on the tailing materials and their engineering properties.

The current task for remediation of the tailings and settling/polishing ponds consists of the following:

- Investigation of the tailings in the South Pond, North Pond and Northwest Pond, which have been under water in the summer months and have not been fully investigated to date;
- Complete model of pond, to design dewatering program to result in zone at center with sufficient strength to support cover design (in flooded areas of pond);
- Complete Preliminary Design of tailings covers;
- Complete Preliminary Design of settling/polishing pond covers;
- Complete a design for tailings surface preparation, including re-grading the surface of the tailings (taking into account design to drain and consolidate the central, soft portions of the ponds currently under water);
- Evaluate long term stability of each dam, including provisions to re-slope or buttress any dams that may need this re-contouring for long term stability (specifically related to long term seismic events); and
- Develop long term maintenance plans for the ponds, including provisions to repair damage to the covers and to manage long term seepage from the ponds.

The first task, the investigation program, is presented in this report. The remaining tasks will be presented in a Preliminary Design Report, under separate cover.

3.1 Tailings Investigation Sites

The tailings investigation has been carried out on the following tailings ponds:

- South Pond;
- Central Pond;
- North Pond; and
- Northwest Pond.

This investigation did not include investigation of the settling pond or polishing pond downstream of the existing water treatment plant. The sludges in the settling pond have been investigated previously, and the sludge in the bottom of the polishing pond is expected to be too thin to investigate with conventional methods.

3.2 Methodology

To provide the required geotechnical data for the tailings cover and re-grading design, a borehole drilling program was recommended to collect soil samples and provide in-situ soil density information.

The borehole drilling was carried out using an M5 – track mounted auger drill rig supplied by Mobile Augers and Research Ltd., from Edmonton, Alberta. Drilling was conducted from March 8-10, March 12-15 and March 20, 2011. There were fifteen (15) boreholes drilled to depths ranging from 7.16 m to 20.57 m (see Figures 2). There is no borehole record for GA11-T-03, GA11-T-05 or GA11-T-07 as this portion of the Central Pond was investigated by AECOM Canada Ltd. under a separate program related to investigation for potential landfill locations.

Samples were collected at regular intervals (4-5 ft or 1.2-1.5 m) or at changes in material type, and then bagged, labelled and transported to Golder's geotechnical laboratory facility in Edmonton, Alberta. Summary borehole records are provided in Appendix A. The temperature of the soil on the augers was measured using a hand held thermistor immediately after the auger was removed from the ground, where possible. These temperatures are recorded on the borehole records in the additional lab testing column.

3.2.1 Instrumentation

Standpipes were installed in three of the boreholes (GA11-T-01, GA11-T-04 and GA11-T-13) to a depth of 6 m below ground surface. A standpipe was also installed in GA11-T-11 to a depth of 9.6 m. The standpipes were constructed with 10 feet (3.1 m) of 2" (50 mm) slotted PVC pipe at the bottom and then solid 2" (50 mm) PVC to the surface of the borehole. The slotted portion of the standpipe was backfilled using manufactured silica sand up to approximately 0.3 m above the slotted section, where a bentonite seal was developed over the 0.6 m of standpipe above the sand. The remaining upper section of the standpipe was backfilled with soil cuttings produced from the drilling. Approximately 1.0 m of stick-up above the ground surface was left in place and the top of the pipe was sealed using a standard J-plug.

4.0 RESULTS

4.1 Field Results

Based on the visual assessment of material types in the field, the soils encountered have been generally described as;

- Clayey silt (tailings);
- Silt (tailings);
- Peat;
- Silty clay (till);
- Sand; and
- Gravel.

Frost penetration was measured in each of the boreholes and ranged from 0.8 m to 2.0 m below ground level.

Possible bedrock contact was identified in Borehole GA11-T-02, and it was observed that this borehole is in close proximity (approximately 100 m) to a bedrock outcrop that is exposed at the north end of the South Tailings Pond.

Groundwater was not identified in any of the boreholes drilled during this investigation, but one borehole in each of the tailings pond areas was developed as a groundwater monitoring well. Water levels were read June 17, 2011 in 3 of the 4 boreholes where the standpipes were installed. The standpipe in Borehole GA11-T-13 located in the Northwest Tailings Pond was underwater at the time of sampling. It is anticipated that the water levels have essentially stabilized since the standpipes were installed and the results are provided in the table below:

Table 1: Results of Groundwater Measurements, June 17, 2011

Borehole No.	Time of Test	Stickup Above Ground	Depth to Water Level
GA11-T-11	11:17	0.99 m	10.51 m
GA11-T-04	11:31	0.97 m	6.52 m
GA11-T-01	11:53	1.04 m	6.35 m
GA11-T-13	UNDERWATER		

4.2 Laboratory Results

All samples collected during the borehole drilling program were tested for moisture content. Selected samples were tested for particle size (sieve) analysis, Atterberg Limits, hydrometers, soil-water characteristics and consolidation characteristics. The selected samples are considered to be representative of the soil type from which they were collected. The number of tests conducted on the samples provided, are as follows:

- 180 moisture contents;
- 48 particle size analyses;
- 67 Atterberg Limits;
- 9 Soil-Water Characteristic Curves; and
- 2 Consolidation – Falling Head Hydraulic Conductivity tests.

Individual laboratory test result sheets are provided in Appendix B. Select test results are also provided on the borehole records. A summary of index laboratory test results are provided below.

Table 2: Soil Parameters – Tailings Ponds – Giant Mine

Borehole	Depth (ft)	Sample ID	Soil Type	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-01 (Central Pond)	1-2	SA1	Silty - Sand	9.9	61.1	32.3	6.6		NP
	2.5-4	SA2	(Clayey Silt)	24.2					
	5-6	SA3	Clayey - Silt	27.4	2.1	82.8	15.2	25	22
	7.5-9	SA4	Clayey - Silt	27.6	0.2	83.9	15.9		NP
	10.5-11.5	SA5	Sandy-Silt	31.2	29.7	58.4	11.9		NP
	12.5-14	SA6	(Clayey Silt)	25.8					
	15-15.5	SA7	Clayey - Silt	41.7	0.5	79.6	19.9	32	25
	17.5-19	SA8	(Clayey Silt)	33.7					
	20-21	SA9	Sandy - Silt	23.4	15.5	73.8	10.7		NP
	22.5-24	SA10	(Clayey Silt)	29.2					
	25-26	SA11	Sandy - Silt	23.7	13.8	75.5	10.7		NP
	25-26	SA12	(Clayey Silt)	24.2					
	35-36	SA13	Clayey - Silt	29.0	2.4	79.2	18.4	27	23
	37.5-39	SA15	(Clayey - Silt)	29.9				23	17
	41-42	SA16	(Clayey - Silt)	27.9					
	47.5-49	SA17	(Clayey - Silt)	27.5					
	49.5-50	SA18	(Peat)	45.7					
	52.5-54	SA19	(Silty Clay)	24.9					
	54.5-56	SA20	(Silty Clay)	27.5					
GA11-T-02 (Central Pond)	1-2	SA1	(Silt)	44.3					
	3-5	SA2	Sand and Silt		55.5	39.1	5.4		NP
	10-11	SA5	Clayey - Silt	22.5	11.5	75.0	13.5		NP
	15-16	SA7	Clayey - Silt	34.6	3.8	79.0	17.2	24	20
	17.5-19	SA8	(Silt)	35.4					
	20-21	SA9	Sandy, Clayey - Silt	26.6	16.7	69.5	13.8		NP
	22.5-24	SA10	(Silt)	24.8					
	25-26	SA11	Sand and Silt	23.2	46.9	42.1	11.0		NP
	29-30	SA13	(Silt)	30.8					
	30-31	SA14	BR	17.9					
GA11-T-04 (Central Pond)	1-2	SA1	(Sand and Silt)	28.2					
	2.5-4	SA2	(Sand and Silt)	20.0					
	5-6	SA3	(Sand and Silt)	15.2					
	7.5-9	SA4	(Sand and Silt)	9.7					
	10-11	SA5	Sandy, Clayey - Silt	27.5	18.9	66.0	15.0		NP
	13-14	SA6	Sandy, Clayey - Silt		15.4	71.6	13.0		NP
	15-17	SA7	Silt	19.7				26	23
	17.5-19	SA8	Clayey, Sand and Silt	24.8	51.8	35.9	12.2		NP

Borehole	Depth (ft)	Sample ID	Soil Type	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
	20-21	SA9	(Silt)	20.0					
	22.5-24	SA10	Sandy-Silt	19.1	32.1	60.6	7.3		NP
	25-26	SA11	(Silt)	27.6					
	27.5-28	SA12	Sandy- Silt	23.7	28.7	63.6	7.7		NP
	35-36	SA13	(Silt)	28.5					
	37.5-39	SA14	(Silt)	30.9					
	45-46	SA15	Sandy-Silt	22.8	28.1	60.0	11.9		NP
	47.5-49	SA16	(Silt)	30.5					
	54-55	SA17	(Silt)	23.6					
	61-63	SA18	(Silt)	32.5					NP
	65.5-67	SA19	(Peat)	116.2					
GA11-T-06 (Central Pond)	15-16	SA6	(Clayey Silt)	38.2					
	17.5-19	SA7	Sandy-Silt	24.0	38.1	55.0	6.9		
	20-21	SA8	(Clayey Silt)	29.9					
	22.5-24	SA9	Silt	25.1	11.1	85.7	3.2		NP
	25-26	SA10	(Clayey Silt)	34.7					
	27.5-29	SA11	Sandy-Silt	23.6	27.2	71.5	1.3		NP
	34-35	SA12	Sandy - Silt	29.3	14.2	74.9	10.9		NP
	44-45	SA14	(Clayey Silt)	16.8					
	47.5-49	SA15	Silty-Sand	24.3	67.3	26.9	5.8		NP
	54.5-55.5	SA16	(Clayey Silt)	22.8					
	64-65	SA17	(Peat)	25.1					
	65.5-66.5	SA18	(Sand)	18.4					
GA11-T-08 (North Pond)	1-2	SA1	(Silt)	21.0					
	4.5-5.5	SA2	(Silt)	23.7					
	7.5-9	SA3	(Silt)	27.1					
	10-11	SA4	(Silt)	20.6					
	12.5-14	SA5	(Silt)	22.4					NP
	15-16	SA6	(Silt)	20.1					
	17.5-19	SA7	(Silt)	21.5					NP
	20.21	SA8	(Silt)	20.2					
	22.5-23.5	SA9A	(Silt)	29.1				23	18
	23.5-24	SA9B	(Sand & Gravel)	14.6					
	25-26	SA10	(Silty Clay)	17.6					NP

Borehole	Depth (ft)	Sample ID	Soil Type	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-09 (North Pond)	1-2	SA1	(Silt)	27.9					
	4-5	SA2	Sand		74.0	20.5	5.5		NP
	6-7	SA3	(Silt)	21.2					NP
	10-11	SA5	(Silt)	26.8				24	23
	15-16	SA7	(Silt)	32.0					
	17-18	SA8	(Sand and Gravel)	11.2					
	20.5-21.5	SA9	(Clayey Silt)	20.9				25	24
	24-25	SA10	(Clayey Silt)	23.0					
	27.5-29	SA11	(Clayey Silt)	33.0					
	29.5-30.5	SA12	(Peat)	26.7					
	31.5-32.5	SA13	(Silty Clay)	40.9					
GA11-T-10 (North Pond)	1-2	SA1	(Silt and Sand)	24.0					
	5-6	SA2	(Silt and Sand)	22.2					NP
	7.5-9	SA3	(Silt and Sand)	31.6					
	10-11	SA4	(Clayey Silt)	29.4					NP
	15-16	SA6	(Clayey Silt)	26.4					NP
	17.5-19	SA7	(Clayey Silt)	30.6					
	20-21	SA8	(Clayey Silt)	25.6					
	22.5-24	SA9	(Clayey Silt)	29.6					
	25-26	SA10	(Clayey Silt)	38.9				32	27
	27.5-29	SA11	(Silty Clay)	11.3					
GA11-T-11 (North Pond)	1-2	SA1	(Clayey Silt)	42.3					
	4-5	SA2	(Clayey Silt)	32.3					
	5-7.5	SA3	Sandy - Silt		19.8	68.9	11.3		NP
	10.5-11.5	SA4	(Sandy Silt)	8.4					
	12.5-14	SA5	Clayey - Silt	34.5	1.2	81.5	17.3		
	15-16	SA6	(Clayey Silt)	39.2					
	17.5-19	SA7	Clayey - Silt	40.3	0.5	85.2	14.2		NP
	20-21	SA8	(Clayey Silt)	36.5					
	22.5-24	SA9	Clayey - Silt	34.5	0.6	86.4	13.0	26	24
	25-26	SA10	(Clayey Silt)	39.2					
	27.5-29	SA11	Clayey - Silt	41.0	0.6	85.6	13.9		NP
	34-35	SA12	(Clayey Silt)	34.6					
	37.5-39	SA13	Clayey - Silt	35.8	0.3	82.6	17.1		NP
	41-42	SA14	(Peat)	63.9					
	44-45	SA15	(Silty Clay)	33.8					
	46-47	SA16	(Silty Sand)	31.5					

Borehole	Depth (ft)	Sample ID	Soil Type	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-12 (Northwest Pond)	16.5-17.5	SA6	Sandy-Silt	23.2	22.2	75.4	2.4		NP
	17.5-19	SA7	(Silty Sand)	13.9					
	20-21	SA8	Silt	31.9	2.0	91.1	6.9		NP
	22.5-24	SA9	(Silt)	23.9					
	25-26	SA10	Silt	29.7	3.2	89.2	7.6		NP
	34-35	SA12	(Silt)	26.6					
	39-40	SA13	Sandy-Silt	19.0	30.3	67.7	2.0		NP
	44-45	SA14	(Silt)	18.3					
	49-50	SA15	Sandy-Silt	21.6	32.6	47.4	20.0		NP
	54.5-55.5	SA16	(Silt)	24.0					
	59-60	SA17	Sandy - Silt	20.2	14.0	83.6	2.4		NP
	65-66	SA18	(Clay)	37.6					
GA11-T-13 (Northwest Pond)	1-2	SA1	(Clayey Silt)	22.3					
	5-6	SA2	(Clayey Silt)	31.5					
	6-8	SA3	Clayey - Silt		0.0	83.2	16.8		
	10-11	SA4	(Clayey Silt)	29.5					
	12.5-14	SA5	(Clayey Silt)	32.1					
	15-16	SA6	(Clayey Silt)	25.1					NP
	17.5-19	SA7	(Clayey Silt)	29.0					
	20-21	SA8	(Clayey Silt)	24.4					NP
	22.5-24	SA9	(Clayey Silt)	29.7					
	25-26	SA10	(Clayey Silt)	26.6					NP
	27.5-29	SA11	(Clayey Silt)	30.5					
	30-31	SA12	(Clayey Silt)	31.4					NP
	35-36	SA13	(Clayey Silt)	30.3					
	40-41	SA14	(Silty Clay)	29.6					
GA11-T-14 (Northwest Pond)	15-16	SA6	Clayey - Silt	29.9	0.2	85.1	14.7	29	24
	17.5-19	SA7	(Clayey Silt)	31.3					
	20-21	SA8	Clayey - Silt	32.3	0.0	85.6	14.4		NP
	22.5-24	SA9	(Clayey Silt)	28.7					
	25-26	SA10	Clayey - Silt	36.4	0.3	85.0	14.7	31	25
	27.5-29	SA11	(Clayey Silt)	38.7					
	34-35	SA12	Clayey-Silt	22.1	3.5	67.2	27.5	27	17
	37.5-39	SA13	(Clayey Silt)	27.6					
	43-44	SA14	Clayey - Silt	31.1	2.1	80.3	17.7		NP
	47.5-49	SA15	(Silty Clay)	30.0					
	54-55	SA16	(Clayey Silt)	29.1					

Borehole	Depth (ft)	Sample ID	Soil Type	Moisture Content (%)	Sand Content (%)	Silt Content (%)	Clay Content (%)	Liquid Limit	Plastic Limit
GA11-T-15 (Northwest Pond)	1-2	SA1	(Clayey Silt)	14.9					
	6-7	SA2	(Clayey Silt)	29.0					
	7.5-9	SA3	(Clayey Silt)	24.4					
	9.5-10.5	SA4	(Clayey Silt)	25.2					
	12.5-14	SA5	(Silty Sand)	18.5					
	15-16	SA6	(Silty Sand)	21.0					
	17.5-18	SA7	(Silty Sand)	33.6					
	18.5-19	SA8	(Silty Clay)	33.2					
	20-21	SA9	(Silty Clay)	18.7					
GA11-T-16 (Northwest Pond)	1-2	SA1	(Clayey Silt)	22.1					
	5-6	SA2	(Clayey Silt)	27.2					
	7.5-9	SA3	(Clayey Silt)	34.7					NP
	10-11	SA4	(Clayey Silt)	28.3					
	15-16	SA6	(Clayey Silt)	41.0				25	24
	17.5-19	SA7	(Clayey Silt)	26.8					
	20-21	SA8	(Clayey Silt)	24.4					NP
	22.5-24	SA9	(Clayey Silt)	36.9					
	25-26	SA10	(Clayey Silt)	29.4					NP
	27.5-29	SA11	(Clayey Silt)	39.1					
	35-36	SA12	(Clayey Silt)	39.3					NP
	37.5-39	SA13	(Clayey Silt)	38.5					
	42-43	SA14	(Silty Clay)	41.5					
GA11-T-17 (Northwest Pond)	1-2	SA1	(Clayey Silt)	27.3					
	6-7	SA2	(Clayey Silt)	27.7					
	7.5-9	SA3	Sandy, Clayey - Silt	26.4	18.4	67.7	13.9		
	10-11	SA4	(Clayey Silt)	20.5					
	12.5-14.0	SA5	Sandy, Clayey - Silt	24.0	16.3	71.1	12.6		NP
	15-16	SA6	(Clayey Silt)	23.0					
	17.5-19	SA7	(Clayey Silt)	23.8					
	20-21	SA8	(Clayey Silt)	31.8					
	22.5-24	SA9	Sandy - Silt	23.5	19.1	69.0	11.9		NP
	25-26	SA10A	Clayey - Silt	24.4	4.2	82.5	13.3		NP
	27.5-29	SA10B	(Clayey Silt)	28.1					
	34-35	SA11	(Clayey Silt)	26.1					
	37.5-39	SA12	Clayey - Silt	21.6	0.1	84.1	15.8		NP
	44-43	SA13	(Clayey Silt)	31.6					
	50-51	SA14	(Silty Clay)	24.1					

NP = non-plastic

Blank box = no test carried out

() = Visual field identification

Generally the soils sampled are classified as clayey silt, sandy silt or silt with little to some sand or clay. Thin (<1 m) sand or sand and gravel seams were identified in Boreholes GA11-T-08 and GA11-T-09 located in the North Tailings Pond. It is assumed that some segregation of the tailings has occurred resulting in the loss of fines at these locations and only the sand or sand and gravel sized materials are left. A thin (<1 m) peat seam has also been identified above a layer of silty clay assessed as "Till" in several of the boreholes. This indicates that the ponds were likely constructed directly over the in-situ soils.

The range and average Atterberg limits for each of the soil types encountered are indicated as follows:

Clayey-Silt:	Plastic Limit Range -	17 to 27	Average – 23
	Liquid Limit Range -	25 to 32	Average – 27
Sandy-Silt:	Plastic Limit Range -	NP	
	Liquid Limit Range -	NP	
Silt:	Plastic Limit Range -	17 to 24	Average – 22
	Liquid Limit Range -	23 to 32	Average – 26

Falling head hydraulic conductivity tests were carried out on two mixed samples from GA11-T-14 samples 2 and 3. The two samples were tested twice; once on May 4, 2011 and secondly on May 26, 2011. Hydraulic conductivity's (m/s) were recorded as 1.8×10^{-8} (May 4) at a maximum effective stress of 501 kPa and 1.8×10^{-8} at 1251 kPa (May 26). The summary laboratory results are provided in Appendix B.

Soil-water characteristic curves were measured for samples from GA11-T-06 (Sample 3), GA11-T-12 (Sample 2) and GA11-T-14 (Samples 2 and 3 mixed together). Water content (gravimetric and volumetric) was measured over a suction range from 0.25 kPa to 295,000 kPa for samples from GA11-T-06 and GA11-T-12. For the samples from GA11-T-14 the suction range was from 0.25 kPa to 400 kPa. Results for these tests are provided in Appendix B.

Soil temperatures were recorded on the summary borehole logs in Appendix A. The temperatures were measured to assess whether the soils were frozen (permafrost impacted) or not. Frozen soils will be difficult to excavate during the tailing pond remediation and may require ripping prior to excavation with conventional excavating equipment.

5.0 CLOSURE

We trust this report provides you with the information you require at this time. Should you have any questions regarding the contents of this report, or require any further information, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

ORIGINAL SIGNED AND SEALED

Rob Buchanan, M.A., P.Geo.
Senior Geoscientist

Dave Caughill, M.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

RB/DC/rs

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

PRELIMINARY
NOT FOR CONSTRUCTION

Golder Associates

DO NOT SCALE DRAWINGS

Revision/Révision	Description/Description	Date/Date
1	ISSUED WITH RPT-0003-REV1	2012-06-29
0	ISSUED WITH RPT-0001-REV0	2011-09-06
0	ISSUED WITH RPT-0001-REV0	2011-08-2

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

TAILINGS AREAS AND SLUDGE PONDS

Approved by/Approuvé par: DC

Designed by/Conçept par:

Drawn by/Dessiné par: JEF

PWGSC Project Manager/Administrateur de Projets TPSGC: PWGSC

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

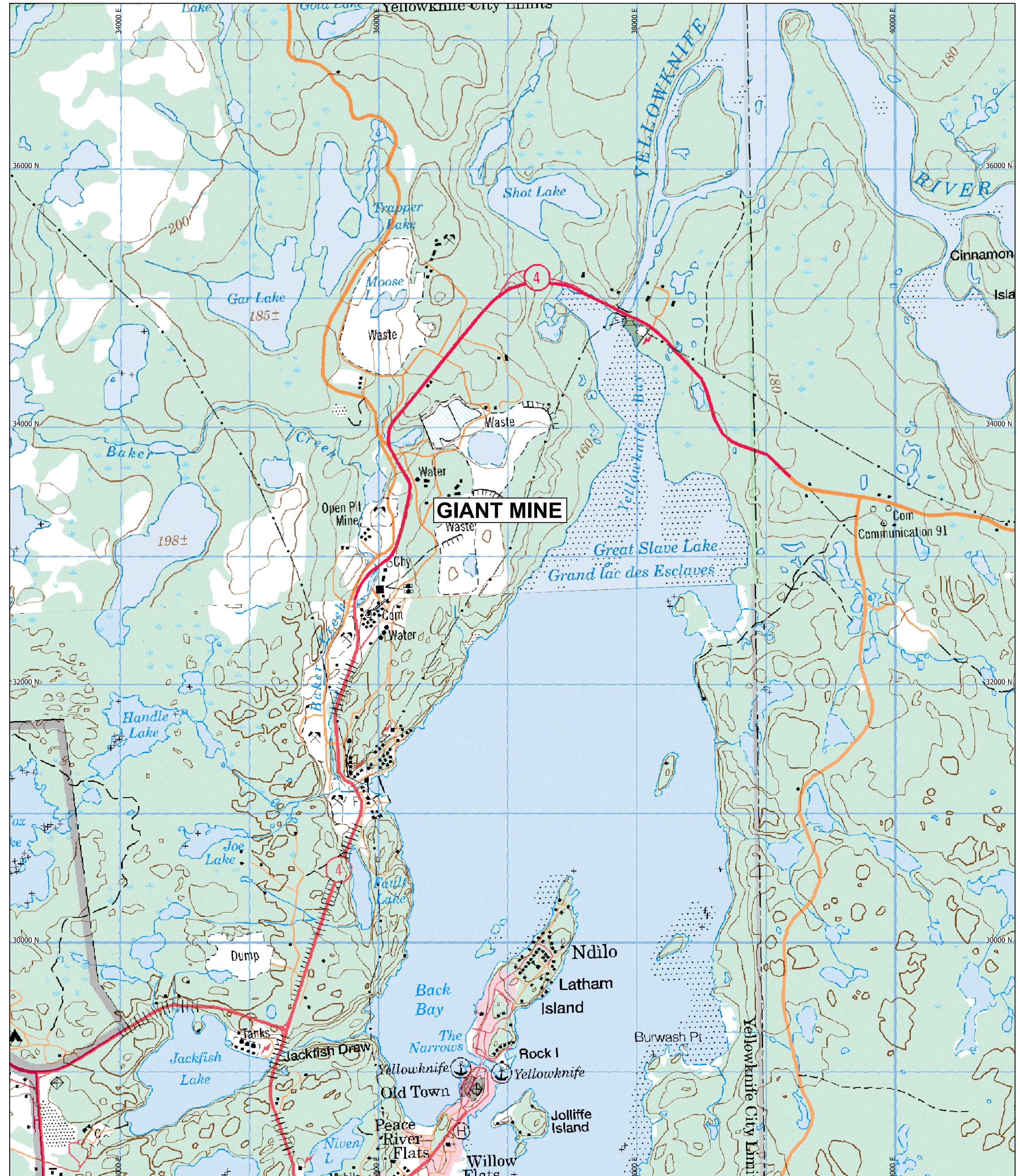
Client/client: PWGSC

Drawing title/Titre du dessin

SITE LOCATION PLAN

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.307	FIGURE 1 OF 4	1

KEY PLAN
SCALE N.T.S.



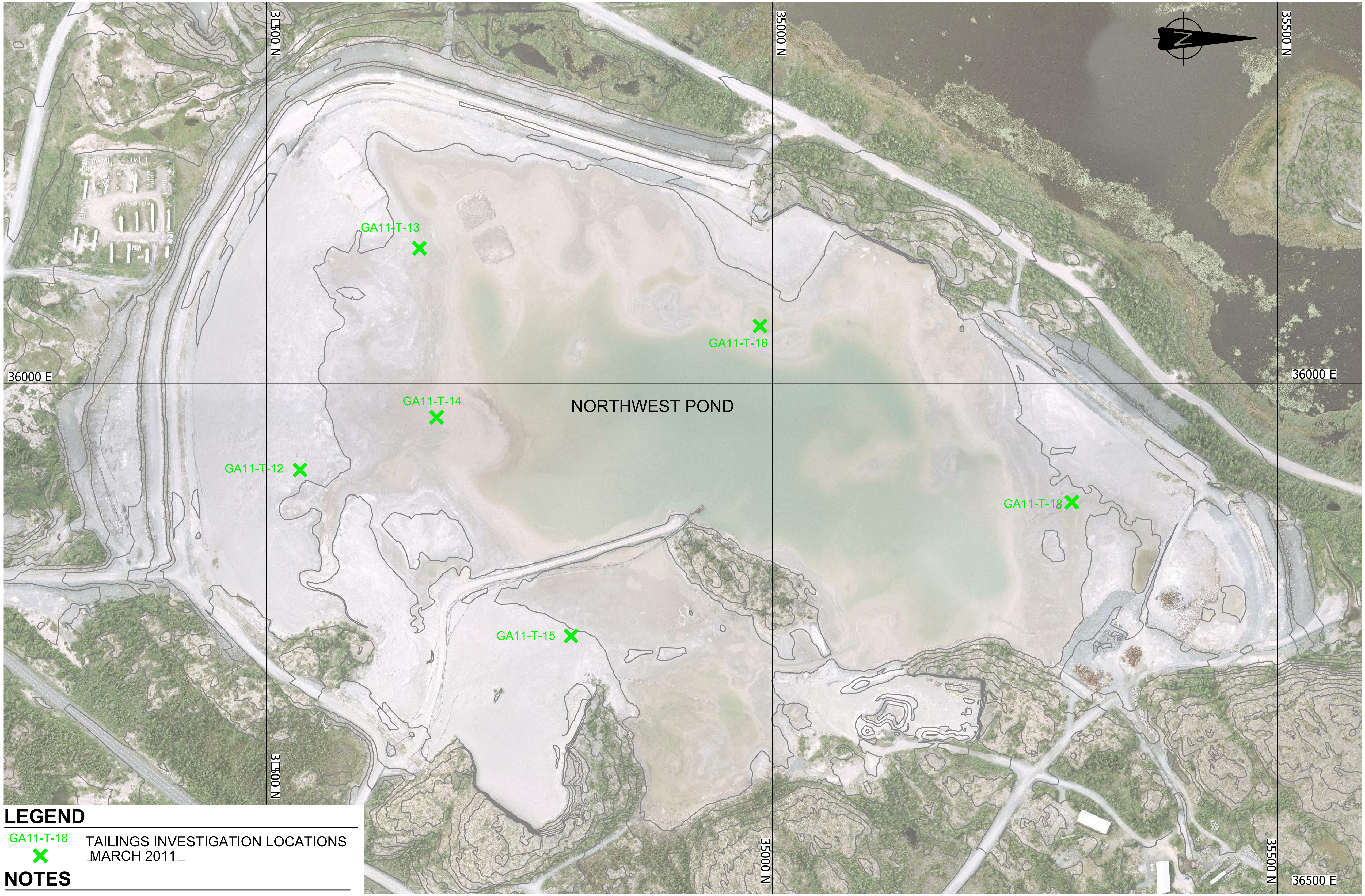
PLAN
SCALE 1:40000

0 400 800 1200 1600 2000
SCALE IN METRES

NOTES
COORDINATES SHOWN ARE IN METRES GPRM GRID.

REFERENCE

PROJECTION TRANSVERSE MERCATOR DATUM NAD83 COORDINATE SYSTEM UTM ZONE 11.



LEGEND

GA11-T-18 ✕ TAILINGS INVESTIGATION LOCATIONS (MARCH 2011)

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.0m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE "GIANT MINE - CONTOURS (0.5m) - 2009 - GMRP.dwg, DATE RECEIVED JANUARY 10, 2011
2. PWGSC, CAD FILE "GiantMine_GRP.sid, DATE RECEIVED JANUARY 10, 2011

0 40 80 120 160 200
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

Golder Associates

DO NOT SCALE DRAWINGS

Revision/Revision	Description/Description	Date/Date
1	ISSUED WITH RPT-0001-REV1	2012-06-29
0	ISSUED WITH RPT-0001-REV0	2011-09-06
0	ISSUED WITH RPT-0001-REV0	2011-08-2

Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

TAILINGS AREAS AND SLUDGE PONDS

Approved by/Approuve par: DC
Designed by/Concept par: DC
Drawn by/Dessine par: MR
PWGSC Project Manager/Administrateur de Projets TPSGC:
PWGSC, Architectural and Engineering Resources Manager/Ressources Architectural et de Directeur d'ingénierie, TPSGC:
Client/client: PWGSC

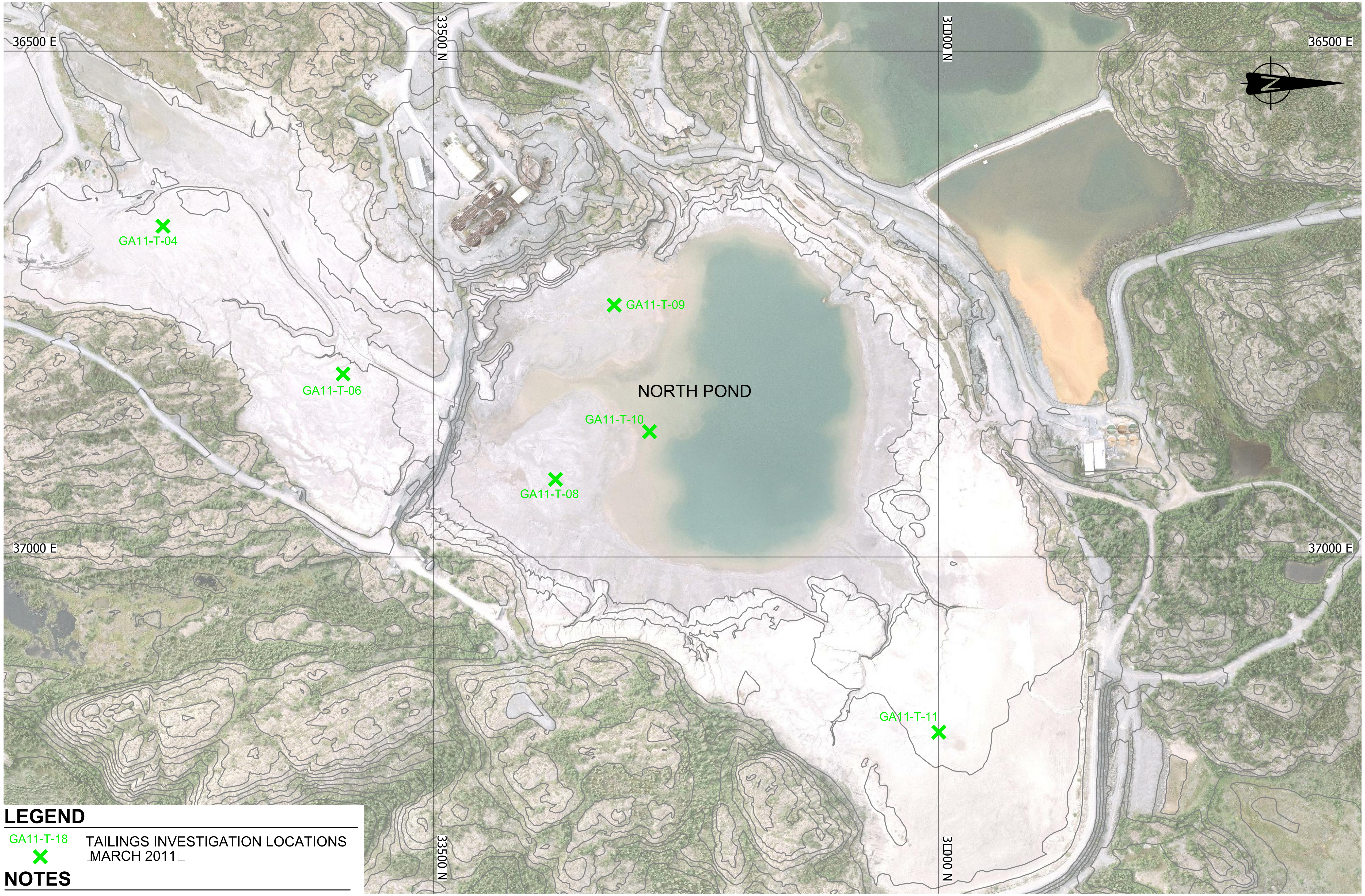
Drawing title/Titre du dessin
AUGER DRILLING INVESTIGATION LOCATIONS AT NORTHWEST POND

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.307	FIGURE 2 OF 4	1

Drawing File: N:\Bur-Graphics\Projects\2009\1427\09-1427-0006\Drafting\2100\2110\AUGER DRILLING INVESTIGATION LOCATIONS AT THE NORTHWEST POND.dwg Layout:R-014204.307_RPT-0001_CF02-R1 Wednesday, June 27, 2012 9:30:51 AM By: rhoriyck

A0 – PWGSC – ANSI B–L1 – 11X17

R-014204-30_-RPT-0001-CF02-R1



LEGEND

GA11-T-18 ✕ TAILINGS INVESTIGATION LOCATIONS □MARCH 2011□

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.□m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE□GIANT MINE - CONTOURS □0.□m□- 2009 - GMRP.d□g, DATE RECEIVED□□ANUARY 10, 2011
2. PWGSC, CAD FILE□GiantMine_GRP.sid, DATE RECEIVED□□ANUARY 10, 2011

0 40 80 120 160 200

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

Golder Associates

DO NOT SCALE DRAWINGS

Revision/ Révision	Description/Description	Date/Date
1	ISSUED WITH RPT-0001-REV1	2012-06-29
0	ISSUED WITH RPT-0001-REV0	2011-09-06
0	ISSUED WITH RPT-0001-REV0	2011-08-2□

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE
REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

TAILINGS AREAS AND SLUDGE PONDS

Approved by/Approuve par
DC

Designed by/Concept par
DC

Drawn by/Dessine par
MR

PWGSC Project Manager/Administrateur de Projets TPSGC

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

Client/client
PWGSC

Drawing title/Titre du dessin

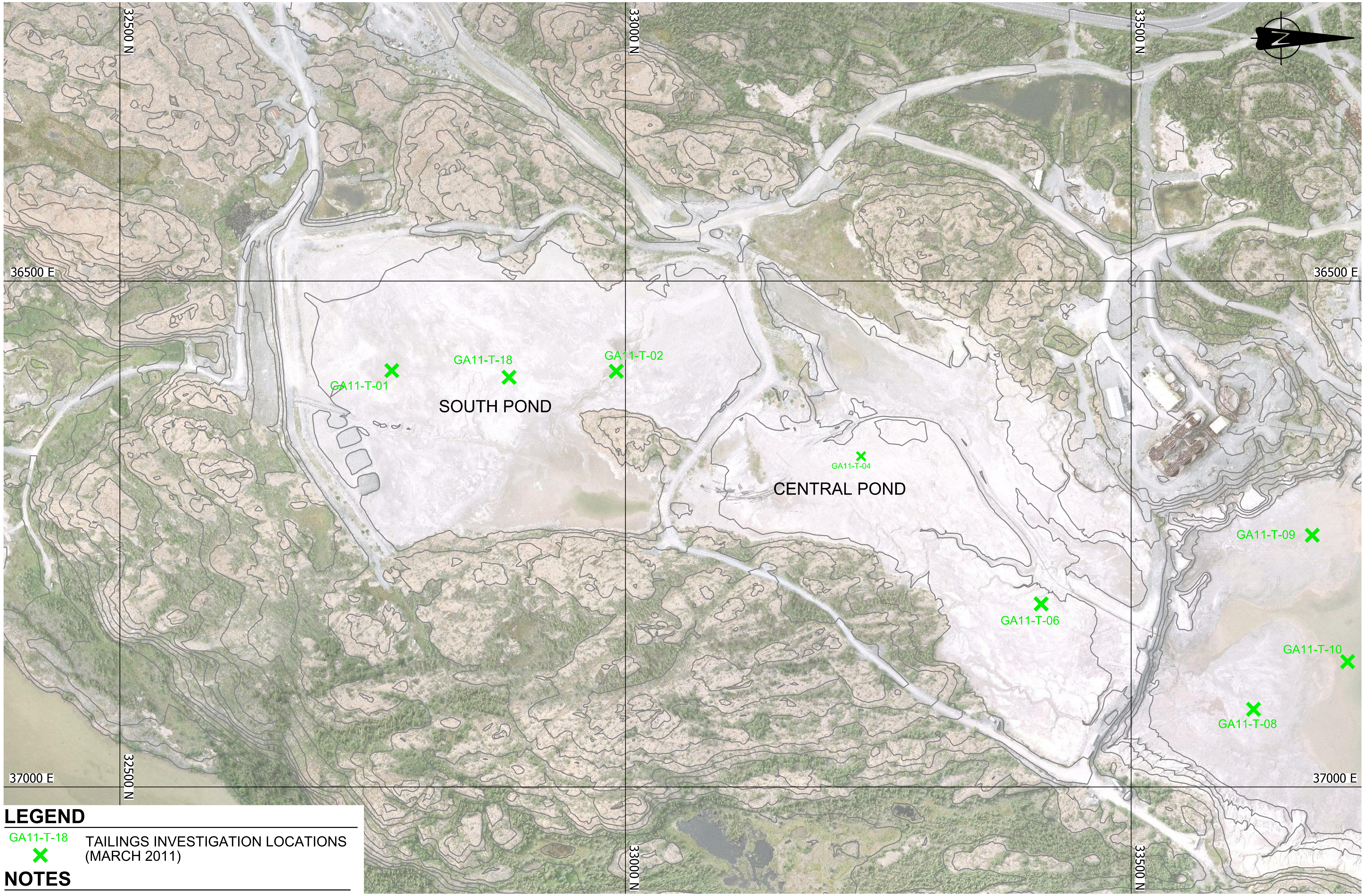
AUGER DRILLING
INVESTIGATION LOCATIONS
AT THE NORTH POND

Project No./No. du projet	Sheet/Feuille	Revision no./ La Révision no.
R.014204.307	FIGURE 3 OF 4	1

Drawing File: N:\Bur-Graphics\Projects\2009\1427\09-1427-0006\Drafting\2100\2110\AUGER DRILLING INVESTIGATION LOCATIONS AT THE NORTH POND.dwg Layout:R-014204.307_RPT-0001_CF03-R1 Wednesday, June 27, 2012 9:30:50 AM By: rhoriyck

A0 – PWGSC – ANSI B-L1 – 11X17

R-014204-30□-RPT-0001-CF03-R1



LEGEND

GA11-T-18 ✕ TAILINGS INVESTIGATION LOCATIONS (MARCH 2011)

NOTES

1. BATHYMETRIC CONTOURS SHOWN ARE IN METRES TO GMRP DATUM AT 2.5m INTERVALS.
2. COORDINATES SHOWN ARE IN METRES GMRP GRID.

REFERENCES

1. PWGSC, CAD FILE: GIANT MINE - CONTOURS (0.5m) - 2009 - GMRP.dwg, DATE RECEIVED: JANUARY 10, 2011
2. PWGSC, CAD FILE: GiantMine_GRP.sid, DATE RECEIVED: JANUARY 10, 2011

0 40 80 120 160 200
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

Golder Associates

DO NOT SCALE DRAWINGS

Revision/Révision	Description/Description	Date/Date
1	ISSUED WITH RPT-0001-REV1	2012-06-29
0	ISSUED WITH RPT-0001-REV0	2011-09-06
0	ISSUED WITH RPT-0001-REV0	2011-08-25

Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT
YELLOWKNIFE, N.W.T.

TAILINGS AREAS AND SLUDGE PONDS

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

Drawing title/Titre du dessin
AUGER DRILLING INVESTIGATION LOCATIONS AT SOUTH AND CENTRAL PONDS

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.307	FIGURE 4 OF 4	1

Drawing File: N:\Bur-Graphics\Projects\2009\1427\09-1427-0006\Drafting\2100\2110\AUGER DRILLING INVESTIG LOCATIONS AT THE SOUTH AND CENTRAL PONDS.dwg Layout:R-014204.307_RPT-0001_CF04-R1 Thursday, June 28, 2012 11:53:53 AM By: rhorlyck

A0 - PWGSC - ANSI B-L1 - 11X17

R-014204-307-RPT-0001-CF04-R1

APPENDIX A

Borehole Logs

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-01

LOCATION: See Location Plan

BORING DATE: March 8, 2011

DATUM: Geodetic

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m) | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) | WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: M5 - Track Mounted, Mobile Augers and Research Ltd.

Ground Surface

Description	Elev. / Depth (m)
SILTY SAND, little to some sand, grey (Tailings)	0.00
Sandy CLAYEY SILT, grey, soft to firm (Tailings) --- Frost penetration to 1.4 m	1.40
SILT, little to some sand, little clay, grey, soft to firm	9.45

Number	Type	Blows/0.3m	Additional Lab. Testing
1	AS		Gravel = 0%, Sand = 61.1%, Silt = 32.3%, Clay = 6.6%, non-plastic
2	SS	48	
3	AS		-0.2 °C, Gravel = 0%, Sand = 2.1%, Silt = 82.8%, Clay = 15.2%, I_p = 2
4	SH		Gravel = 0%, Sand = 0.2%, Silt = 83.9%, Clay = 15.9%, I_p = 6
5	AS		Gravel = 0%, Sand = 29.7%, Silt = 58.4%, Clay = 11.9%, non-plastic
6	SS	7	
7	AS		+2.0 °C, Gravel = 0%, Sand = 0.5%, Silt = 79.6%, Clay = 19.9%, I_p = 7
8	SS	4	
9	AS		+1.9 °C, Gravel = 0%, Sand = 15.5%, Silt = 73.8%, Clay = 10.7%, non-plastic
10	SS	4	
11	AS		+1.6 °C, Gravel = 0%, Sand = 13.8%, Silt = 75.5%, Clay = 10.7%, non-plastic
12	SS	4	
13	AS		+0.8 °C

Piezometer or standpipe installation:

Stick-up= 0.97 m

Cuttings

Bentonite Seal

18 Mar 2012 ∇

Sand

Screen Section

Slough

Slough

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-01

LOCATION: See Location Plan

BORING DATE: March 8, 2011

DATUM: Geodetic

Depth (m)	Boring Method	Description	Elev. / Depth (m)	Sample No.	Type	Blows/0.3m	Water Content	Additional Lab. Testing	Piezometer or Standpipe Installation
10	M5 - Track Mounted	SILT, little to some sand, little clay, grey, soft to firm *(continued)*						Gravel = 0% Sand = 2.4% Silt = 79.2% Clay = 18.4% I_p = 4	
				14	AS				
11	M5 - Track Mounted / Mobile Augers and Research Ltd.								
				15	SS	6		Gravel = 0% Sand = 8.3% Silt = 77.5% Clay = 14.2% I_p = 6	
12				16	AS			+0.3 °C	
13									Slough
14				17	SS	16			
15		PEAT, dark brown-black, fibrous	15.09	18	AS				
16		SILTY CLAY, trace gravel, light brown, (TILL)	15.85	19	AS				
				20	AS				
17		End of BOREHOLE.	17.53						

Notes:
Sloughing to 4.6 m.
Standpipe installed to 6.1 m.
Groundwater level measured at 3.8 mbgs on March 18, 2012.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-02

LOCATION: See Location Plan

N: 6932991 E: 636589

BORING DATE: March 9, 2011

DATUM: Geodetic

BORING METHOD: M5 - Track Mounted; Mobile Augers and Research Ltd.

SOIL PROFILE

DEPTH (m)	DESCRIPTION	ELEV. DEPTH (m)
	Ground Surface	
0	SILTY SAND, some clay, very soft to firm (Tailings)	0.00
	--- Frost penetration to 0.9 m	
2	CLAYEY SILT, some sand, very soft to firm (Tailings)	2.07
7	SAND and SILT, some clay, firm (Tailings)	7.19
9	CLAYSHALE, weathered (BEDROCK)	9.14
	End of BOREHOLE.	9.45
10	Refusal of auger at 9.8 m.	

SAMPLES AND ADDITIONAL LAB TESTING

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	SH		Gravel = 0% Sand = 55.5% Silt = 39.1% Clay = 5.4% non-plastic
3	AS		
4	SS		1 blow for 450 mm
5	AS		1.1 °C Gravel = 0% Sand = 11.5% Silt = 75.0% Clay = 13.5% non-plastic
6	SS		1 blow for 450 mm
7	AS		1.0 °C Gravel = 0% Sand = 3.8% Silt = 79.0% Clay = 17.2% I_p = 3
8	SS	5	
9	AS		1.4 °C Gravel = 0% Sand = 16.7% Silt = 69.5% Clay = 13.8% non-plastic
10	SS	5	
11	AS		1.7 °C Gravel = 0% Sand = 46.9% Silt = 42.1% Clay = 11% non-plastic
12	SS	7	
13	AS		
14	AS		

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ : 10 20 30 40

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl : 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-02

LOCATION: See Location Plan

N: 6932991 E: 636589

BORING DATE: March 9, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		Notes: Borehole backfilled with cuttings upon completion.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-04

LOCATION: See Location Plan

N: 6933233 E: 636673

BORING DATE: March 10, 2011

DATUM: Geodetic

BORING METHOD: M5 - Track Mounted; Mobile Augers and Research Ltd.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○): 10, 20, 30, 40

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT (Wp, W, Wl): 10, 20, 30, 40

PIEZOMETER OR STANDPIPE INSTALLATION: Stick-up= 0.96 m

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Ground Surface						
0	Sandy CLAYEY SILT, little clay, grey (Tailings)	0.00					
			1	AS			
1			2	SS		Refusal (frozen)	Cuttings
			3	AS		-0.4 °C	
2	--- Frost penetration to 1.8 m						
			4	SS	9	non-plastic	Bentonite Seal
3			5	AS		0.4 °C Gravel = 0% Sand = 18.9% Silt = 66% Clay = 15% non-plastic	
4			6	TO		Gravel = 0% Sand = 15.4% Silt = 71.6% Clay = 13.0%	Screen Section
5			7	AS		0.0 °C	18 Mar 2012 ▽
			8	SS	13	Gravel = 0% Sand = 51.8% Silt = 35.9% Clay = 12.2% non-plastic	
6	SANDY SILT, some clay, grey (Frozen Tailings)	5.94					
			9	AS		-0.1 °C	
7			10	SS	48	Gravel = 0% Sand = 32.1% Silt = 60.6% Clay = 7.3% non-plastic	
			11	AS		-0.1 °C	
8							Cuttings
			12	SS	27	Gravel = 0% Sand = 28.7% Silt = 63.6% Clay = 7.7%	
9							
10							

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-04

LOCATION: See Location Plan

N: 6933233 E: 636673

BORING DATE: March 10, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	M5 - Track Mounted; Mobile Augers and Research Ltd.	SANDY SILT, some clay, grey (Frozen Tailings) *(continued)*							Cuttings
					13	AS		-0.3 °C	
11									
					14	SS	27		
12									
		SANDY SILT, some clay, medium to dark grey (Tailings)		12.80					
13									
					15	AS		0.0 °C Gravel = 0% Sand = 28.1% Silt = 60% Clay = 11.9% I_p = 0	
14									
					16	SS	6		
15									
16									
					17	AS		0.1 °C	
17									
18									
19									
					18	AS		Gravel = 0% Sand = 0.4% Silt = 80.1% Clay = 19.5% non-plastic	
		PEAT, dark to light brown, fibrous		19.66					
20									

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 10, 20, 30, 40

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10, 20, 30, 40

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-04

LOCATION: See Location Plan

BORING DATE: March 10, 2011

DATUM: Geodetic

N: 6933233 E: 636673

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (10, 20, 30, 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (Wp ├──○W──┤ Wl) (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		PEAT, dark to light brown, fibrous *(continued)*			19 19	AS AS			116.2 ○		Cuttings
		End of BOREHOLE. Notes: Standpipe installed to 6.1 m. Groundwater level measured at 5.4 mbgs on March 18, 2011.		20.57							
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-06

LOCATION: See Location Plan

BORING DATE: March 10, 2011

DATUM: Geodetic

N: 6933411 E: 636819

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research Ltd.

SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
Ground Surface	
SANDY SILT, some clay, grey (Tailings)	0.00
SILT, some clay, grey (Tailings) --- Frost penetration to 2.0 m	1.71
SANDY SILT, trace clay, grey (Tailings) --- Frozen to 5.6 m	4.51

CONTINUED NEXT PAGE

SAMPLES AND ADDITIONAL LAB TESTING

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		Gravel = 0%, Sand = 26%, Silt = 69%, Clay = 5%
2	AS		Gravel = 0%, Sand = 3%, Silt = 88%, Clay = 9%
3	TO		Gravel = 0%, Sand = 7%, Silt = 89%, Clay = 4%
4	AS		Gravel = 0%, Sand = 4%, Silt = 87%, Clay = 9%
5	SS	6	
6	AS		
7	SS	17	Gravel = 0%, Sand = 38.1%, Silt = 55.0%, Clay = 6.9%
9	SS	28	Gravel = 0%, Sand = 11.1%, Silt = 85.7%, Clay = 3.2%, non-plastic
8	AS		
10	AS		
11	SS	32	Gravel = 0%, Sand = 27.2%, Silt = 71.5%, Clay = 1.3%, non-plastic

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○; 10, 20, 30, 40

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl; 10, 20, 30, 40

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 – 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-06

LOCATION: See Location Plan

BORING DATE: March 10, 2011

DATUM: Geodetic

N: 6933411 E: 636819

Boring method: M5 - Track Mounted; Mobile Augers and Research Ltd.

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT (w)	ADDITIONAL LAB. TESTING
10	SANDY SILT, trace clay, grey (Tailings) *(continued)* --- Dark grey at 10.0 m						
			12	AS		~29	Gravel = 0% Sand = 14.2% Silt = 74.9% Clay = 10.9% non-plastic
11			13	SS	13		
12							
13							
	SILTY SAND, some clay, grey (Tailings)	13.47	14	AS		~17	
14							
			15	SS	7	~24	Gravel = 0% Sand = 67.3% Silt = 26.9% Clay = 5.8% non-plastic
15							
16			16	AS		~23	
17	--- Light grey at 17.0 m						
18							
	PEAT, light-dark brown to black, fibrous	18.59	17	AS		~25	
19							
		19.81					
20							

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-06

LOCATION: See Location Plan

BORING DATE: March 10, 2011

DATUM: Geodetic

N: 6933411 E: 636819

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES – NUMBER	SAMPLES – TYPE	SAMPLES – BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10, 20, 30, 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		SAND, medium to coarse, medium to dark grey *(continued)*			18 18	AS AS			○ (approx. 18)		
		End of BOREHOLE. Note: Borehole backfilled with cuttings upon completion.		20.57							
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-08

SHEET 1 OF 1

LOCATION: See Location Plan

N: 6933621 E: 636923

BORING DATE: March 15, 2011

DATUM: Geodetic

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m) | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (10, 20, 30, 40) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) | WATER CONTENT PERCENT (Wp, W, Wl) (10, 20, 30, 40) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: M5-Track Mounted, Mobile Augers and Research Ltd.

Description	Elev. Depth (m)
Ground Surface	
SANDY SILT, some clay, medium to dark grey, very soft to soft (Tailings)	0.00
--- Frost penetration to 0.9 m	
SAND and GRAVEL	7.16
SILTY CLAY, some gravel, some fine to medium sand, suspected cobbles, light brown, (TILL)	7.92
End of BOREHOLE.	8.38

Note:
Borehole backfilled with cuttings upon completion.

Number	Type	Blows/0.3m	Additional Lab. Testing
1	AS		
2	AS		+0.4 °C
			+1.9 °C
3	SS	2	Gravel = 1.5% Sand = 19.8% Silt = 67.1% Clay = 11.5%
4	AS		+2.0 °C
5	SS	3	Gravel = 0% Sand = 28.1% Silt = 65.0% Clay = 6.9% non-plastic
6	AS		+3.0 °C
7	SS	3	Gravel = 0% Sand = 35.8% Silt = 54.5% Clay = 9.8% non-plastic
8	AS		+3.8 °C
9A	SS		Gravel = 0% Sand = 9.1% Silt = 80.5% Clay = 10.4% I_p = 5
9B	SS	11	
10	AS		

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

BOREHOLE - EXPANDED ADD. LAB TESTING DRAFT GIANT MINE LOGS.GPJ CALGARY.GDT 6/15/12

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-09

SHEET 1 OF 2

LOCATION: See Location Plan

N: 6933679 E: 636751

BORING DATE: March 14, 2011

DATUM: Geodetic

Boring method: M5-Track Mounted, Mobile Augers and Research Ltd.

Ground Surface

Depth (m)	Description	Elev. Depth (m)	Sample No.	Type	Blows/0.3m	Water content (%)	Additional lab testing
0.00	SANDY SILT, some clay, grey (Tailings)	0.00					
			1	AS		~27	
			2	TO			Gravel = 0%, Sand = 74.0%, Silt = 20.5%, Clay = 5.5%, non-plastic
			3	AS		~21	+2.0 °C, Gravel = 0%, Sand = 15.6%, Silt = 72.8%, Clay = 11.6%, non-plastic
			4	SS	3		
			5	AS		~26 (H)	+3.2 °C, Gravel = 0%, Sand = 25.6%, Silt = 64.1%, Clay = 10.3%, I_p = 1
			6	SS	0		
			7	AS		~29	
5.03	SAND and GRAVEL, some silt, grey (Tailings)	5.03	8	AS		~11	
5.79	Clayey SANDY SILT, grey, soft to stiff (Tailings)	5.79	9	AS		~20 (H)	Gravel = 0.4%, Sand = 10.0%, Silt = 75.3%, Clay = 14.3%, I_p = 1
			10	AS		~22	+4.7 °C, Gravel = 1.1%, Sand = 14.3%, Silt = 68.5%, Clay = 16.1%, non-plastic
	--- Trace to some organic soil at 8.5 m		11	SS	10	~29	
9.14	PEAT, dark brown to black, fibrous	9.14	12	AS		~26	
9.45	SILTY CLAY, trace to little gravel, grey, (TILL)	9.45	13	AS		~37	

CONTINUED NEXT PAGE

Column headings: DEPTH SCALE METRES; BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.3m); DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-09

LOCATION: See Location Plan

N: 6933679 E: 636751

BORING DATE: March 14, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10											
		End of BOREHOLE. Note: Borehole backfilled with cuttings upon completion.		10.21							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

RECORD OF BOREHOLE: GA11-T-10

PROJECT No.: 09-1427-0006

LOCATION: See Location Plan

N: 6933714 E: 636876

BORING DATE: March 15, 2011

SHEET 1 OF 1

DATUM: Geodetic

BORING METHOD: M5-Track Mounted; Mobile Augers and Research Ltd.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80)

SHEAR STRENGTH Cu, kPa (10, 20, 30, 40) — nat V. + Q - ●; rem V. ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3})

WATER CONTENT PERCENT (10, 20, 30, 40) — Wp ⊢—○W—⊣ Wl

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
	Ground Surface	
0	SILT and SAND, some clay, grey (Tailings)	0.00
	--- Frost penetration to 1.4 m	
3	Clayey SANDY SILT, little to some fine sand, (Tailings)	2.90
	--- Trace organics at 7.9 m	
8	CLAYEY SILT, trace gravel, grey, (TILL)	8.23
9	End of BOREHOLE.	8.84

Note:
Borehole backfilled with cuttings upon completion.

SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	AS		
2	AS		+1.1 °C, Gravel = 0%, Sand = 49.4%, Silt = 40.9%, Clay = 9.7%, non-plastic
3	SS	1	
4	AS		Gravel = 0%, Sand = 16.9%, Silt = 71.4%, Clay = 11.8%, non-plastic
5	SS	1	
6	AS		+3.4 °C, Gravel = 0%, Sand = 16.9%, Silt = 71.4%, Clay = 11.8%, non-plastic
7	SS	4	
8	AS		+2.4 °C
9	SS	0	
10	AS		+4.7 °C, Gravel = 0%, Sand = 1.4%, Silt = 82.7%, Clay = 15.9%, I_p = 5
11	SS	13	

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-11

SHEET 1 OF 2

LOCATION: See Location Plan

BORING DATE: March 15, 2011

DATUM: Geodetic

N: 6934000 E: 637173

BORING METHOD: M5 - Track Mounted; Mobile Augers and Research Ltd.

Ground Surface

Piezometer: Stick-up= 0.92 m

Depth (m)	Description	Elev./Depth (m)	Sample No.	Type	Blows/0.3m	Water content / Wp–Wl	Additional Lab. Testing	Piezometer or Standpipe Installation
0	CLAYEY SILT, grey, soft to firm (Tailings)	0.00						Cuttings
			1	AS		○		
	--- Frost penetration to 0.8 m						+0.5 °C	
			2	AS		○		
							+1.7 °C	
2.29	SANDY SILT, some clay, light grey (Tailings)	2.29						
			3	TO		Wp–Wl	Gravel = 0%, Sand = 19.8%, Silt = 68.9%, Clay = 11.9%, I_p = 3	Cuttings
			4	AS		○	+3.4 °C	
3.66	CLAYEY SILT, grey to brown, soft (Tailings)	3.66						
			5	SS	3	○	Gravel = 0%, Sand = 1.2%, Silt = 81.5%, Clay = 17.3%	
			6	AS		○		
			7	SS	5	Wp–Wl, ○	Gravel = 0%, Sand = 0.5%, Silt = 85.2%, Clay = 14.2%, I_p = 4	
			8	AS		○	+4.1 °C	Bentonite Seal
			9	SS	4	Wp–Wl, ○	Gravel = 0%, Sand = 0.6%, Silt = 86.4%, Clay = 13.0%, I_p = 2	
			10	AS		○	+4.2 °C	
								Screen Section
			11	SS	4	○	Gravel = 0%, Sand = 0.6%, Silt = 85.6%, Clay = 13.9%, non-plastic	
								18 Mar 2011 ▽
10								Cuttings

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Column scales: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (10, 20, 30, 40) nat V. + Q - ●, rem V. ⊕ U - ○; HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40)

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-11

LOCATION: See Location Plan

N: 6934000 E: 637173

BORING DATE: March 15, 2011

DATUM: Geodetic

Boring method: M5 - Track Mounted; Mobile Augers and Research Ltd.

Description	Elev. / Depth (m)	Sample Number	Type	Blows/0.3m	Additional Lab. Testing	Piezometer or Standpipe Installation
CLAYEY SILT, grey to brown, soft (Tailings) *(continued)*		12	AS		+4.4 °C	Cuttings
		13	SS	7	Gravel = 0% Sand = 0.3% Silt = 82.6% Clay = 17.1% non-plastic	
PEAT, brown, stiff, fibrous	12.19	14	AS			
SILTY CLAY, trace gravel, brown, (TILL)	13.11	15	AS			
SILTY SAND, fine to medium, trace to little clay, grey	14.02	16	AS			
End of BOREHOLE.	14.48					

Water content for sample 14 is labelled 63.9 on the plot.

Notes:
Standpipe installed to 9.7 m.
Groundwater level measured at 9.2 mbgs on March 18, 2011.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-12

LOCATION: See Location Plan

N: 6934533 E: 636085

BORING DATE: March 12, 2011

DATUM: Geodetic

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research Ltd.

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
0	Ground Surface					
	SANDY SILT, light grey, soft to firm (Tailings)	0.00	1	AS		-3.2 °C; Gravel = 0%; Sand = 24%; Silt = 68%; Clay = 8%
1.5	SILT and SAND to SILTY SAND, soft to firm (Tailings) --- Frost penetration to 1.5 m	1.49	2	AS		+1.5 °C; Gravel = 0%; Sand = 54%; Silt = 42%; Clay = 4%
			3	SS	6	Gravel = 0%; Sand = 73%; Silt = 24%; Clay = 3%
			4	AS		Gravel = 0%; Sand = 23%; Silt = 72%; Clay = 5%
3.66	SILT to SANDY SILT, some clay, light to dark grey, very soft to firm (Tailings)	3.66	5	TO		Gravel = 0%; Sand = 47%; Silt = 51%; Clay = 2%
			6	AS		Gravel = 0%; Sand = 22.2%; Silt = 75.4%; Clay = 2.4%; non-plastic
			7	SS	2	
			8	AS		Gravel = 0%; Sand = 2.0%; Silt = 91.1%; Clay = 6.9%; non-plastic
7	--- Soft at 7.0 m		9	SS	3	
			10	AS		Gravel = 0%; Sand = 3.2%; Silt = 89.2%; Clay = 7.6%; I_p = 4
8.5	--- Firm at 8.5 m		11	SS	5	
10						

Column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION

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DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-12

LOCATION: See Location Plan

N: 6934533 E: 636085

BORING DATE: March 12, 2011

DATUM: Geodetic

Boring method: M5 - Track Mounted, Mobile Augers and Research Ltd.

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	ADDITIONAL LAB. TESTING
10	SILT to SANDY SILT, some clay, light to dark grey, very soft to firm (Tailings) *(continued)*				
			12	AS	
12			13	AS	Gravel = 0%, Sand = 30.3%, Silt = 67.7%, Clay = 2.0%, non-plastic
			14	AS	
15			15	AS	Gravel = 0%, Sand = 32.6%, Silt = 47.4%, Clay =20.0%, non-plastic
			16	AS	
18			17	AS	Gravel = 0%, Sand = 14.0%, Silt = 83.6%, Clay = 2.4%, non-plastic
	CLAY, trace silt, trace gravel, interbedded fine to medium sand layers, brown, (TILL)	19.20			
20			18	AS	

Column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. +, Q - ●, rem V. ⊕, U - ○; 10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl; 10, 20, 30, 40); STRATA PLOT; BLOWS/0.3m; PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-12

LOCATION: See Location Plan

N: 6934533 E: 636085

BORING DATE: March 12, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10 20 30 40)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		CLAY, trace silt, trace gravel, interbedded fine to medium sand layers, brown, (TILL) *(continued)*			18	AS					
		End of BOREHOLE.		20.57							
21		Note: Borehole backfilled with cuttings upon completion.									
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-13

LOCATION: See Location Plan

N: 6934651 E: 635866

BORING DATE: March 12, 2011

DATUM: Geodetic

Boring method: M5 - Track Mounted, Mobile Augers and Research Ltd.

Ground Surface

Depth (m)	Description	Elev./Depth (m)	Sample No.	Type	Blows/0.3m	Additional Lab. Testing	Piezometer or Standpipe Installation
0	CLAYEY SILT, trace to some fine sand, grey, very soft (Tailings)	0.00					Stick-up= 0.96 m
			1	AS			
1	--- Frost penetration to 1.1 m						Cuttings
			2	AS			
2			3	TO		Gravel = 0% Sand = 0.0% Silt = 83.2% Clay = 16.8%	
							Bentonite Seal
3			4	AS			
4			5	SS	1		18 Mar 2011 (water level)
			6	AS		Gravel = 0% Sand = 11.6% Silt = 74.9% Clay = 13.5% non-plastic	Screen Section
5			7	SS	2		
6			8	AS		Gravel = 0% Sand = 2.5% Silt = 86.7% Clay = 10.8% non-plastic	
7	--- Soft at 7.1 m		9	SS	4		
			10	AS		Gravel = 0% Sand = 3.2% Silt = 81.7% Clay = 15.1% non-plastic	Cuttings
8	--- Firm at 8.5 m		11	SS	6		
9			12	AS		Gravel = 0% Sand = 1.0% Silt = 83.1% Clay = 15.9% non-plastic	
10							

Chart columns: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa — nat V. + Q - ●, rem V. ⊕ U - ○ (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT, Wp —○W— Wl (10, 20, 30, 40).

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-13

SHEET 2 OF 2

LOCATION: See Location Plan

N: 6934651 E: 635866

BORING DATE: March 12, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
10	M5 - Track Mounted, Mobile Augers and Research Ltd.	CLAYEY SILT, trace to some fine sand, grey, very soft (Tailings) *(continued)*					Cuttings
				13	AS		
11							
12		SILTY CLAY, trace to little gravel, light to medium brown, (TILL)	11.89				
				14	AS		
13		End of BOREHOLE. Notes: Standpipe installed to 6.1 m. Groundwater level measured at 4.1 mbgs on March 18, 2011.	12.95				
14							
15							
16							
17							
18							
19							
20							

Column headings: SOIL PROFILE; SAMPLES; STRATA PLOT; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40); ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-14

LOCATION: See Location Plan

N: 6934668 E: 636033

BORING DATE: March 13, 2011

DATUM: Geodetic

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80

SHEAR STRENGTH Cu, kPa (nat V. + , Q - ●, rem V. ⊕, U - ○): 10, 20, 30, 40

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}

WATER CONTENT PERCENT (Wp ⊢—○W—⊣ Wl): 10, 20, 30, 40

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research, Ltd.

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
0	Ground Surface					
	CLAYEY SILT, trace sand, grey, very soft (Tailings)	0.00				
			1	AS		
1						
	--- Frost penetration at 1.4 m					
			2	AS		
2						AS2+SS3 Gravel = 0% Sand = 4% Silt = 90% Clay = 6%
			3	SS	1	
3			4	AS		+2.6 °C
4			5	SS	2	
			6	AS		+1.2 °C Gravel = 0% Sand = 0.2% Silt = 85.1% Clay = 14.7% I_p = 5
5						
	--- Soft at 5.5 m		7	SS	4	
6			8	AS		+1.7 °C Gravel = 0% Sand = 0% Silt = 85.6% Clay = 14.4% non-plastic
7			9	SS	4	
			10	AS		+1.6 °C Gravel = 0% Sand = 0.3% Silt = 85.0% Clay = 14.7% I_p = 6
8						
	--- Very soft at 8.5 m		11	SS	2	
9						
10						

PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-14

LOCATION: See Location Plan

N: 6934668 E: 636033

BORING DATE: March 13, 2011

DATUM: Geodetic

BORING METHOD: M5 - Track Mounted; Mobile Augers and Research, Ltd.

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	CLAYEY SILT, trace sand, grey, very soft (Tailings) *(continued)*					
			12	AS		+3.0 °C Gravel = 1.8% Sand = 3.5% Silt = 67.2% Clay = 27.5% I_p = 10
11	--- Firm at 11.6 m		13	SS	5	
12						
13			14	AS		+3.0 °C Gravel = 0.0% Sand = 2.1% Silt = 80.3% Clay = 17.7% I_p = 1
14	SILTY CLAY to CLAY, trace gravel, brown, (TILL)	14.33				
			15	AS		+4.3 °C
15–16	CLAYEY SILT, light grey	16.46	16	AS		
17	End of BOREHOLE.	17.68				

Note:
Borehole backfilled with cuttings upon completion.

Chart column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - O (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—O W—⊣ Wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-15

SHEET 1 OF 1

LOCATION: See Location Plan

BORING DATE: March 13, 2011

DATUM: Geodetic

N: 6934801 E: 636249

Boring method: M5 - Track Mounted, Mobile Augers and Research Ltd.

Depth (m)	Description	Elev. / Depth (m)	Sample No.	Type	Blows/0.3m	Additional Lab. Testing
	Ground Surface					
0	Sandy CLAYEY SILT, mottled brown and grey, firm (Tailings)	0.00				
			1	AS		
1.5	--- Frost penetration at 1.5 m					
			2	AS		+3.0 °C
			3	SS	8	Gravel = 0% Sand = 21.6% Silt = 69.7% Clay = 8.6%
			4	AS		+2.4 °C
3.20	SANDY SILT, some clay, grey, firm (Tailings)	3.20				
			5	SS	7	Gravel = 0% Sand = 40.7% Silt = 52.0% Clay = 7.4%
			6	AS		+4.2 °C
			7A	SS	5	Gravel = 0% Sand = 19.7% Silt = 65.6% Clay = 14.6%
5.72	SILTY CLAY, trace to some fibrous peat, little to some gravel, grey to brown, (TILL)	5.72	7B	SS		
			8	AS		
7.16	End of BOREHOLE. Note: Borehole backfilled with cuttings upon completion.	7.16				

Water content plotted (Wp —○W— Wl, percent, scale 10–40) for samples 1 through 8. Other chart columns: Dynamic Penetration Resistance, Blows/0.3m (20, 40, 60, 80); Shear Strength Cu, kPa (nat V. +, Q - ●, rem V. ⊕, U - ○; 10, 20, 30, 40); Hydraulic Conductivity, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); Piezometer or Standpipe Installation.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-16

SHEET 1 OF 2

LOCATION: See Location Plan

N: 6935455 E: 635750

BORING DATE: March 14, 2011

DATUM: Geodetic

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) | SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10, 20, 30, 40) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) | WATER CONTENT PERCENT (Wp ⊢—○W—⊣ Wl) (10, 20, 30, 40) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research Ltd.

Ground Surface

Description	Elev. Depth (m)	Sample Number	Type	Blows/0.3m	Additional Lab. Testing
SILTY SAND, some clay, grey, very soft to soft (Tailings)	0.00				
		1	AS		
--- Frost penetration at 1.4 m					
		2	AS		+0.6 °C
		3	SS	1	Gravel = 0% Sand = 58.5% Silt = 30.4% Clay = 11.1% non-plastic
		4	AS		
		5	SS	3	
CLAYEY SILT, some sand, grey, soft (Tailings)	4.42				
		6	AS		+1.9 °C Gravel = 0% Sand = 4.5% Silt = 82.0% Clay = 13.5% I_p = 0
		7	SS	3	
		8	AS		+2.0 °C Gravel = 0% Sand = 14.4% Silt = 75.6% Clay = 10.0% non-plastic
		9	SS	3	
		10	AS		+0.6 °C Gravel = 0% Sand = 6.7% Silt = 80.0% Clay = 13.3% non-plastic
		11	SS	4	

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-16

LOCATION: See Location Plan

BORING DATE: March 14, 2011

DATUM: Geodetic

N: 6935455 E: 635750

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (10 20 30 40) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	M5 - Track Mounted; Mobile Augers and Research Ltd.	CLAYEY SILT, some sand, grey, soft (Tailings) *(continued)*									
11					12	AS			○	Gravel = 0% Sand = 1.0% Silt = 83.9% Clay = 15.0% non-plastic	
					13A	SS			○		
		SILTY CLAY, trace gravel, brown, (TILL)		11.58	13B	SS	34		○		
12											
		End of BOREHOLE. Refusal of auger at 12.3 m. Notes: Borehole backfilled with cuttings upon completion.		12.34							
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-17

SHEET 1 OF 2

LOCATION: See Location Plan

BORING DATE: March 13, 2011

DATUM: Geodetic

N: 6935296 E: 636117

Boring method: M5 - Track Mounted, Mobile Augers and Research Ltd.

Ground Surface

Sandy CLAYEY SILT, grey, very soft to soft (Tailings) — Elev./Depth 0.00 m

--- Frost penetration to 1.7 m

Depth (m)	Sample No.	Type	Blows/0.3m	Additional Lab. Testing
~0.8	1	AS		
~2.0	2	AS		+1.0 °C
~2.5	3	SS	4	Gravel = 0%, Sand = 18.4%, Silt = 67.7%, Clay = 13.9%
~3.2	4	AS		+2.6 °C
~4.0	5	SS	2	Gravel = 0%, Sand = 16.3%, Silt = 71.1%, Clay = 12.6%, non-plastic
~4.7	6	AS		+3.4 °C
~5.6	7	SS	4	Gravel = 0%, Sand = 34.7%, Silt = 58.7%, Clay = 6.6%
~6.2	8	AS		
~7.1	9	SS	2	Gravel = 0%, Sand = 19.1%, Silt = 69.0%, Clay = 11.9%, non-plastic
~7.7	10A	AS		+3.5 °C, I_p = 0
~8.6	10B	SS	4	Gravel = 0%, Sand = 4.2%, Silt = 82.5%, Clay = 13.3%

Column headings: DEPTH SCALE METRES; BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.3m); DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-17

LOCATION: See Location Plan

N: 6935296 E: 636117

BORING DATE: March 13, 2011

DATUM: Geodetic

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT (W)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	M5 - Track Mounted; Mobile Augers and Research Ltd.	Sandy CLAYEY SILT, grey, very soft to soft (Tailings) *(continued)*							
				11	AS		○	+2.7 °C	
11									
		--- Firm at 11.6 m		12	SS	6	○, Wp–Wl	Gravel = 0% Sand = 0.1% Silt = 84.1% Clay = 15.8% I_p = 2	
12									
13									
				13	AS		○	+3.6 °C	
14									
		SILTY CLAY, medium sand pockets, mottled brown and grey	14.48						
15									
				14	AS		○		
16									
		End of BOREHOLE. Note: Borehole backfilled with cuttings upon completion.	16.31						
17									
18									
19									
20									

Chart headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT, Wp —○W— Wl (10, 20, 30, 40)

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

DATA ENTRY: AD

PROJECT No.: 09-1427-0006

RECORD OF BOREHOLE: GA11-T-18

LOCATION: See Location Plan

BORING DATE: March 20, 2011

DATUM: Geodetic

N: 6932885 E: 636595

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research Ltd.

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	Ground Surface					
0	SILT, little to some clay, trace to some sand, light to dark grey, very soft (Tailings)	0.00				
			1	AS		
1						
	--- Frost penetration to 1.7 m					
2			2	AS		+0.9 °C
			3	SS	2	
3						
			4	AS		+1.4 °C
4						
			5	SS	1	
5			6	AS		
6			7	SS	0	
			8	AS		+2.2 °C
7			9	SS	1	
8			10	AS		+1.7 °C
9			11	SS	0	
			12	AS		+2.9 °C
10						

Column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40); STRATA PLOT; PIEZOMETER OR STANDPIPE INSTALLATION

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB

CHECKED: HK

RECORD OF BOREHOLE: GA11-T-18

PROJECT No.: 09-1427-0006
LOCATION: See Location Plan
N: 6932885 E: 636595
BORING DATE: March 20, 2011
DATUM: Geodetic

BORING METHOD: M5 - Track Mounted, Mobile Augers and Research Ltd.

DEPTH SCALE METRES	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	SILT, little to some clay, trace to some sand, light to dark grey, very soft (Tailings) *(continued)*			13	SS	0	
11				14	AS		+2.4 °C
12				15A	SS	8	
				15B	SS		
	PEAT, dark brown to black, fibrous		12.65				
13	SILTY CLAY, trace organic fibers, trace wood chips, light to dark brown		13.26	16	AS		+3.4 °C
14							
	End of BOREHOLE.		14.78				
15	Note: Borehole backfilled with cuttings upon completion.						

Column headings also include: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (10, 20, 30, 40); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10, 20, 30, 40); PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: JJB
CHECKED: HK

APPENDIX B

Laboratory Test Results

Atterbergs

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	10-May-11

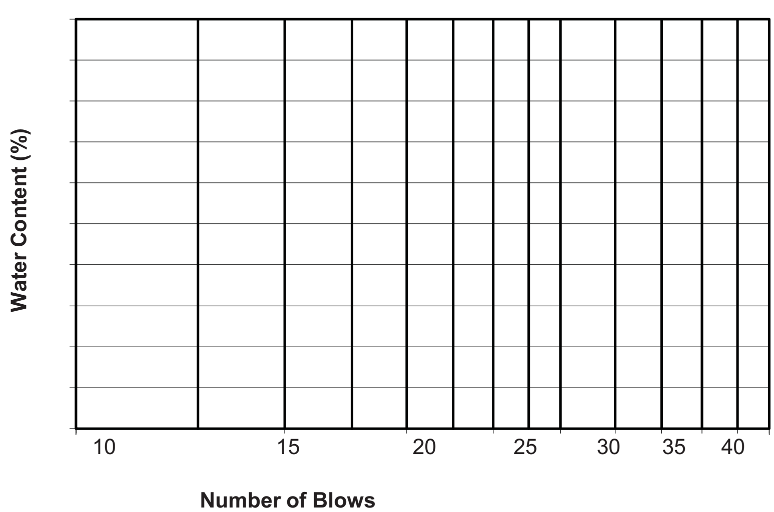
Borehole: GA11-T-01 Sample # : SA1 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 14:29:27 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

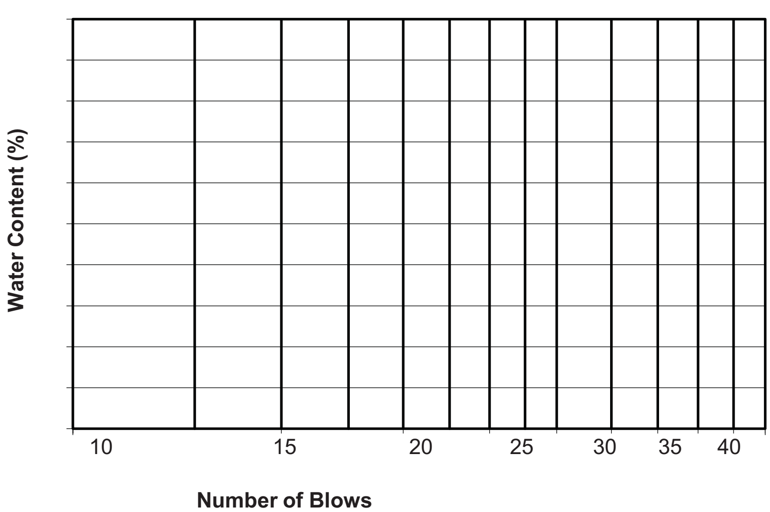
Borehole: GA11-T-01 Sample # : 3 Depth:

Plastic Limit Determination:

Tare #	A						
Mass of wet sample + tare (g)	21.72						
Mass of dry sample + tare (g)	20.36						
Mass of water (g)	1.36						
Mass of tare (g)	14.25						
Mass of dry soil (g)	6.11						
Water content (%)	22.26						

Liquid Limit Determination:

Number of Blows	35	33					
Tare #	B	C					
Mass of wet sample + tare (g)	43.47	39.18					
Mass of dry sample + tare (g)	37.63	34.40					
Mass of water (g)	5.84	4.78					
Mass of tare (g)	13.32	14.55					
Mass of dry soil (g)	24.31	19.85					
Water content (%)	24.02	24.08					
Correction factor	1.022	1.022					
Corrected Limit	24.55	24.61					



Plastic Limit: 22

Liquid Limit: 25

Plasticity Index: 2

Comments:

Digitally signed by Dave
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Date: 2011.05.09 13:59:03 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	10-May-11

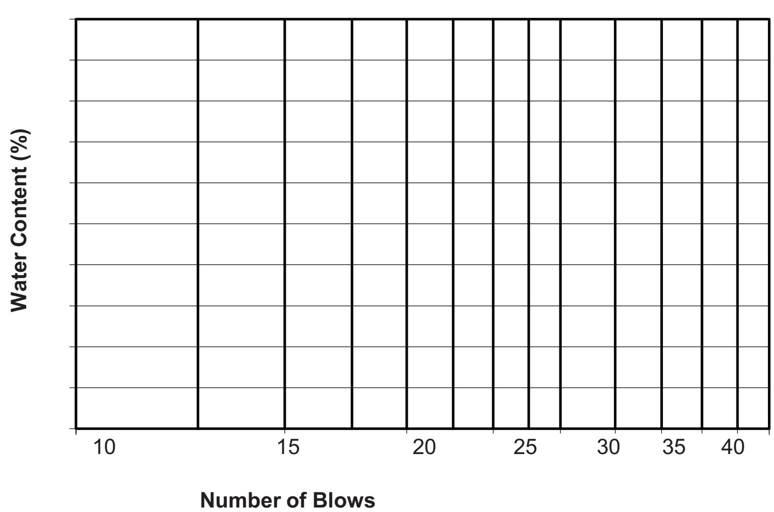
Borehole: GA11-T-01 Sample # : 4 Depth: 7.5-10'

Plastic Limit Determination:

Tare #	A						
Mass of wet sample + tare (g)	20.51						
Mass of dry sample + tare (g)	19.21						
Mass of water (g)	1.30						
Mass of tare (g)	14.26						
Mass of dry soil (g)	4.95						
Water content (%)	26.26						

Liquid Limit Determination:

Number of Blows	15	16					
Tare #	PG-27	PG-25					
Mass of wet sample + tare (g)	65.77	70.68					
Mass of dry sample + tare (g)	56.94	60.47					
Mass of water (g)	8.83	10.21					
Mass of tare (g)	31.17	30.21					
Mass of dry soil (g)	25.77	30.26					
Water content (%)	34.26	33.74					
Correction factor	1.066	1.066					
Corrected Limit	32.14	31.65					



Plastic Limit:	26
Liquid Limit:	32
Plasticity Index:	6

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 14:29:11 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	16-May-11

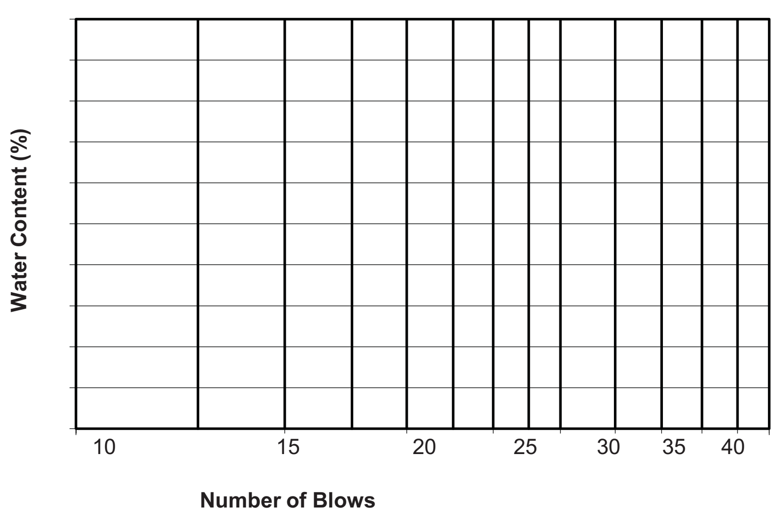
Borehole: GA11-T-01 Sample # : 5 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
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Date: 2011.05.24 15:39:14 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

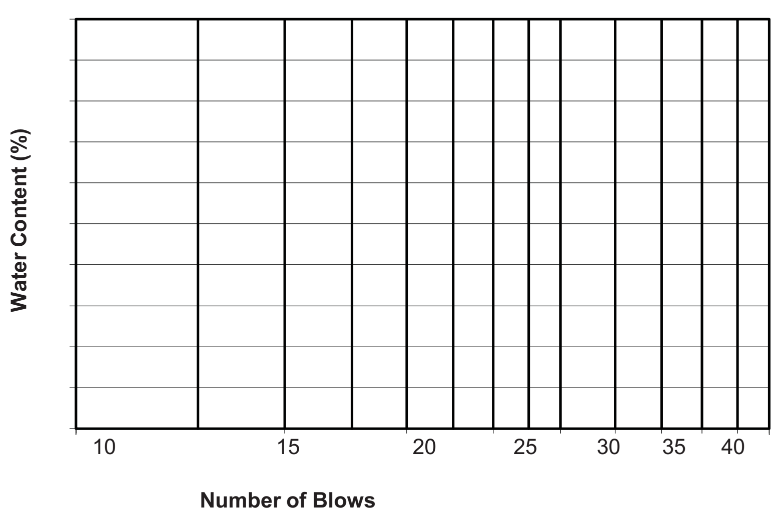
Borehole: GA11-T-01 Sample # : 7 Depth:

Plastic Limit Determination:

Tare #	114						
Mass of wet sample + tare (g)	22.53						
Mass of dry sample + tare (g)	20.88						
Mass of water (g)	1.65						
Mass of tare (g)	14.24						
Mass of dry soil (g)	6.64						
Water content (%)	24.85						

Liquid Limit Determination:

Number of Blows	17	17					
Tare #	17	88					
Mass of wet sample + tare (g)	36.03	40.85					
Mass of dry sample + tare (g)	30.59	34.26					
Mass of water (g)	5.44	6.59					
Mass of tare (g)	14.39	14.48					
Mass of dry soil (g)	16.20	19.78					
Water content (%)	33.58	33.32					
Correction factor	1.050	1.050					
Corrected Limit	31.98	31.73					



Plastic Limit:	25
Liquid Limit:	32
Plasticity Index:	7

Comments:

Digitally signed by Dave
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Date: 2011.05.09 13:58:44 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

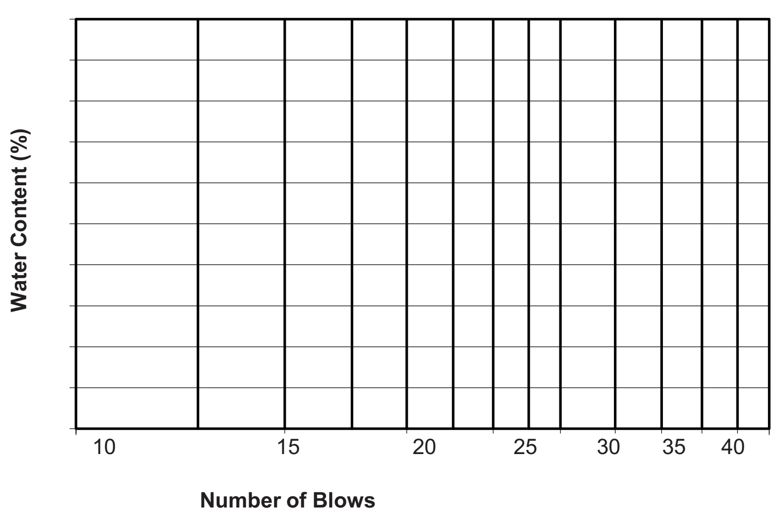
Borehole: GA11-T-01 Sample # : 9 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0
Liquid Limit: 0
Plasticity Index: 0

Comments: Non-plastic

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Date: 2011.05.09 13:48:48 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

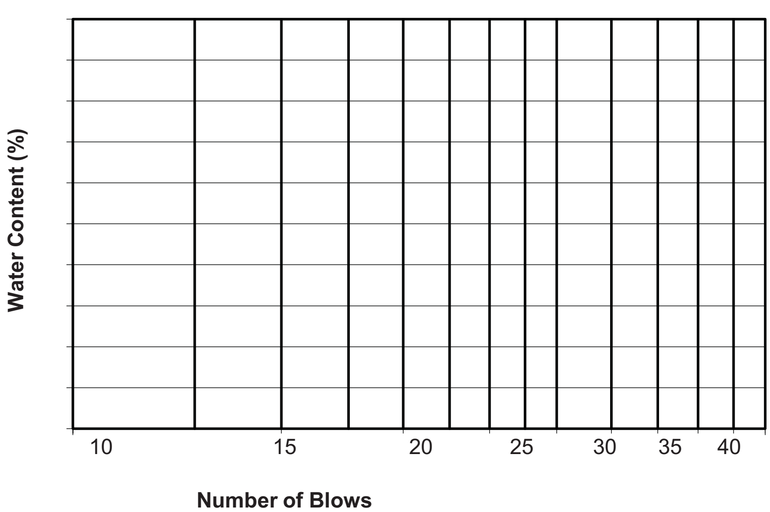
Borehole: GA11-T-01 Sample # : 11 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
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Date: 2011.05.09 13:37:10 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-.1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	28-May-11

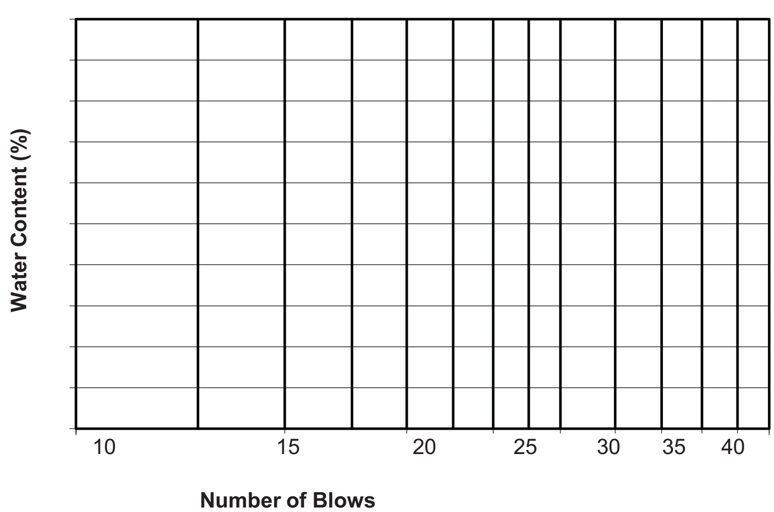
Borehole: GA11-T-01 Sample # : SA15 Depth: 37.5-39'

Plastic Limit Determination:

Tare #	PG-37						
Mass of wet sample + tare (g)	33.08						
Mass of dry sample + tare (g)	32.74						
Mass of water (g)	0.34						
Mass of tare (g)	30.68						
Mass of dry soil (g)	2.06						
Water content (%)	16.50						

Liquid Limit Determination:

Number of Blows	21	21					
Tare #	202	207					
Mass of wet sample + tare (g)	53.65	53.85					
Mass of dry sample + tare (g)	50.07	50.23					
Mass of water (g)	3.58	3.62					
Mass of tare (g)	34.56	34.50					
Mass of dry soil (g)	15.51	15.73					
Water content (%)	23.08	23.01					
Correction factor	0.979	0.979					
Corrected Limit	22.60	22.53					



Plastic Limit:	17
Liquid Limit:	23
Plasticity Index:	6

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.30 16:21:14 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	10-May-11

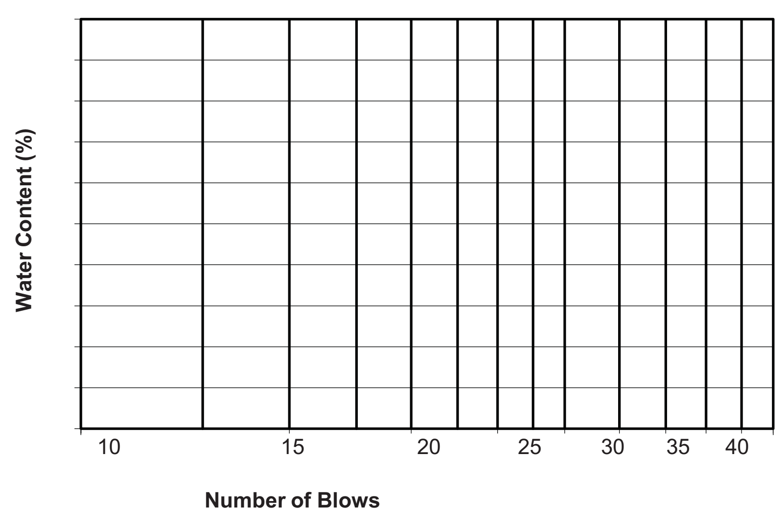
Borehole: GA11-T-02 Sample # : 2 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.05.11 14:31:56 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	16-May-11

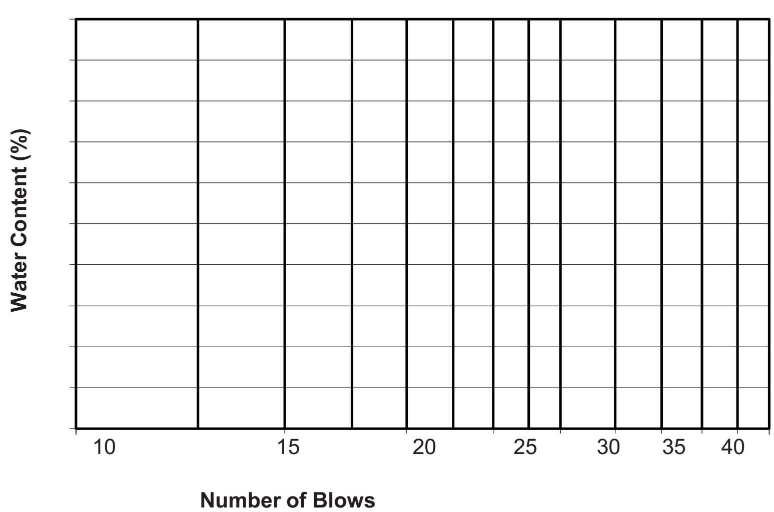
Borehole: GA11-T-02 Sample # : 5 Depth: 10-11'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.24 15:38:56 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

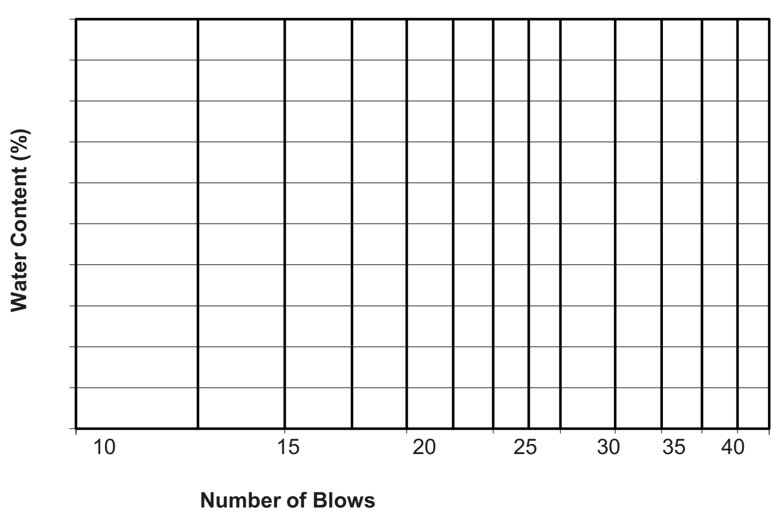
Borehole: GA11-T-02 Sample # : 7 Depth: 15-16'

Plastic Limit Determination:

Tare #	1						
Mass of wet sample + tare (g)	21.70						
Mass of dry sample + tare (g)	20.32						
Mass of water (g)	1.38						
Mass of tare (g)	14.39						
Mass of dry soil (g)	5.93						
Water content (%)	23.27						

Liquid Limit Determination:

Number of Blows	20	20					
Tare #	2	3					
Mass of wet sample + tare (g)	35.32	48.27					
Mass of dry sample + tare (g)	30.88	41.21					
Mass of water (g)	4.44	7.06					
Mass of tare (g)	14.28	14.46					
Mass of dry soil (g)	16.60	26.75					
Water content (%)	26.75	26.39					
Correction factor	0.973	0.973					
Corrected Limit	26.02	25.68					



Plastic Limit: 23

Liquid Limit: 26

Plasticity Index: 3

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:01:23 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	16-May-11

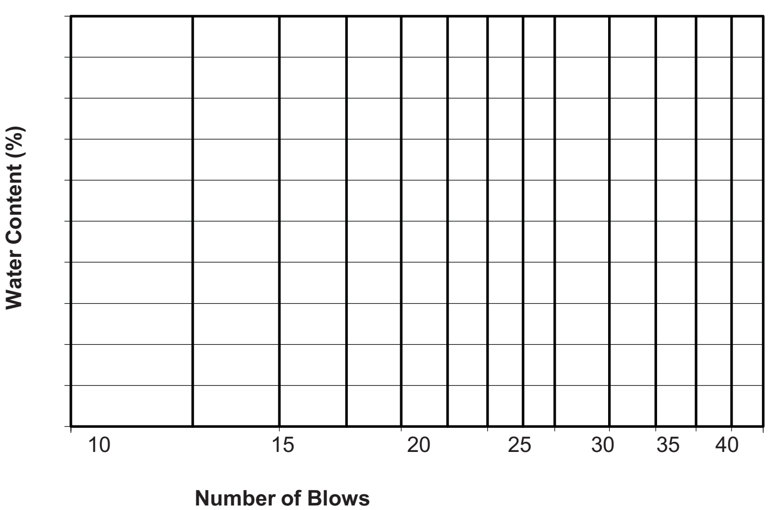
Borehole: GA11-T-02 Sample # : SA7 Depth: 15-16'

Plastic Limit Determination:

Tare #	240						
Mass of wet sample + tare (g)	45.56						
Mass of dry sample + tare (g)	43.91						
Mass of water (g)	1.65						
Mass of tare (g)	35.84						
Mass of dry soil (g)	8.07						
Water content (%)	20.45						

Liquid Limit Determination:

Number of Blows	21	22					
Tare #	256	434					
Mass of wet sample + tare (g)	63.36	65.67					
Mass of dry sample + tare (g)	57.78	59.64					
Mass of water (g)	5.58	6.03					
Mass of tare (g)	35.13	34.81					
Mass of dry soil (g)	22.65	24.83					
Water content (%)	24.64	24.29					
Correction factor	0.979	0.985					
Corrected Limit	24.12	23.92					



Plastic Limit:	20
Liquid Limit:	24
Plasticity Index:	4

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.24 15:38:39 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #: 09-1427-0006 Phase: 2100

Short Title: Giant Mine

Tested By: HVD Date: 16-May-11

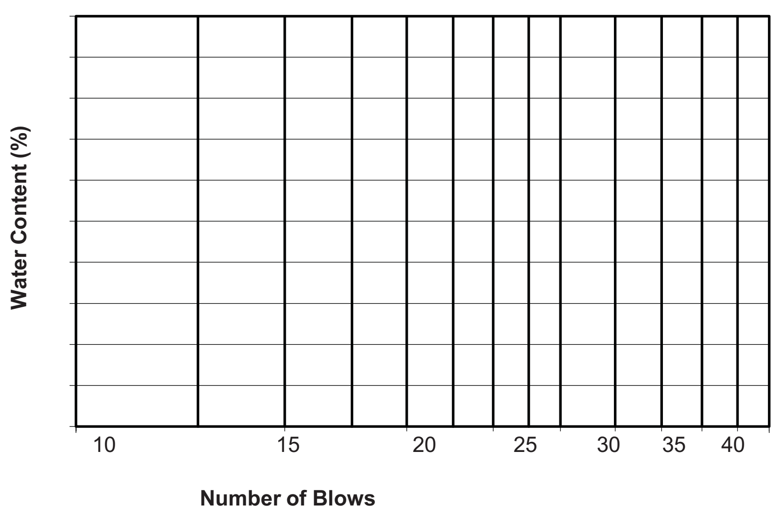
Borehole: GA11-T-02 Sample # : 9 Depth: 20-21'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.24 15:38:23 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	16-May-11

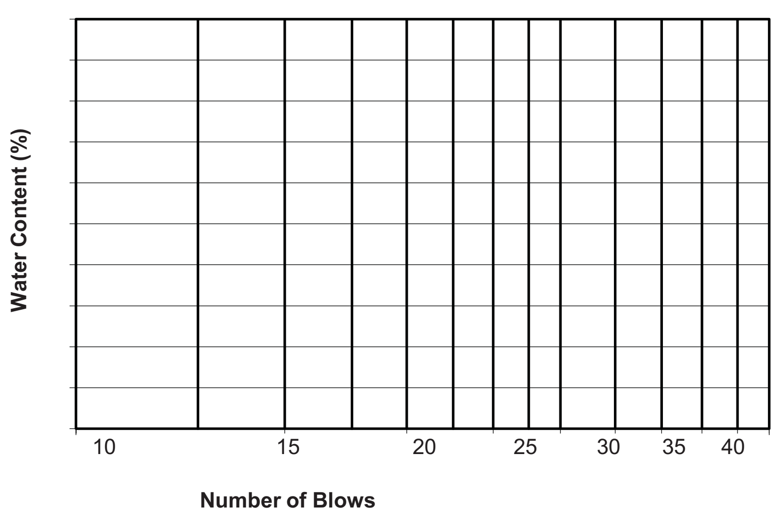
Borehole: GA11-T-02 Sample # : 11 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.24 15:37:51 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	16-May-11

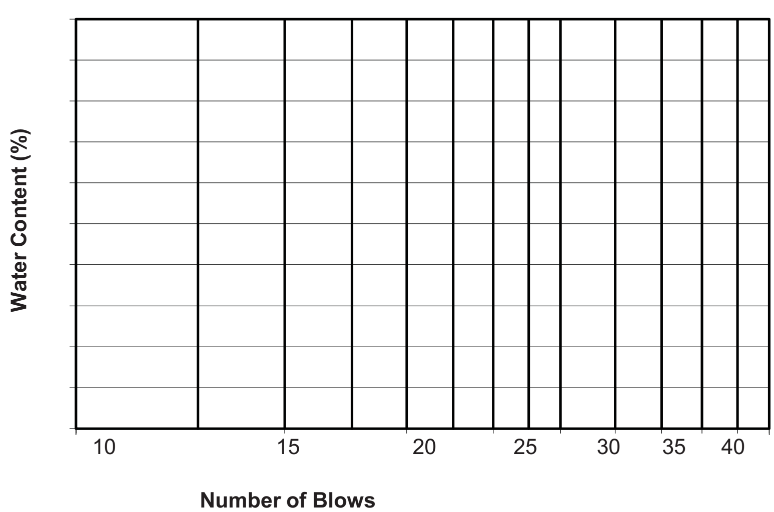
Borehole: GA11-T-04 Sample # : 5 Depth: 10-11'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.24 15:40:52 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006
Phase:	2500
Short Title:	Giant Mine
Tested By:	HVD
Date:	24-May-11

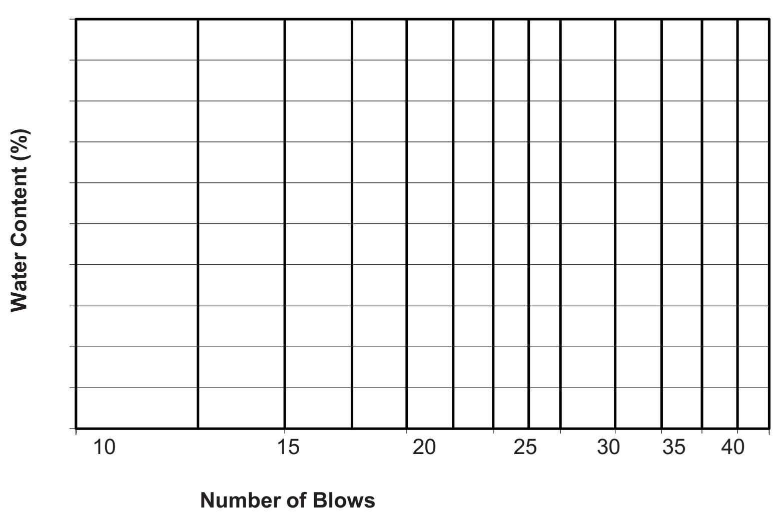
Borehole: GA11-T-04 Sample # : SA6 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:31:04 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

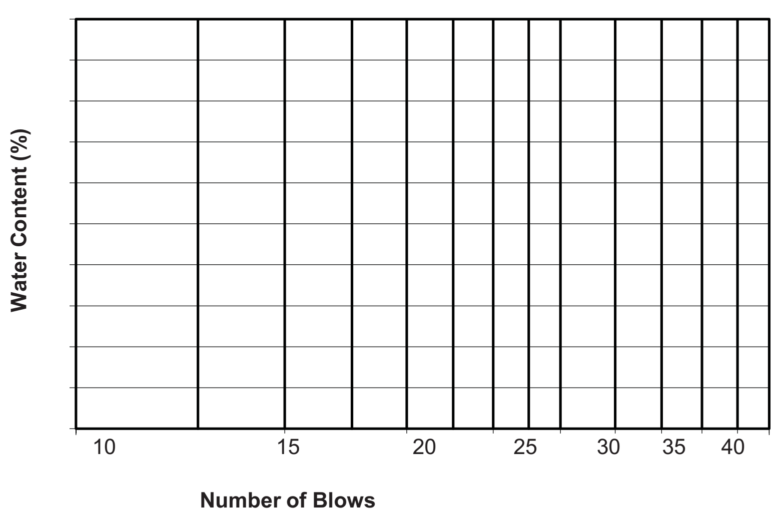
Borehole: GA11-T-04 Sample # : 8 Depth: 17.5-19'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:02:38 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	10-May-11

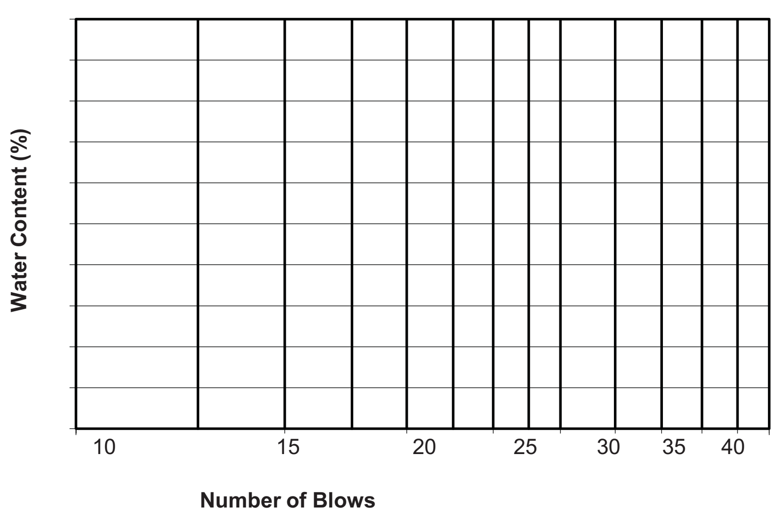
Borehole:	GA11-T-04	Sample # :	10	Depth:	22.5-24'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 14:31:10 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	DM	Date:	29-Apr-11

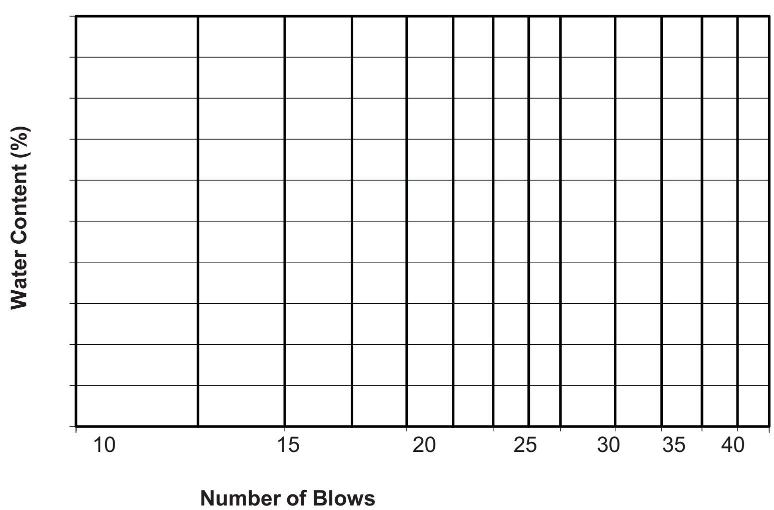
Borehole: GA11-T-04 Sample # : 15 Depth: 45-46'

Plastic Limit Determination:

Tare #	411						
Mass of wet sample + tare (g)	51.19						
Mass of dry sample + tare (g)	48.26						
Mass of water (g)	2.93						
Mass of tare (g)	34.99						
Mass of dry soil (g)	13.27						
Water content (%)	22.08						

Liquid Limit Determination:

Number of Blows	15	15					
Tare #	250	252					
Mass of wet sample + tare (g)	76.86	80.10					
Mass of dry sample + tare (g)	69.02	74.51					
Mass of water (g)	7.84	6.47					
Mass of tare (g)	34.47	47.98					
Mass of dry soil (g)	34.55	26.53					
Water content (%)	22.69	24.39					
Correction factor	1.066	1.066					
Corrected Limit	21.29	22.88					



Plastic Limit: 22

Liquid Limit: 22

Plasticity Index: 0

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd.,
ou=McDonald,
email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:02:13 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	5-May-11

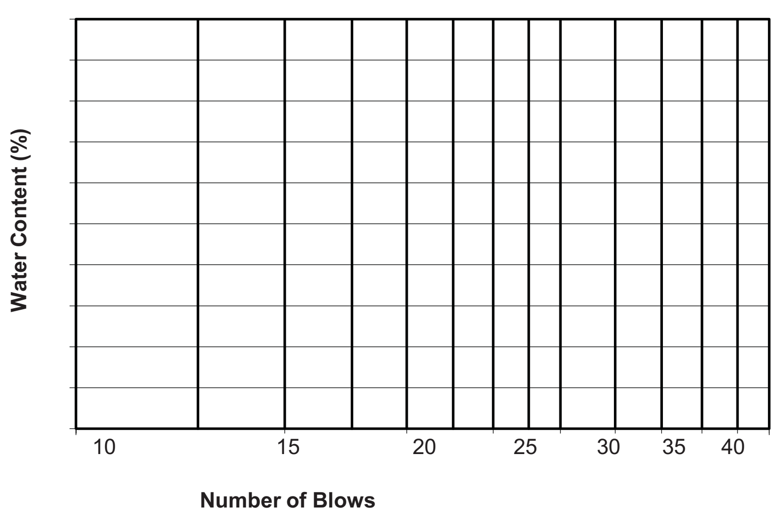
Borehole: GA11-T-06 Sample # : 9 Depth: 22.5-24'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:04:06 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #: 09-1427-0006 Phase: 2100

Short Title: Giant Mine

Tested By: DM Date: 29-Apr-11

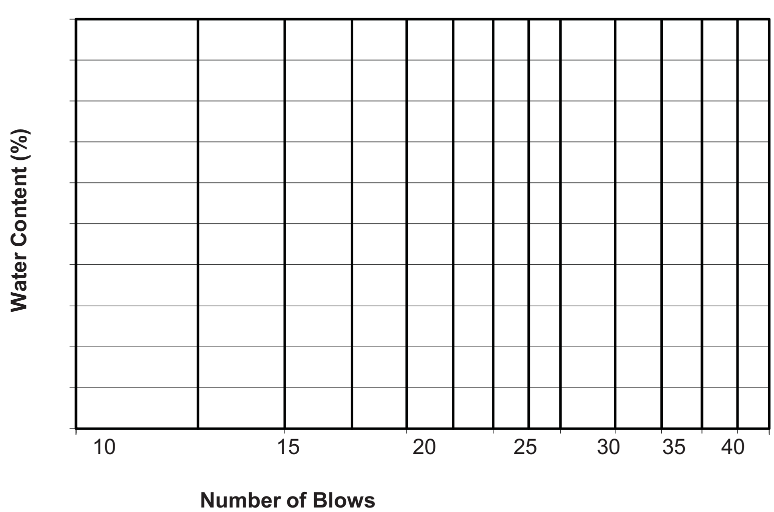
Borehole: GA11-T-06 Sample # : 11 Depth: 27.5-29.6'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:03:43 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	5-May-11

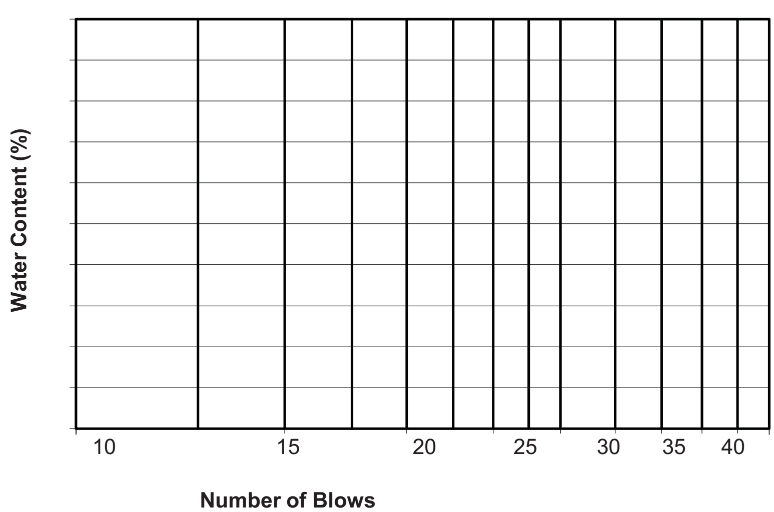
Borehole: GA11-T-06 Sample # : 12 Depth: 34-35'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.09 14:03:26 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	10-May-11

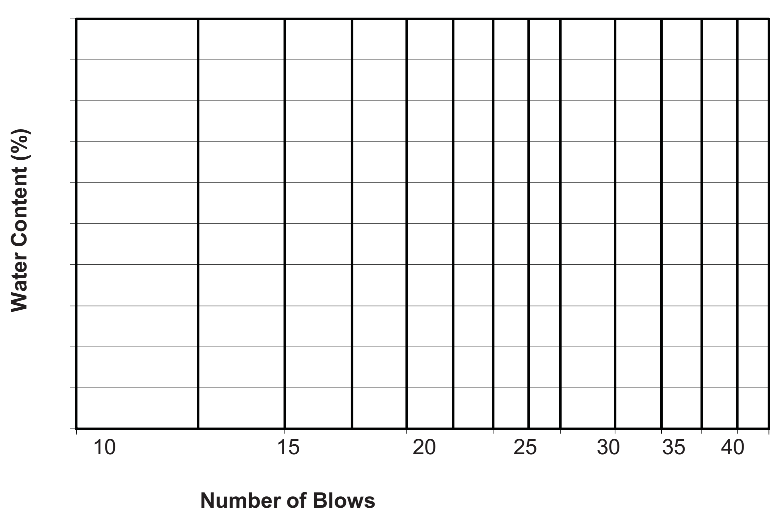
Borehole: GA11-T-06 Sample # : SA15 Depth: 47.5-49'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.05.11 14:30:20 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	1-Jun-11

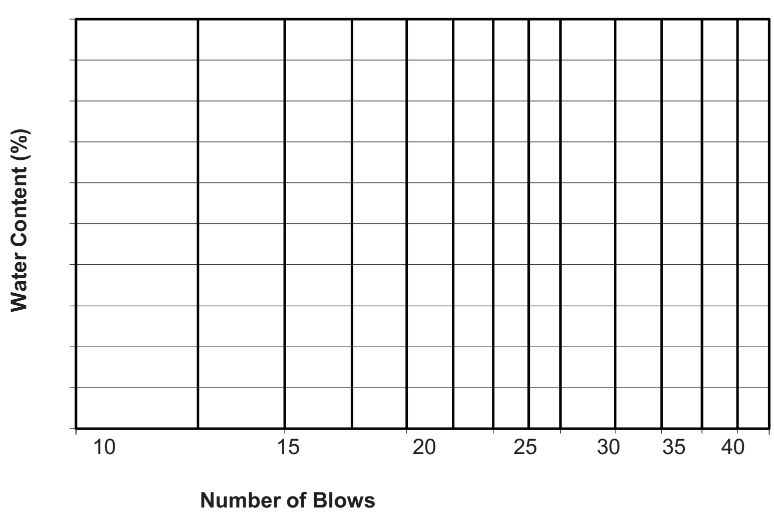
Borehole: GA11-T-08 Sample # : SA3 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Not enough of sample to do atterberg lim

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:29:59 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	MA	Date:	25-May-11

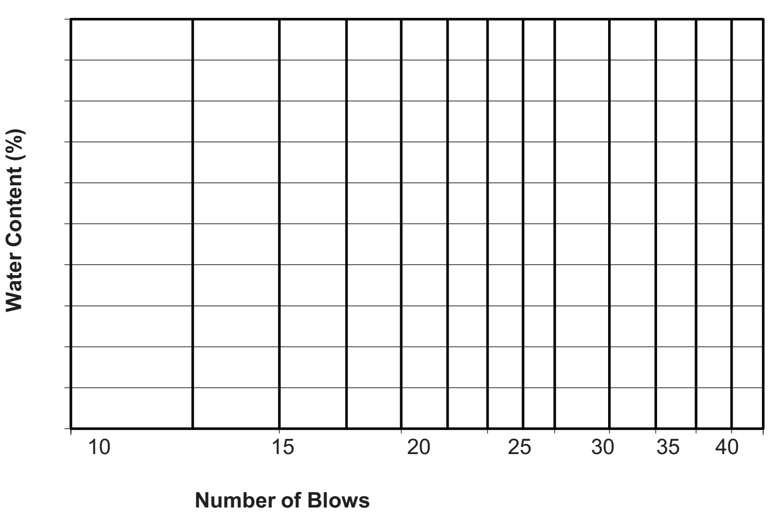
Borehole:	GA11-T-08	Sample # :	SA05	Depth:	12.5-14'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.30 16:20:56 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006
Phase:	2500
Short Title:	Giant Mine
Tested By:	HVD
Date:	24-May-11

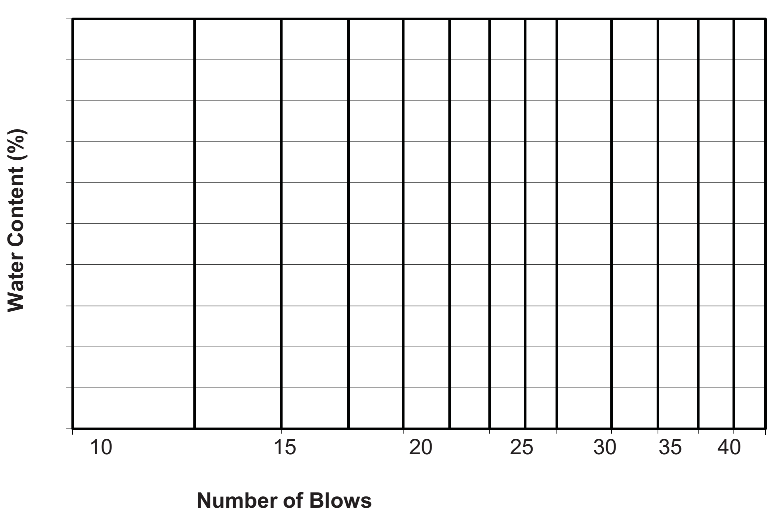
Borehole: GA11-T-09   Sample # : SA6   Depth: 2.5-5'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.06.09 10:29:30 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	2-Jun-11

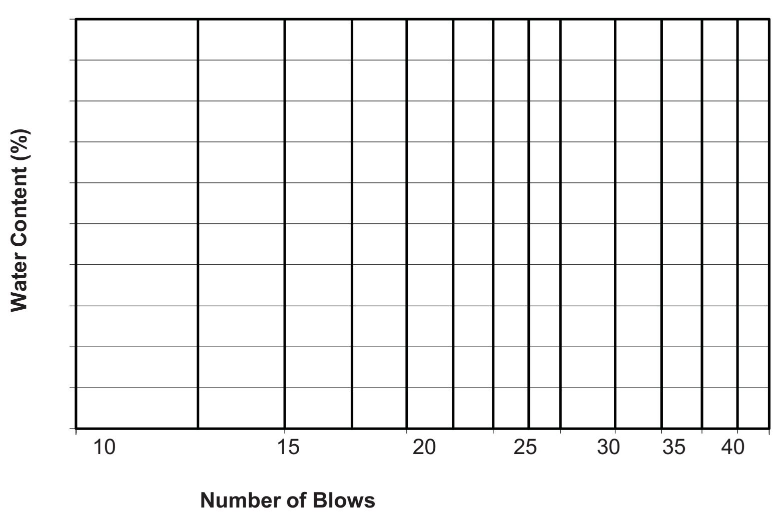
Borehole: GA11-T-08 Sample # : SA7 Depth: 17.5-19'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.06 09:13:40 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	4-Jun-11

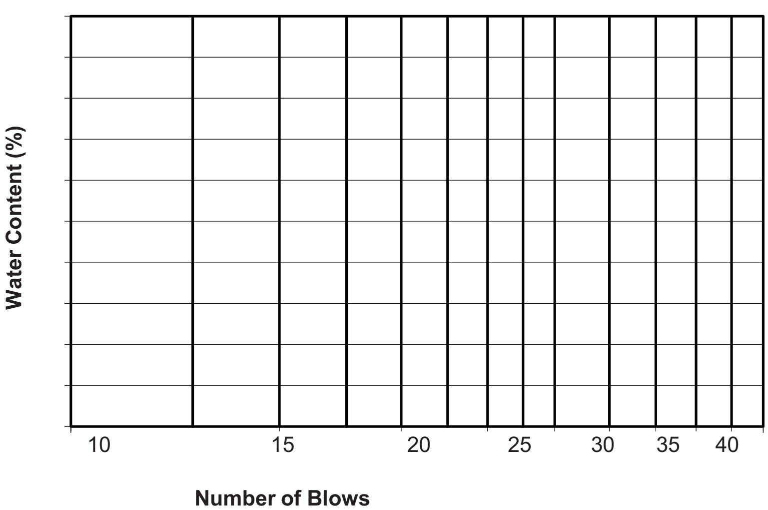
Borehole: GA11-T-08 Sample # : SA9A Depth: 22.5-23.5'

Plastic Limit Determination:

Tare #	PG-33						
Mass of wet sample + tare (g)	32.98						
Mass of dry sample + tare (g)	32.59						
Mass of water (g)	0.39						
Mass of tare (g)	30.39						
Mass of dry soil (g)	2.20						
Water content (%)	17.73						

Liquid Limit Determination:

Number of Blows	28	28					
Tare #	432	403					
Mass of wet sample + tare (g)	54.48	52.42					
Mass of dry sample + tare (g)	50.98	48.90					
Mass of water (g)	3.50	3.52					
Mass of tare (g)	35.27	33.13					
Mass of dry soil (g)	15.71	15.77					
Water content (%)	22.28	22.32					
Correction factor	1.014	1.014					
Corrected Limit	22.59	22.63					



Plastic Limit:	18
Liquid Limit:	23
Plasticity Index:	5

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.06 09:12:26 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

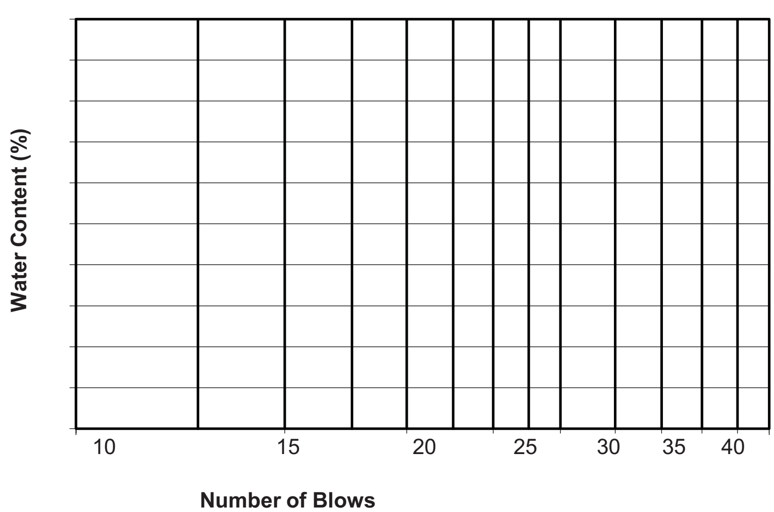
Borehole: GA11-T-09 Sample # : SA3 Depth: 6-7'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:29:02 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	8-Jun-11

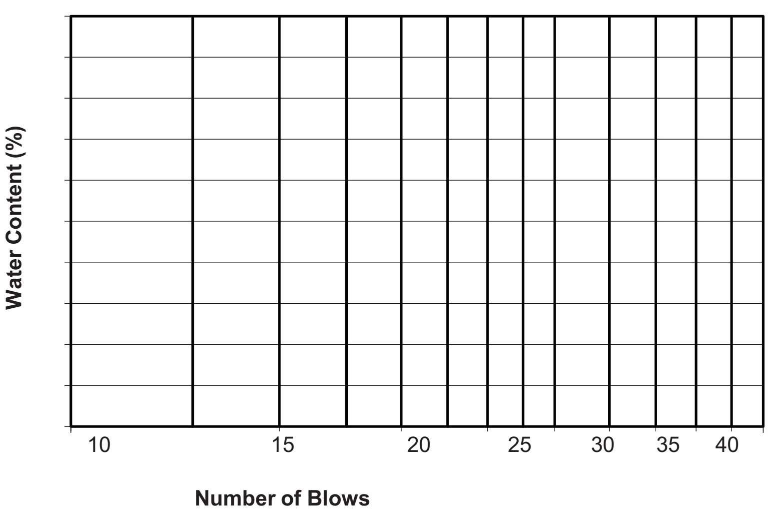
Borehole: GA11-T-09 Sample # : SA5 Depth: 10-11'

Plastic Limit Determination:

Tare #	PG-14						
Mass of wet sample + tare (g)	43.25						
Mass of dry sample + tare (g)	42.86						
Mass of water (g)	0.39						
Mass of tare (g)	41.13						
Mass of dry soil (g)	1.73						
Water content (%)	22.54						

Liquid Limit Determination:

Number of Blows	21	20					
Tare #	408	234					
Mass of wet sample + tare (g)	53.72	57.07					
Mass of dry sample + tare (g)	50.03	52.90					
Mass of water (g)	3.69	4.17					
Mass of tare (g)	34.73	35.78					
Mass of dry soil (g)	15.30	17.12					
Water content (%)	24.12	24.36					
Correction factor	0.979	0.973					
Corrected Limit	23.61	23.70					



Plastic Limit:	23
Liquid Limit:	24
Plasticity Index:	1

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:28:16 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	8-Jun-11

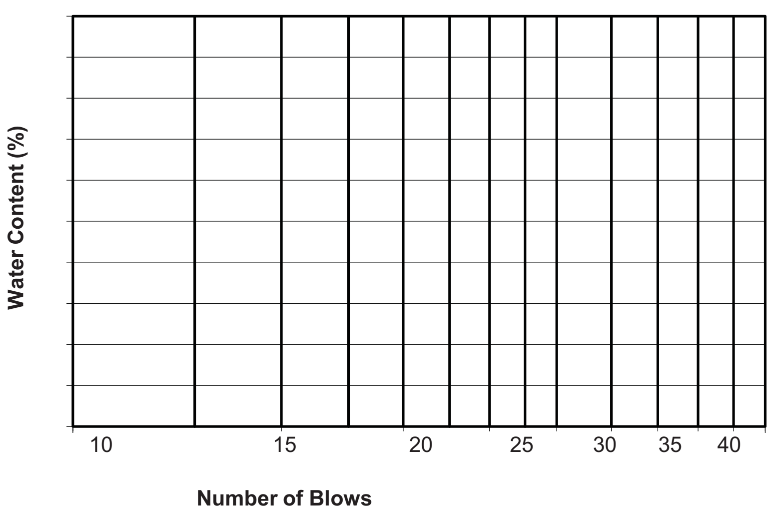
Borehole: GA11-T-09 Sample # : SA9 Depth: 20.5-21.5'

Plastic Limit Determination:

Tare #	PG-30						
Mass of wet sample + tare (g)	33.88						
Mass of dry sample + tare (g)	33.37						
Mass of water (g)	0.51						
Mass of tare (g)	31.25						
Mass of dry soil (g)	2.12						
Water content (%)	24.06						

Liquid Limit Determination:

Number of Blows	20	20					
Tare #	245	217					
Mass of wet sample + tare (g)	58.32	57.89					
Mass of dry sample + tare (g)	53.58	53.21					
Mass of water (g)	4.74	4.68					
Mass of tare (g)	35.36	35.28					
Mass of dry soil (g)	18.22	17.93					
Water content (%)	26.02	26.10					
Correction factor	0.973	0.973					
Corrected Limit	25.31	25.40					



Plastic Limit:	24
Liquid Limit:	25
Plasticity Index:	1

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:27:20 -06'00'

Reviewed by:

Golder Associates

Atterberg Limits Determination

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	2-Jun-11

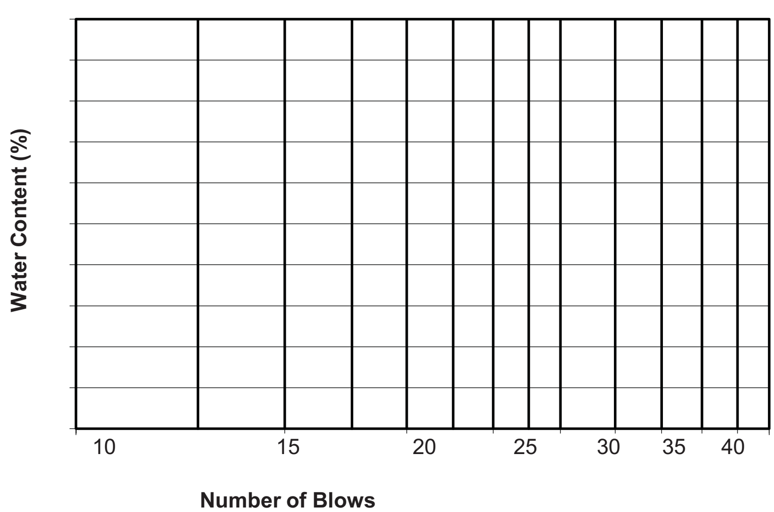
Borehole:	GA11-T-09	Sample # :	SA10	Depth:	24-25'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd.,
ou=McDonald,
email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.06 09:09:07 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

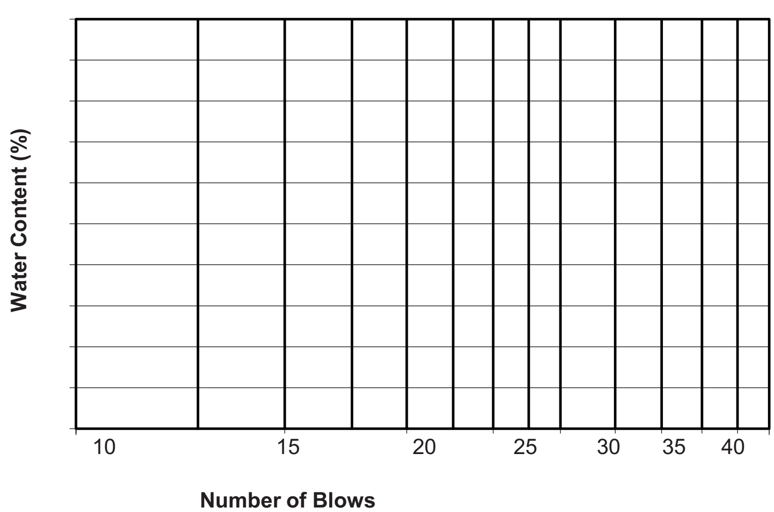
Borehole:	GA11-T-10	Sample # :	SA2	Depth:	5-6'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:26:10 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

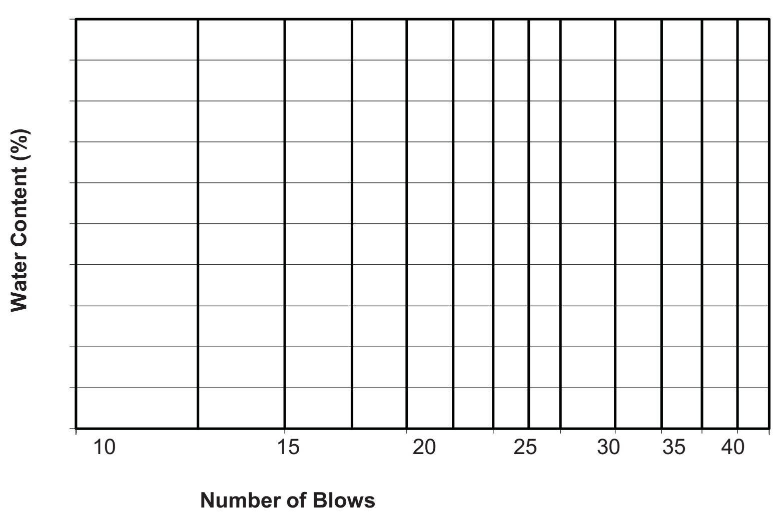
Borehole: GA11-T-10 Sample # : SA4 Depth: 10-11'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:26:38 -06'00'

Reviewed by:

Golder Associates

Atterberg Limits Determination

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

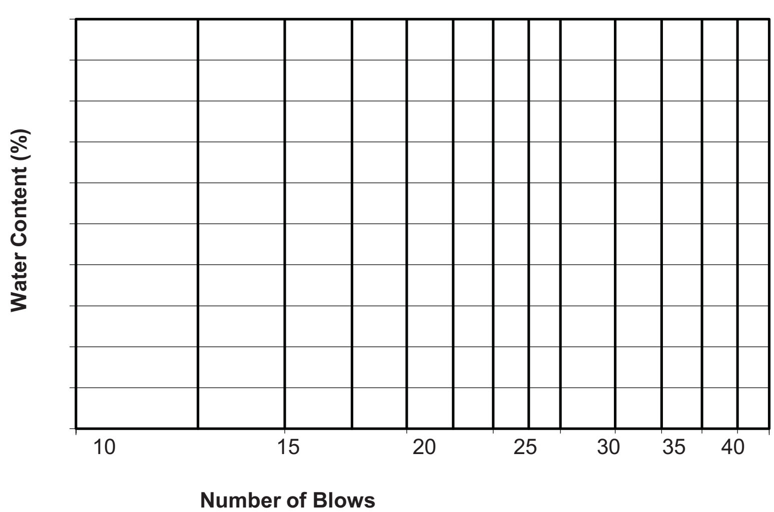
Borehole: GA11-T-10 Sample # : SA6 Depth: 15-16'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:25:39 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	1-Jun-11

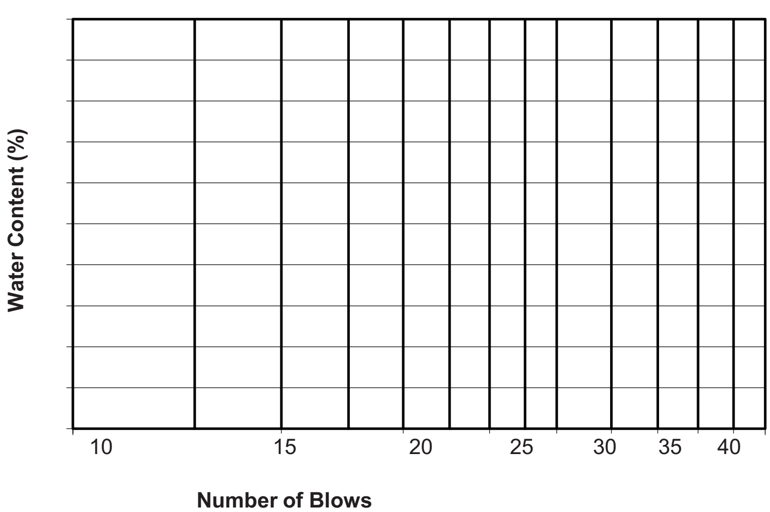
Borehole: GA11-T-10 Sample # : SA8 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Samples not located

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.06.09 10:22:20 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	8-Jun-11

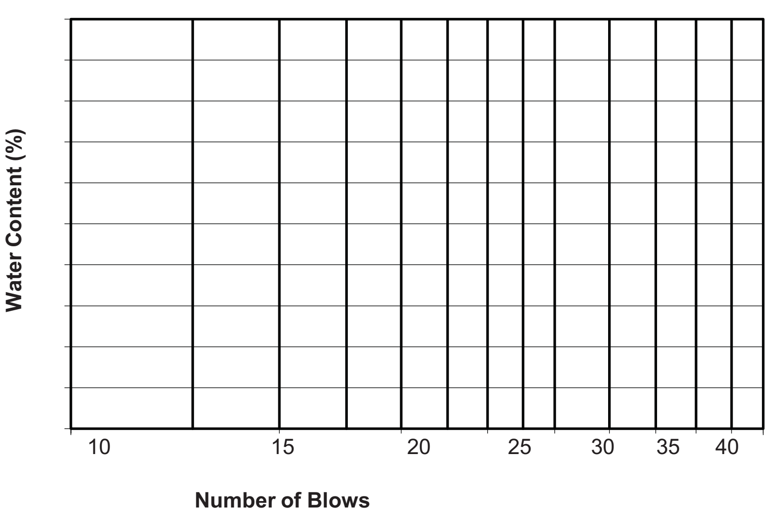
Borehole: GA11-T-10 Sample # : SA10 Depth: 25-26'

Plastic Limit Determination:

Tare #	PG-40						
Mass of wet sample + tare (g)	32.85						
Mass of dry sample + tare (g)	32.40						
Mass of water (g)	0.45						
Mass of tare (g)	30.74						
Mass of dry soil (g)	1.66						
Water content (%)	27.11						

Liquid Limit Determination:

Number of Blows	21	22					
Tare #	204	241					
Mass of wet sample + tare (g)	54.44	53.84					
Mass of dry sample + tare (g)	49.39	49.22					
Mass of water (g)	5.05	4.62					
Mass of tare (g)	33.83	35.01					
Mass of dry soil (g)	15.56	14.21					
Water content (%)	32.46	32.51					
Correction factor	0.979	0.985					
Corrected Limit	31.77	32.02					



Plastic Limit: 27

Liquid Limit: 32

Plasticity Index: 5

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:24:27 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	10-May-11

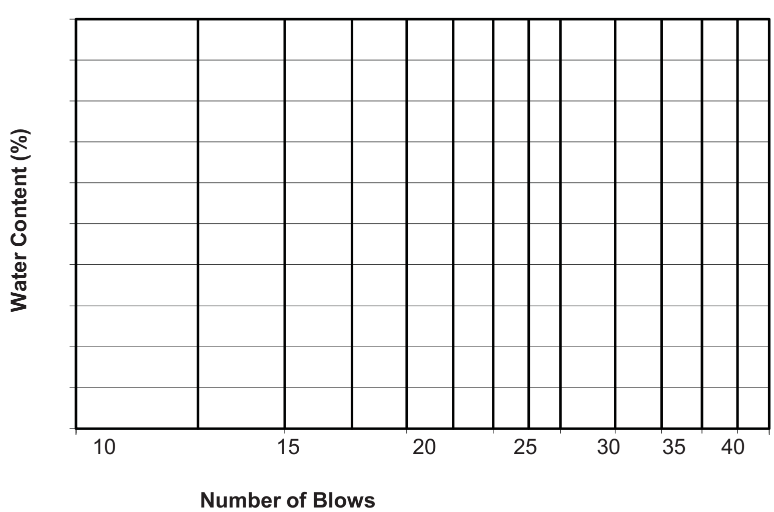
Borehole: GA11-T-11 Sample # : 3 Depth: 5-7.5'

Plastic Limit Determination:

Tare #	1						
Mass of wet sample + tare (g)	19.82						
Mass of dry sample + tare (g)	18.72						
Mass of water (g)	1.10						
Mass of tare (g)	14.42						
Mass of dry soil (g)	4.30						
Water content (%)	25.58						

Liquid Limit Determination:

Number of Blows	27	29					
Tare #	PG-22	PG-24					
Mass of wet sample + tare (g)	58.50	56.27					
Mass of dry sample + tare (g)	51.88	50.55					
Mass of water (g)	6.62	5.72					
Mass of tare (g)	30.32	31.17					
Mass of dry soil (g)	21.56	19.38					
Water content (%)	30.71	29.51					
Correction factor	1.066	1.066					
Corrected Limit	28.80	27.69					



Plastic Limit:	26
Liquid Limit:	28
Plasticity Index:	3

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:44:45 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	10-May-11

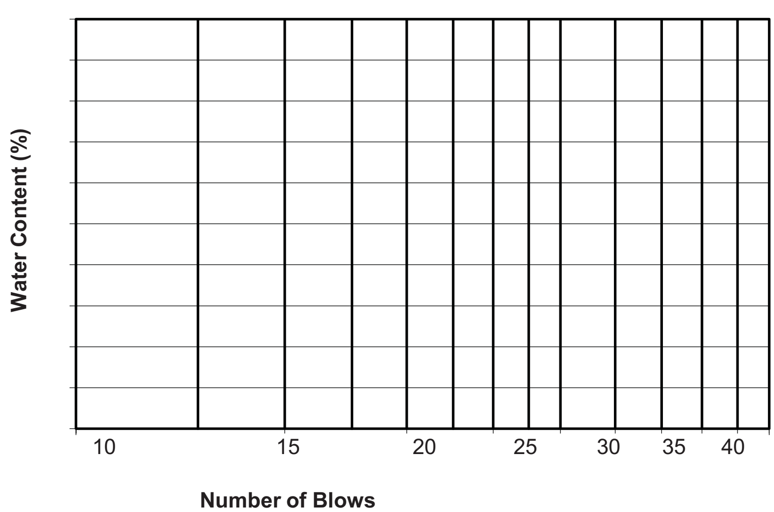
Borehole: GA11-T-11 Sample # : 7 Depth: 17.5-19

Plastic Limit Determination:

Tare #	5						
Mass of wet sample + tare (g)	38.69						
Mass of dry sample + tare (g)	36.95						
Mass of water (g)	1.74						
Mass of tare (g)	31.30						
Mass of dry soil (g)	5.65						
Water content (%)	30.80						

Liquid Limit Determination:

Number of Blows	20	20					
Tare #	35	25					
Mass of wet sample + tare (g)	84.79	70.32					
Mass of dry sample + tare (g)	73.05	59.42					
Mass of water (g)	11.74	10.90					
Mass of tare (g)	41.52	30.08					
Mass of dry soil (g)	31.53	29.34					
Water content (%)	37.23	37.15					
Correction factor	1.066	1.066					
Corrected Limit	34.93	34.85					



Plastic Limit:	31
Liquid Limit:	35
Plasticity Index:	4

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	6-May-11

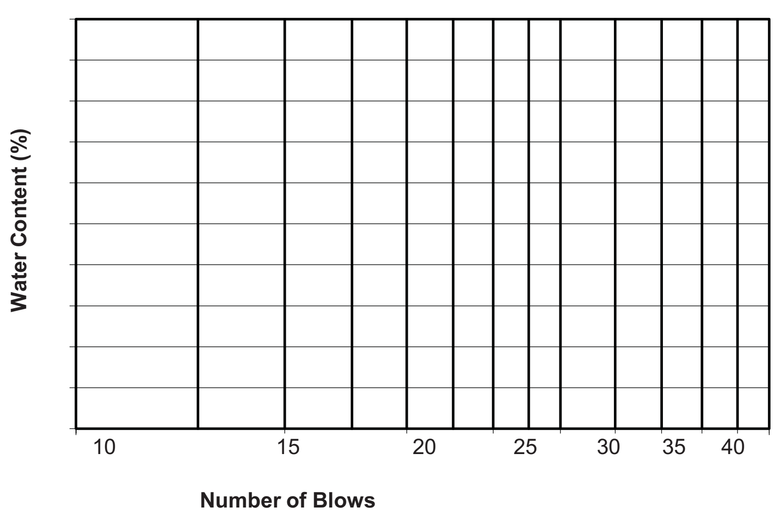
Borehole: GA11-T-11 Sample # : 9 Depth: 22.5-24'

Plastic Limit Determination:

Tare #	PG-27						
Mass of wet sample + tare (g)	38.45						
Mass of dry sample + tare (g)	37.06						
Mass of water (g)	1.39						
Mass of tare (g)	31.18						
Mass of dry soil (g)	5.88						
Water content (%)	23.64						

Liquid Limit Determination:

Number of Blows	15	15					
Tare #	PG-08	PG-25					
Mass of wet sample + tare (g)	63.12	62.36					
Mass of dry sample + tare (g)	55.89	55.44					
Mass of water (g)	7.23	6.92					
Mass of tare (g)	29.99	30.17					
Mass of dry soil (g)	25.90	25.27					
Water content (%)	27.92	27.38					
Correction factor	1.066	1.066					
Corrected Limit	26.19	25.69					



Plastic Limit:	24
Liquid Limit:	26
Plasticity Index:	2

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 08:12:17 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	5-May-11

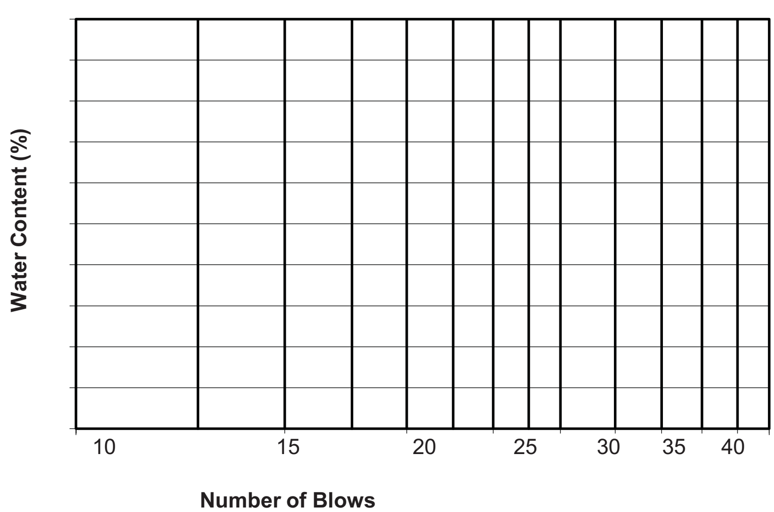
Borehole: GA11-T-11 Sample # : 11 Depth: 27.5-29'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 08:11:59 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	5-May-11

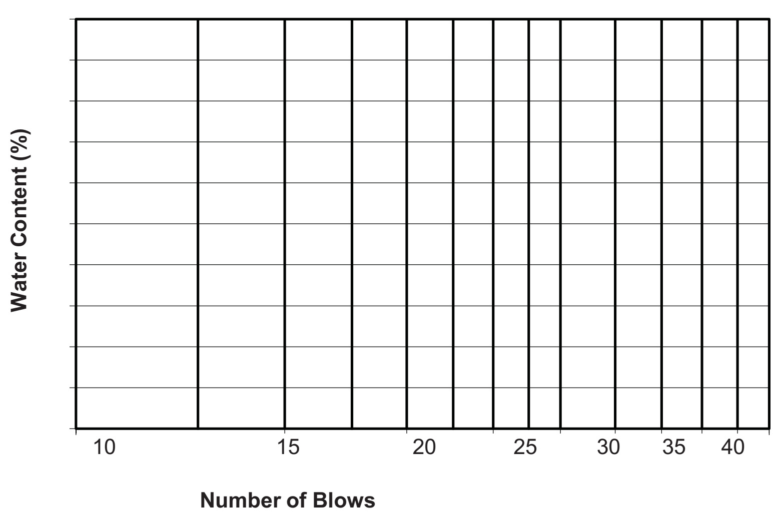
Borehole:	GA11-T-11	Sample # :	13	Depth:	37.5-39'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 08:11:36 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	DM	Date:	29-Apr-11

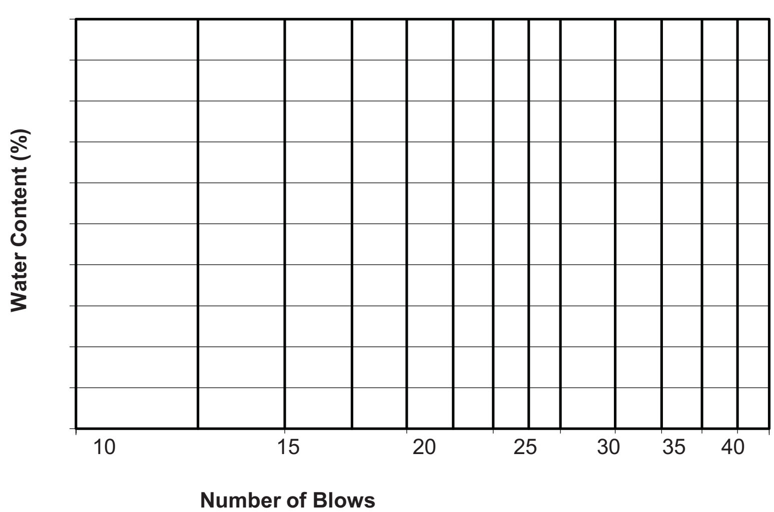
Borehole: GA11-T-12 Sample # : 6 Depth: 16.5-17.5'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:47:28 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	AC/KC	Date:	13-Apr-11

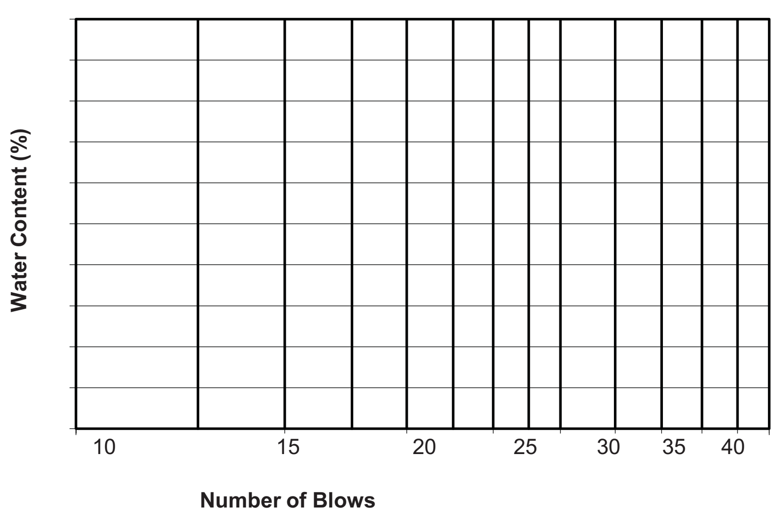
Borehole: GA11-T-12 Sample # : 8 Depth: 20-21'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:47:09 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	AC	Date:	13-Apr-11

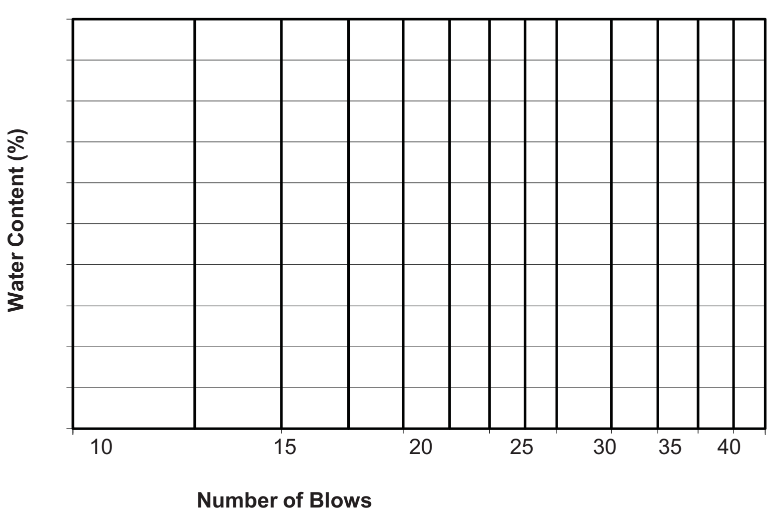
Borehole: GA11-T-12 Sample # : 10 Depth: 25-26'

Plastic Limit Determination:

Tare #	PG-34						
Mass of wet sample + tare (g)	38.47						
Mass of dry sample + tare (g)	36.98						
Mass of water (g)	1.49						
Mass of tare (g)	31.26						
Mass of dry soil (g)	5.72						
Water content (%)	26.05						

Liquid Limit Determination:

Number of Blows	15	15					
Tare #	PG-08	412					
Mass of wet sample + tare (g)	66.82	64.89					
Mass of dry sample + tare (g)	57.81	57.52					
Mass of water (g)	9.01	7.37					
Mass of tare (g)	29.92	34.80					
Mass of dry soil (g)	27.89	22.72					
Water content (%)	32.31	32.44					
Correction factor	1.066	1.066					
Corrected Limit	30.31	30.43					



Plastic Limit:	26
Liquid Limit:	30
Plasticity Index:	4

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:46:52 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	DM	Date:	29-Apr-11

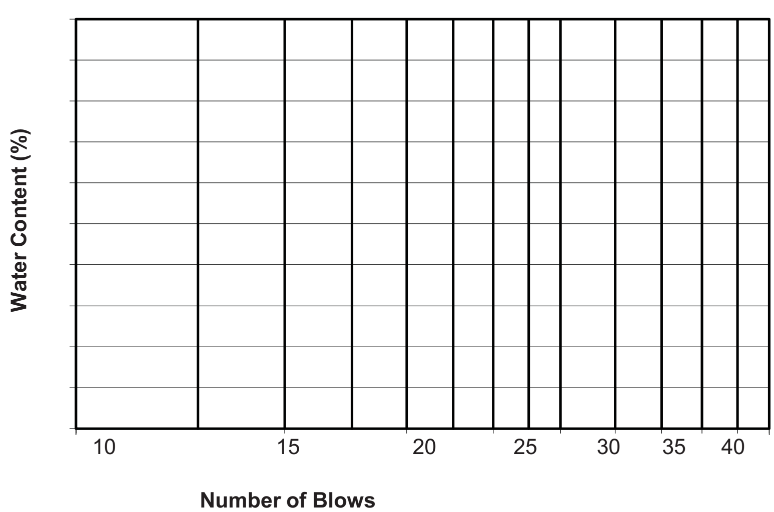
Borehole:	GA11-T-12	Sample # :	13	Depth:	39-40'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:46:36 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #: 09-1427-0006 Phase: 2100

Short Title: Giant Mine

Tested By: LM Date: 5-May-11

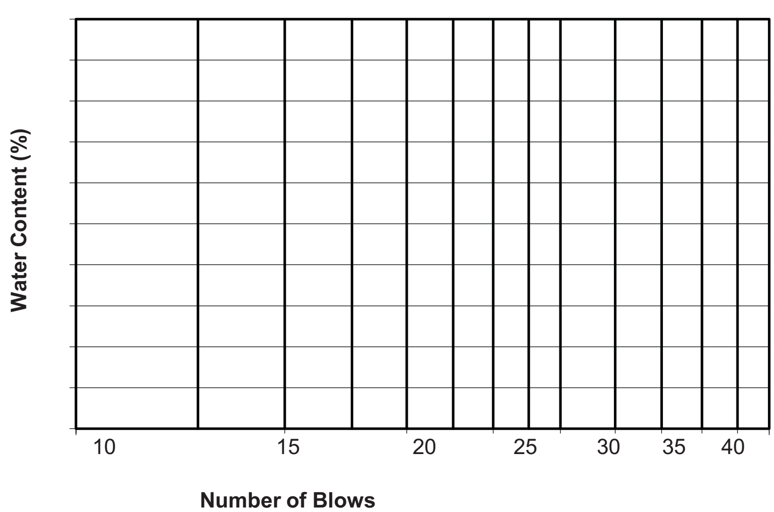
Borehole: GA11-T-12 Sample # : 15 Depth: 49-50'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:46:11 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	5-May-11

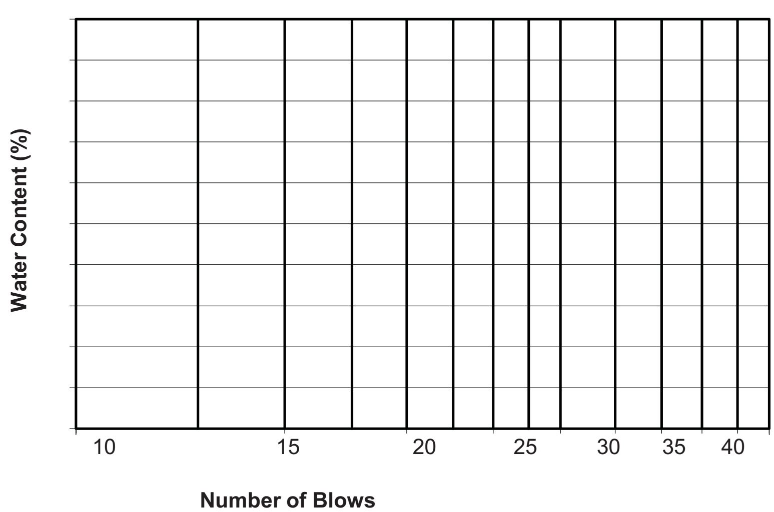
Borehole: GA11-T-12 Sample # : 17 Depth: 59-60'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0
Liquid Limit: 0
Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:45:52 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	1-Jun-11

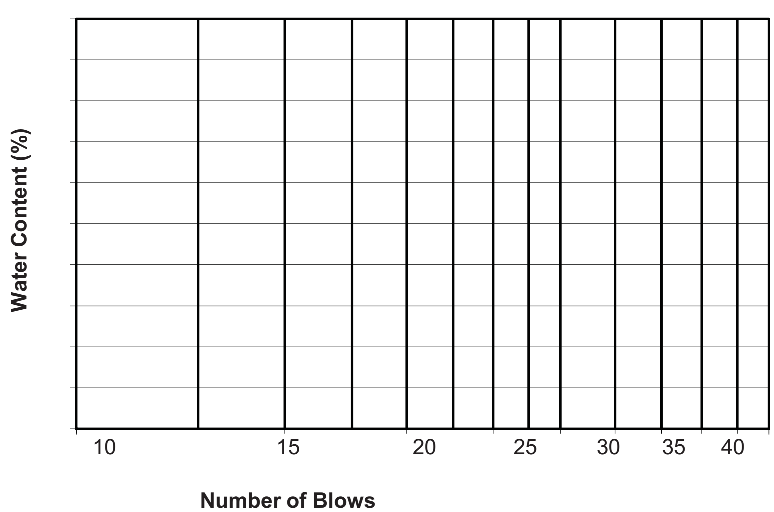
Borehole: GA11-T-13 Sample # : SA3 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Not enough of sample to do atterberg lim

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.06.09 10:21:40 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

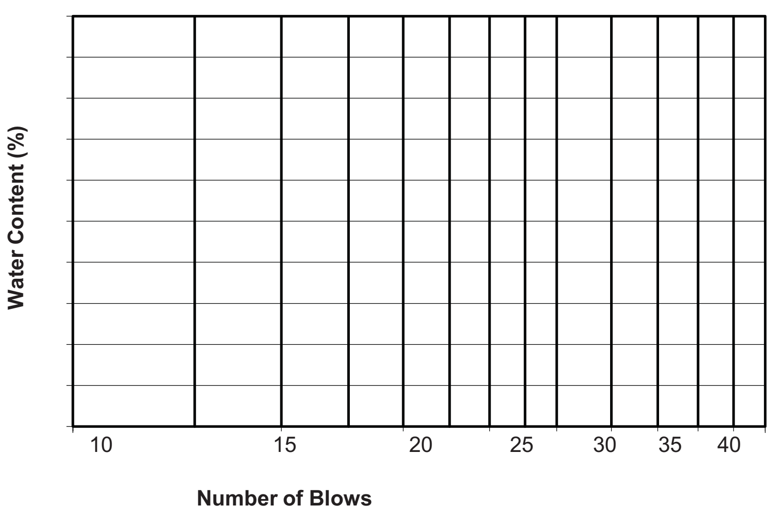
Borehole: GA11-T-13 Sample # : SA6 Depth: 15-16'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0
Liquid Limit: 0
Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:21:00 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

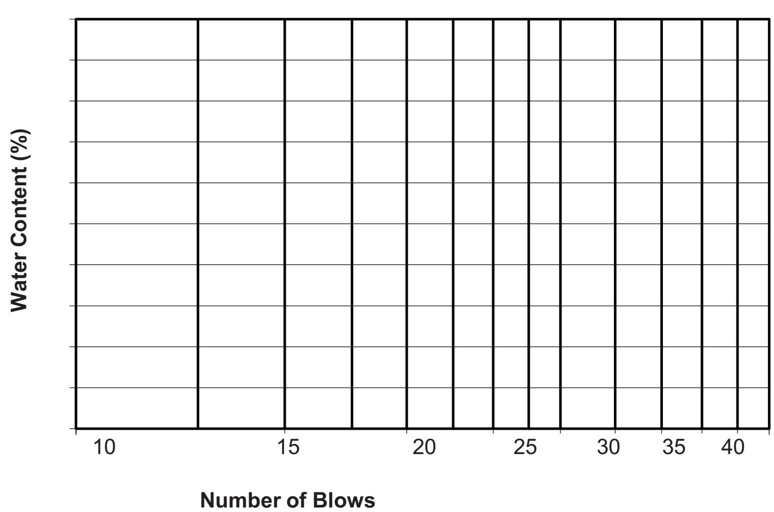
Borehole:	GA11-T-13	Sample # :	SA8	Depth:	10-11'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:20:30 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

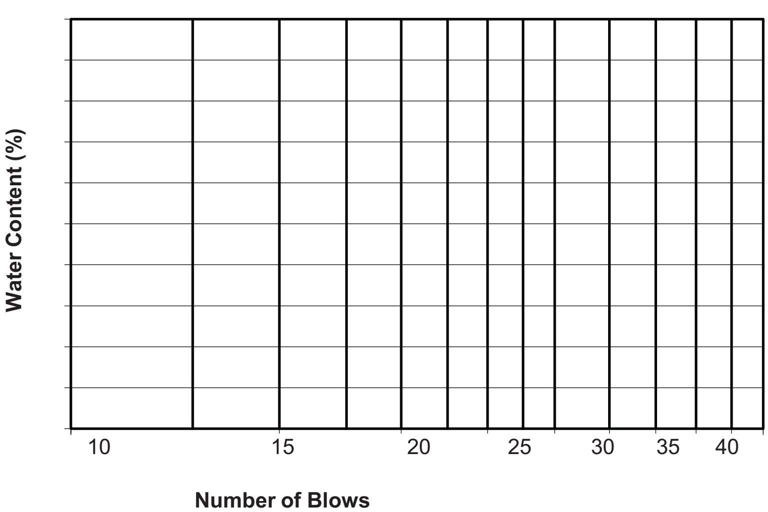
Borehole:	GA11-T-13	Sample # :	SA10	Depth:	25-26'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:20:01 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

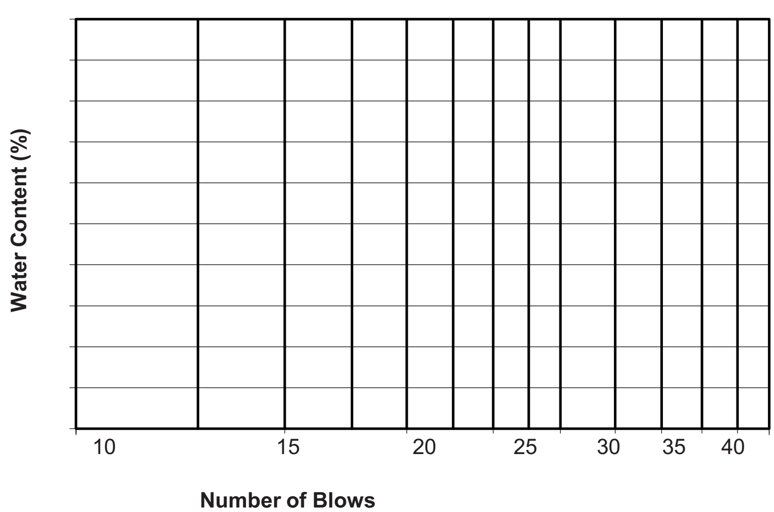
Borehole: GA11-T-13 Sample # : SA12 Depth: 30-31'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non plastic

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.06.09 10:19:30 -06'00'

Reviewed by:

Golder Associates

Atterberg Limits Determination

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

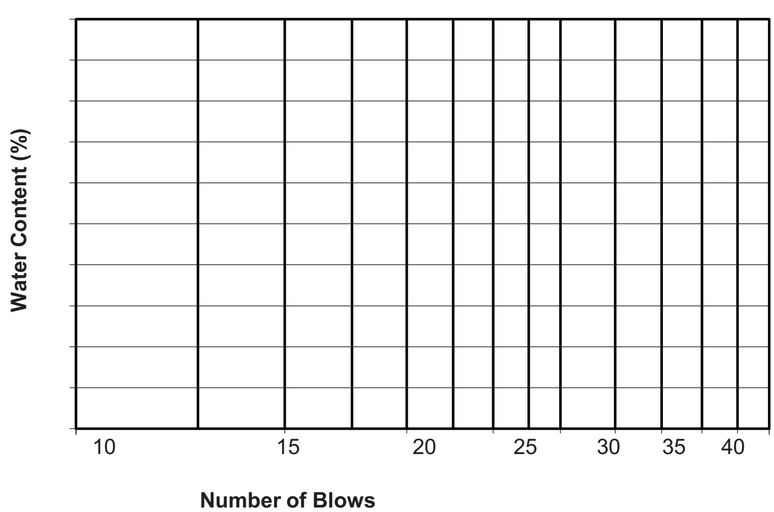
Borehole:	GA11-T-14	Sample # :	6	Depth:	15-16'

Plastic Limit Determination:

Tare #	105						
Mass of wet sample + tare (g)	20.78						
Mass of dry sample + tare (g)	19.55						
Mass of water (g)	1.23						
Mass of tare (g)	14.45						
Mass of dry soil (g)	5.10						
Water content (%)	24.12						

Liquid Limit Determination:

Number of Blows	18	20					
Tare #	PG-13	A74					
Mass of wet sample + tare (g)	30.80	53.52					
Mass of dry sample + tare (g)	25.90	44.76					
Mass of water (g)	4.90	8.76					
Mass of tare (g)	9.94	14.32					
Mass of dry soil (g)	15.96	30.44					
Water content (%)	30.70	28.78					
Correction factor	1.043	0.973					
Corrected Limit	29.44	28.00					



Plastic Limit:	24
Liquid Limit:	29
Plasticity Index:	5

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:50:10 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	AC/KC	Date:	13-Apr-11

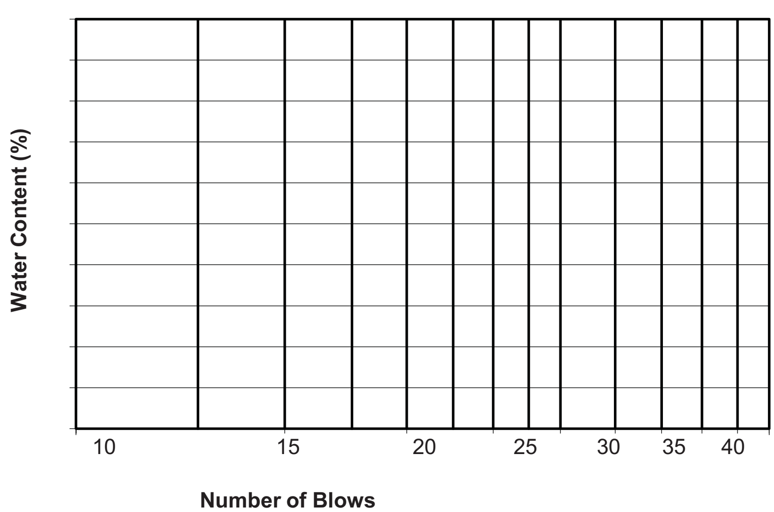
Borehole: GA11-T-14 Sample # : 8 Depth: 20-21'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:49:51 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

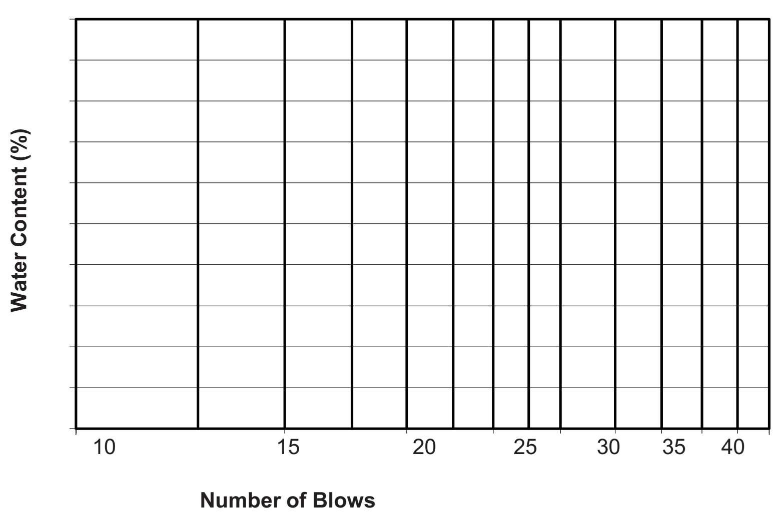
Borehole: GA11-T-14 Sample # : 10 Depth: 25-26'

Plastic Limit Determination:

Tare #	X19						
Mass of wet sample + tare (g)	20.40						
Mass of dry sample + tare (g)	19.20						
Mass of water (g)	1.20						
Mass of tare (g)	14.40						
Mass of dry soil (g)	4.80						
Water content (%)	25.00						

Liquid Limit Determination:

Number of Blows	21	19					
Tare #	PG-27	A46					
Mass of wet sample + tare (g)	36.86	46.85					
Mass of dry sample + tare (g)	30.45	39.35					
Mass of water (g)	6.41	7.50					
Mass of tare (g)	10.18	14.29					
Mass of dry soil (g)	20.27	25.06					
Water content (%)	31.62	29.93					
Correction factor	0.979	1.036					
Corrected Limit	30.96	31.01					



Plastic Limit:	25
Liquid Limit:	31
Plasticity Index:	6

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:49:28 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	10-May-11

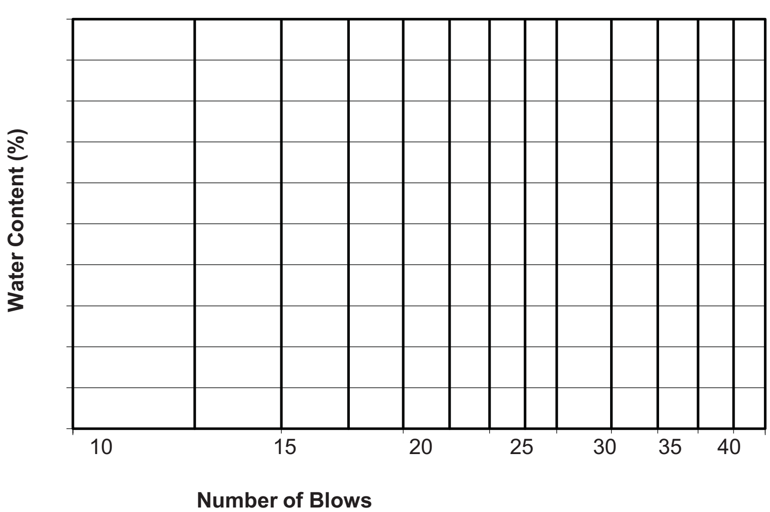
Borehole: GA11-T-14 Sample # : SA14 Depth: 43-44'

Plastic Limit Determination:

Tare #	241						
Mass of wet sample + tare (g)	53.17						
Mass of dry sample + tare (g)	49.19						
Mass of water (g)	3.98						
Mass of tare (g)	34.98						
Mass of dry soil (g)	14.21						
Water content (%)	28.01						

Liquid Limit Determination:

Number of Blows	22	22					
Tare #	PG-36	PG-12					
Mass of wet sample + tare (g)	61.42	63.04					
Mass of dry sample + tare (g)	54.65	56.04					
Mass of water (g)	6.77	7.00					
Mass of tare (g)	31.03	31.34					
Mass of dry soil (g)	23.62	24.70					
Water content (%)	28.66	28.34					
Correction factor	0.985	1.036					
Corrected Limit	28.23	29.36					



Plastic Limit:	28
Liquid Limit:	29
Plasticity Index:	1

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:48:46 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	AC	Date:	13-Apr-11

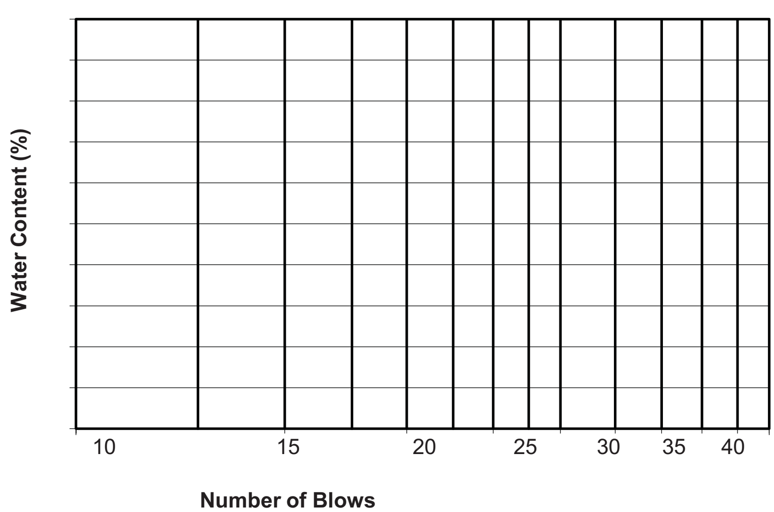
Borehole: GA11-T-14 Sample # : SA16 Depth: 54-55

Plastic Limit Determination:

Tare #	PG-10						
Mass of wet sample + tare (g)	47.96						
Mass of dry sample + tare (g)	46.84						
Mass of water (g)	1.12						
Mass of tare (g)	40.31						
Mass of dry soil (g)	6.53						
Water content (%)	17.15						

Liquid Limit Determination:

Number of Blows	23	30					
Tare #	418	229					
Mass of wet sample + tare (g)	69.85	72.49					
Mass of dry sample + tare (g)	62.01	64.58					
Mass of water (g)	7.84	7.91					
Mass of tare (g)	33.57	34.92					
Mass of dry soil (g)	28.44	29.66					
Water content (%)	27.57	26.67					
Correction factor	0.990	1.022					
Corrected Limit	27.29	27.26					



Plastic Limit: 17
Liquid Limit: 27
Plasticity Index: 10

Comments: CL

Reviewed by:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:52:12 -06'00'

Golder Associates

Atterberg Limits Determination

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	25-May-11

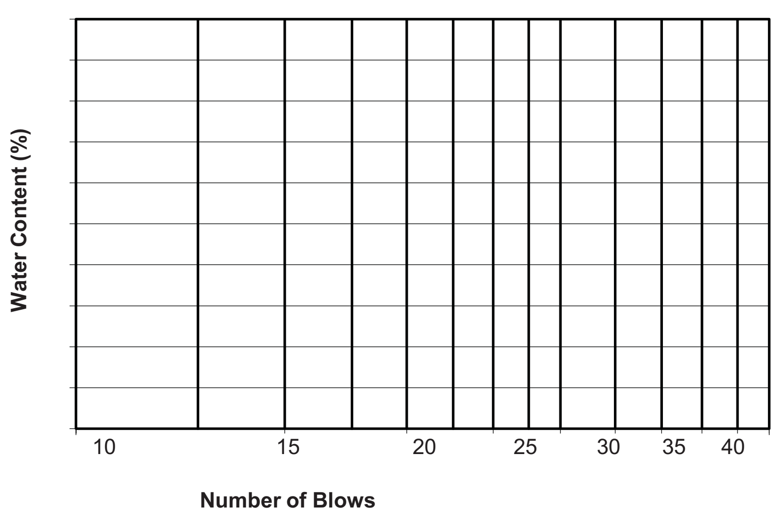
Borehole:	GA11-T-16	Sample # :	SA03	Depth:	7.5-9'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.30 16:20:37 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	2-Jun-11

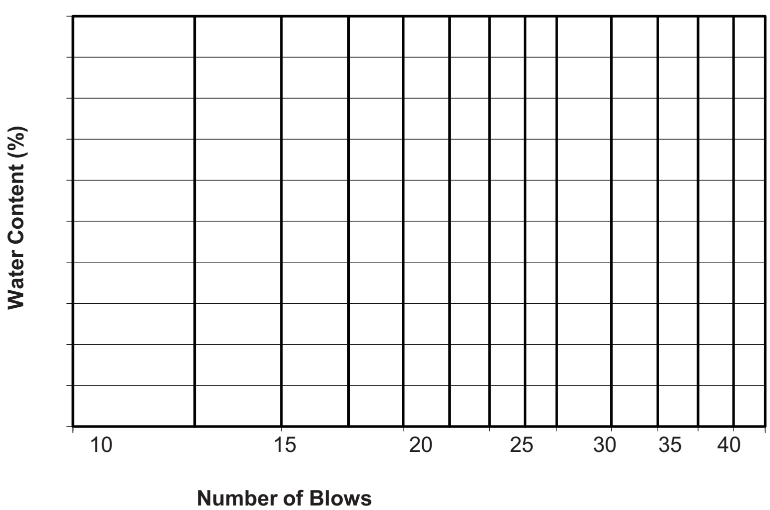
Borehole:	GA11-T-16	Sample # :	SA6	Depth:	15-16'

Plastic Limit Determination:

Tare #	PG-06						
Mass of wet sample + tare (g)	33.20						
Mass of dry sample + tare (g)	32.78						
Mass of water (g)	0.42						
Mass of tare (g)	31.06						
Mass of dry soil (g)	1.72						
Water content (%)	24.42						

Liquid Limit Determination:

Number of Blows	26	26					
Tare #	217	253					
Mass of wet sample + tare (g)	54.01	51.61					
Mass of dry sample + tare (g)	50.33	48.33					
Mass of water (g)	3.68	3.28					
Mass of tare (g)	35.27	35.08					
Mass of dry soil (g)	15.06	13.25					
Water content (%)	24.44	24.75					
Correction factor	1.005	1.005					
Corrected Limit	24.56	24.88					



Plastic Limit:	24
Liquid Limit:	25
Plasticity Index:	0

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.06 09:08:24 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	2-Jun-11

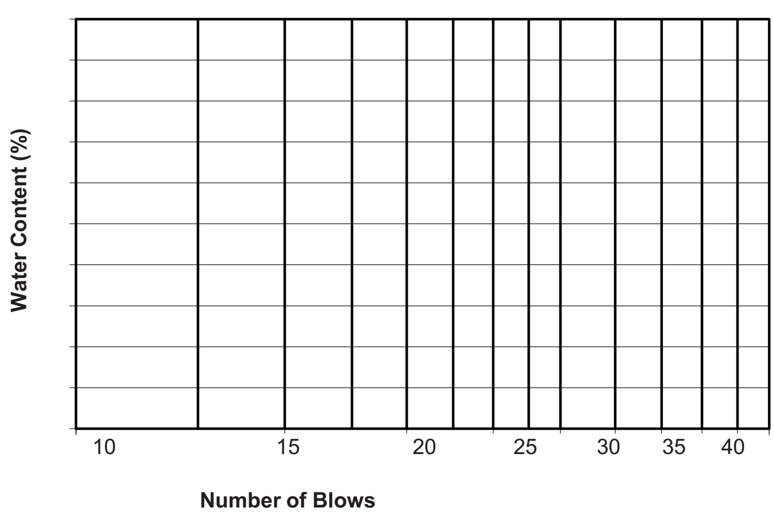
Borehole: GA11-T-16 Sample # : SA8 Depth:

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.06 09:06:49 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

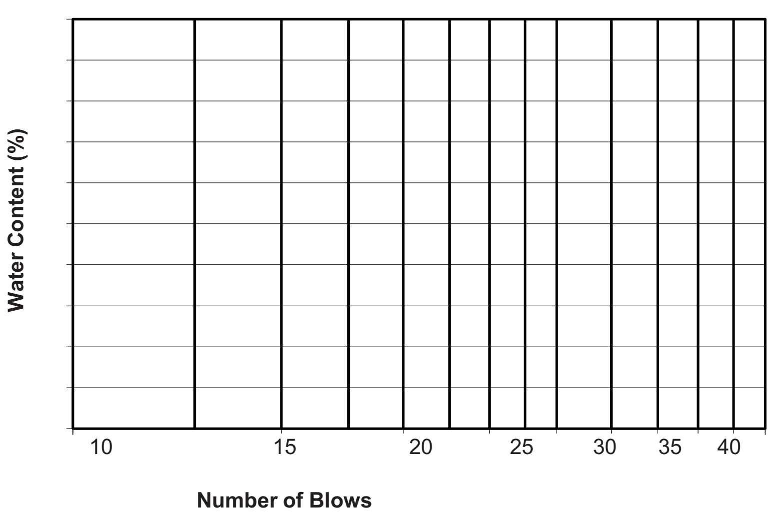
Borehole:	GA11-T-16	Sample # :	SA10	Depth:	25-26'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:18:45 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2500
Short Title:	Giant Mine		
Tested By:	HVD	Date:	7-Jun-11

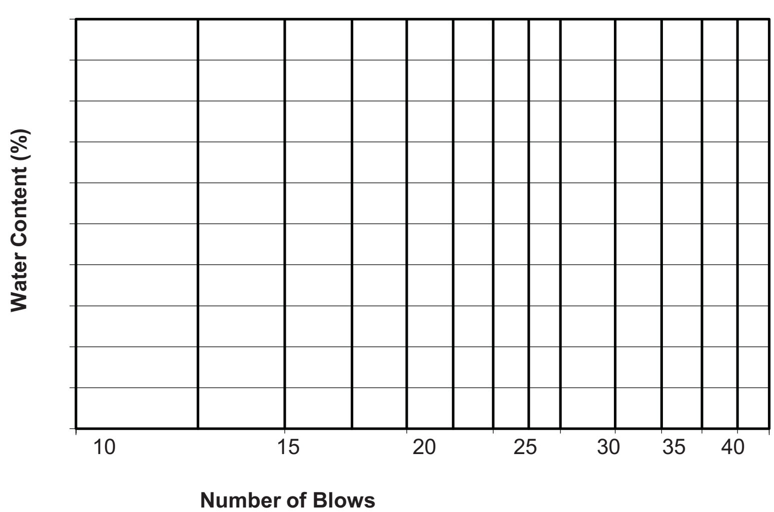
Borehole: GA11-T-16 Sample # : SA12 Depth: 35-36'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit:	0
Liquid Limit:	0
Plasticity Index:	0

Comments: Non plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 10:17:55 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	HVD	Date:	10-May-11

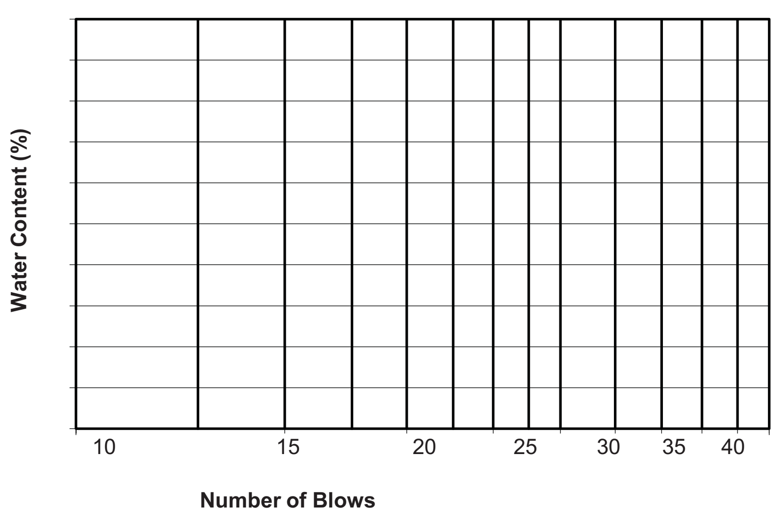
Borehole: GA11-T-17 Sample # : SA5 Depth: 12.5-14'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 13:54:51 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	LM	Date:	8-May-11

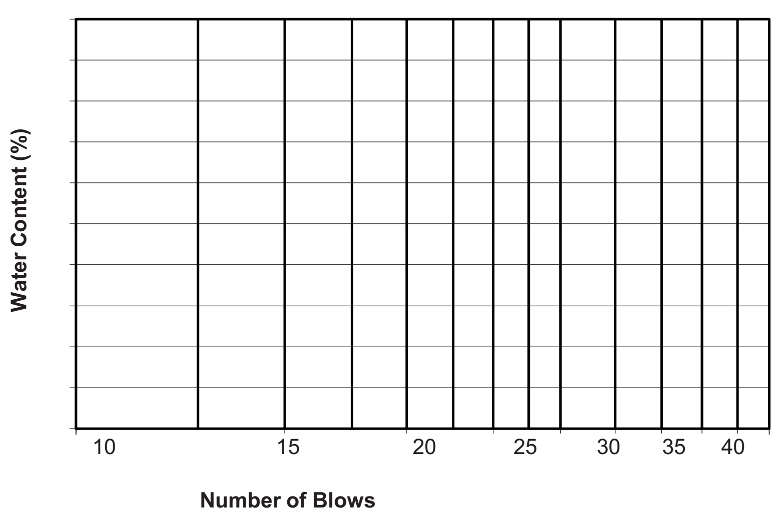
Borehole: GA11-T-17 Sample # : 9 Depth: 22.5-24'

Plastic Limit Determination:

Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							

Liquid Limit Determination:

Number of Blows							
Tare #							
Mass of wet sample + tare (g)							
Mass of dry sample + tare (g)							
Mass of water (g)							
Mass of tare (g)							
Mass of dry soil (g)							
Water content (%)							
Correction factor							
Corrected Limit							



Plastic Limit: 0

Liquid Limit: 0

Plasticity Index: 0

Comments: Non-plastic

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.05.11 14:36:56 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	DM	Date:	29-Apr-11

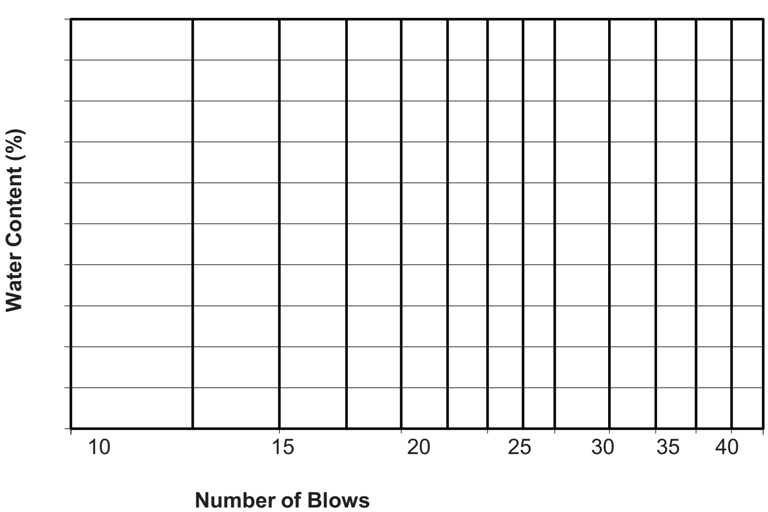
Borehole:	GA11-T-17	Sample # :	10A	Depth:	25-26'

Plastic Limit Determination:

Tare #	PG15						
Mass of wet sample + tare (g)	47.95						
Mass of dry sample + tare (g)	44.67						
Mass of water (g)	3.28						
Mass of tare (g)	30.57						
Mass of dry soil (g)	14.10						
Water content (%)	23.26						

Liquid Limit Determination:

Number of Blows	15	15					
Tare #	233	417A					
Mass of wet sample + tare (g)	65.76	66.42					
Mass of dry sample + tare (g)	59.60	59.95					
Mass of water (g)	6.16	6.47					
Mass of tare (g)	34.57	34.39					
Mass of dry soil (g)	25.03	25.56					
Water content (%)	24.61	25.31					
Correction factor	1.066	1.066					
Corrected Limit	23.09	23.75					



Plastic Limit:	23
Liquid Limit:	23
Plasticity Index:	0

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 14:36:09 -06'00'

Reviewed by:

Atterberg Limits Determination

Golder Associates

Project #:	09-1427-0006	Phase:	2100
Short Title:	Giant Mine		
Tested By:	DM	Date:	29-Apr-11

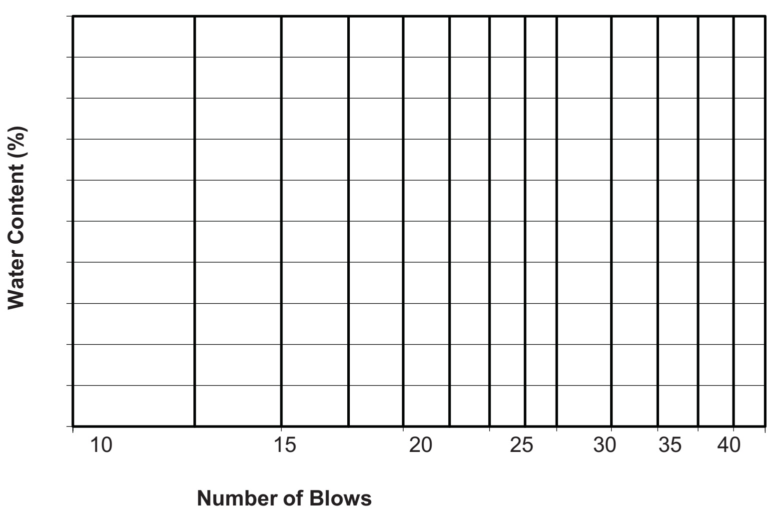
Borehole: GA11-T-17 Sample # : 12 Depth: 37.5-39'

Plastic Limit Determination:

Tare #	PG-09						
Mass of wet sample + tare (g)	41.60						
Mass of dry sample + tare (g)	39.13						
Mass of water (g)	2.47						
Mass of tare (g)	31.08						
Mass of dry soil (g)	8.05						
Water content (%)	30.68						

Liquid Limit Determination:

Number of Blows	15	15					
Tare #	402	421					
Mass of wet sample + tare (g)	67.82	72.54					
Mass of dry sample + tare (g)	59.47	62.45					
Mass of water (g)	8.35	10.09					
Mass of tare (g)	35.44	34.39					
Mass of dry soil (g)	24.03	28.06					
Water content (%)	34.75	35.96					
Correction factor	1.066	1.066					
Corrected Limit	32.60	33.73					



Plastic Limit:	31
Liquid Limit:	33
Plasticity Index:	2

Comments:

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.11 14:37:14 -06'00'

Reviewed by:

Consolidation

CONSOLIDATION - FALLING HEAD HYDRAULIC CONDUCTIVITY TEST

Golder Associates

Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested By:	D.B	Date:	May 4, 2011
Sample:	GA11-T-14 SA2, SA3 (mix together)		

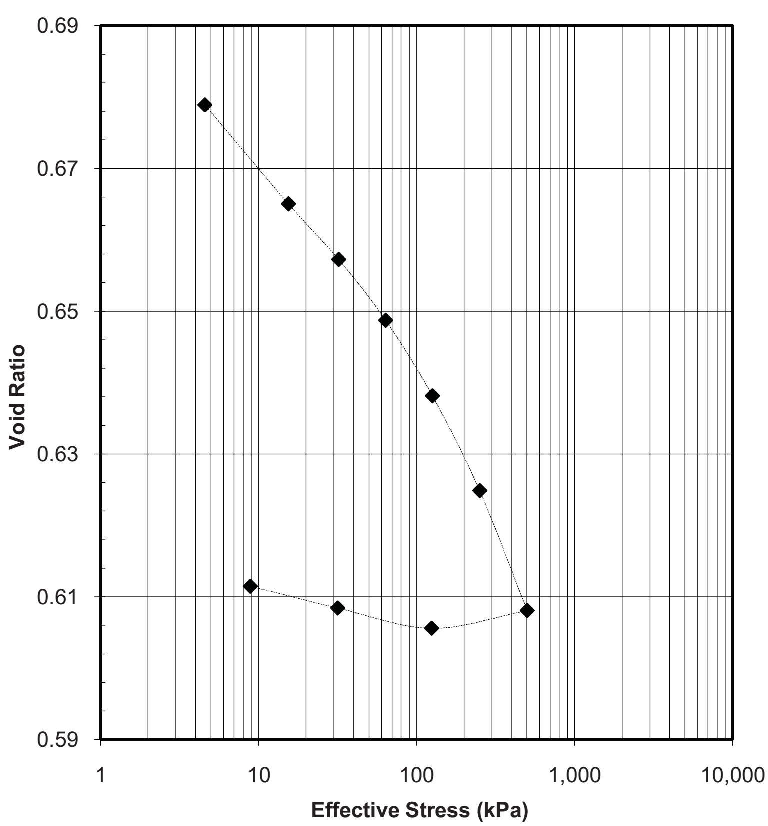
Test Results:

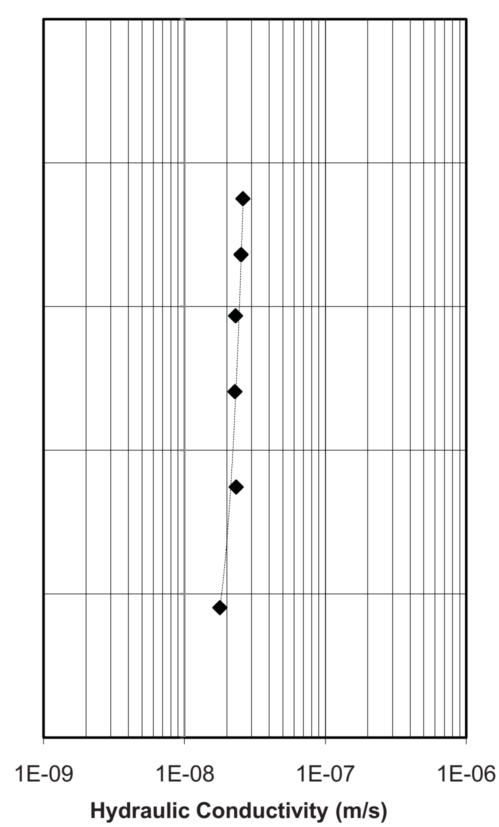
Effective Stress (kPa)	Void Ratio	Hydraulic Conductivity (m/s)
4.6	0.68	
15	0.67	2.6E-08
32	0.66	2.5E-08
64	0.65	2.3E-08
126	0.64	2.3E-08
251	0.62	2.3E-08
501	0.61	1.8E-08
125	0.61	
32	0.61	
8.9	0.61	

Sample Data:

Specific gravity:	2.85	(measured)
Diameter:	63.4	mm
Initial height:	27.2	mm
Initial water content:	25.9	% (prior to saturation)
Initial dry density:	1698	kg/m^3 (prior to loading)
Initial void ratio:	0.68	(prior to loading)
Final water content:	21.6	%
Final dry density:	1770	kg/m^3

Comments:





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

CONSOLIDATION - FALLING HEAD HYDRAULIC CONDUCTIVITY TEST

Golder Associates

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested By: D.B. Date: May 26, 2011
Sample: GA11-T-14 SA2, SA3 (Mix Together)

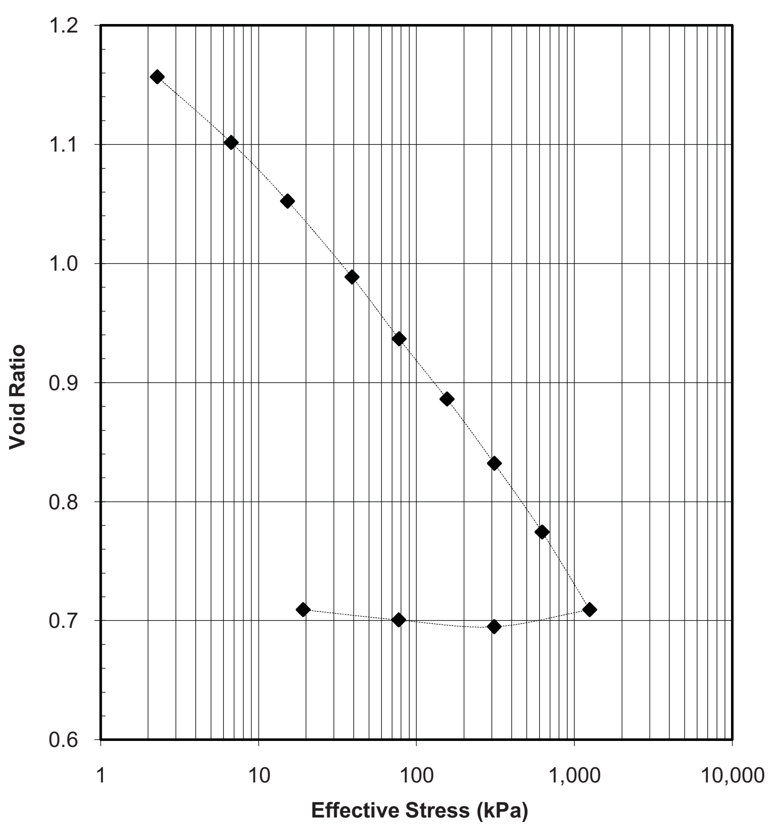
Test Results:

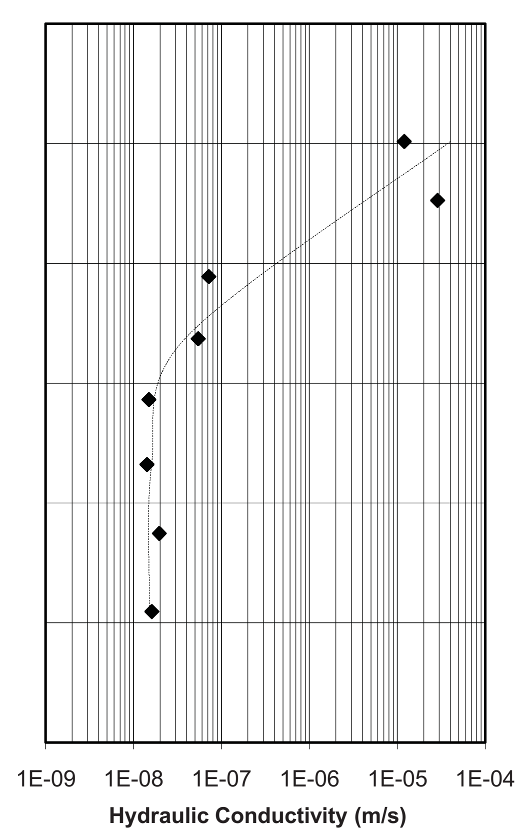
Effective Stress (kPa)	Void Ratio	Hydraulic Conductivity (m/s)
2.3	1.16	
6.7	1.10	1.2E-05
15	1.05	2.9E-05
39	0.99	7.2E-08
77	0.94	5.4E-08
156	0.89	1.5E-08
311	0.83	1.4E-08
625	0.77	2.0E-08
1251	0.71	1.6E-08
311	0.69	
77	0.70	
19	0.71	

Sample Data:

Specific gravity:	2.85	(measured)
Diameter:	63.6	mm
Initial height:	28.5	mm
Initial water content:	27.2	% (prior to saturation)
Initial dry density:	1321	kg/m^3 (prior to loading)
Initial void ratio:	1.16	(prior to loading)
Final water content:	25.8	%
Final dry density:	1669	kg/m^3

Comments:





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

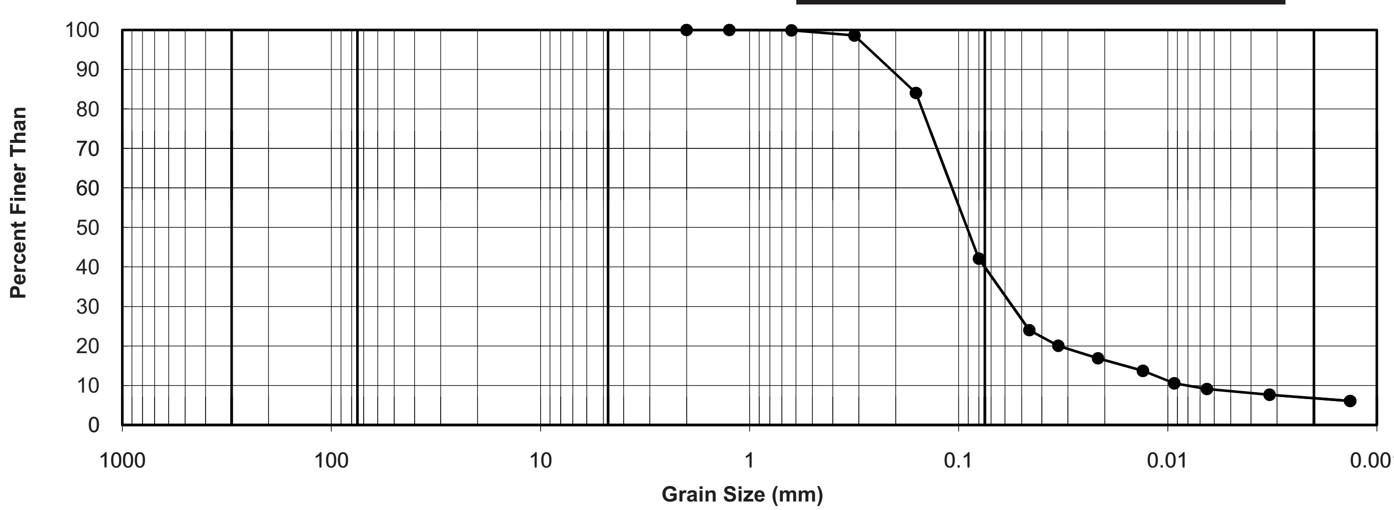
Hydrometers

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	GAINT MINE			
Client:	AECOM	Date Sampled:	April 4, 2011	

Sample Number	GA11-T-01, SA1
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	10.6
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
1.25	100.0	
0.6	99.9	
0.32	98.6	
0.16	84.1	
0.080	42.1	
0.046	24.0	Hydrometer
0.033	20.0	
0.022	16.9	
0.013	13.7	
0.009	10.5	
0.006	9.1	
0.003	7.7	
0.001	6.1	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	61.1	Silt%	32.3	Clay%	6.6

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:52:11 -06'00'

Reviewed By: ______________________

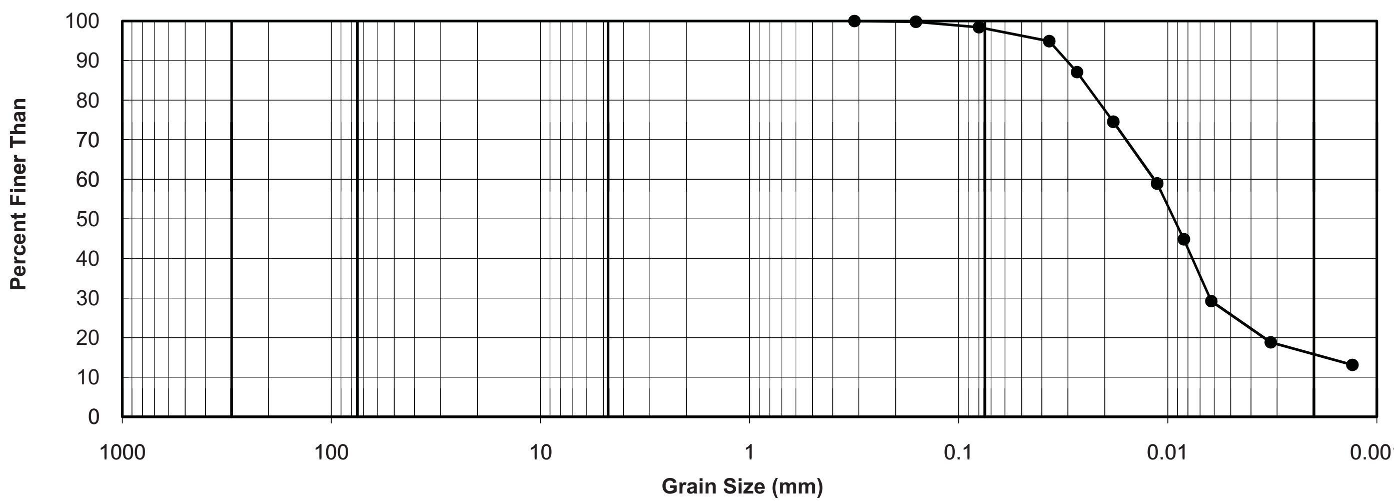
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	GAINT MINE			
Client:	AECOM	Date Sampled:	April 4, 2011	

Sample Number	GA11-T-01, SA3
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	28.4
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	99.8	Sieve
0.080	98.4	Sieve
0.037	94.9	Hydrometer
0.027	87.1	Hydrometer
0.018	74.6	Hydrometer
0.011	58.9	Hydrometer
0.008	44.9	Hydrometer
0.006	29.2	Hydrometer
0.003	18.8	Hydrometer
0.001	13.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 2.1 Silt% 82.8 Clay% 15.2

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:50:57 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number GA11-T-01, SA4
Sample Location Giant Mine

Sampled By JB

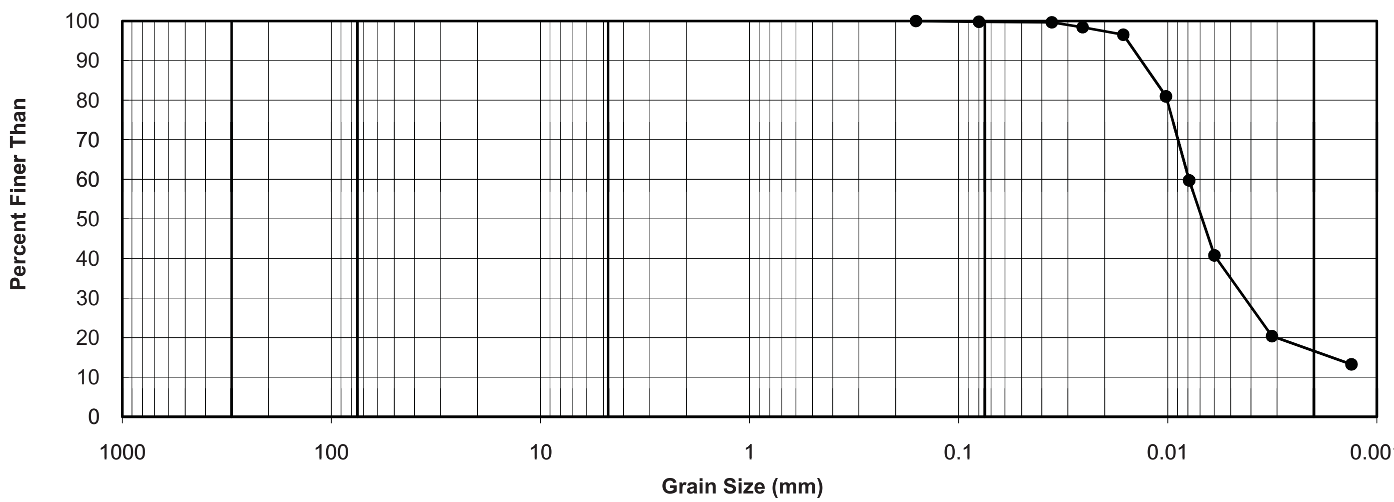
Source
Sample Description

In situ Water Content 37.1
Date Tested Wednesday, April 20, 2011
Tested By AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.8	Sieve
0.036	99.7	Hydrometer
0.026	98.4	Hydrometer
0.016	96.5	Hydrometer
0.010	81.0	Hydrometer
0.008	59.7	Hydrometer
0.006	40.8	Hydrometer
0.003	20.4	Hydrometer
0.001	13.2	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.2 Silt% 83.9 Clay% 15.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:08:43 -06'00'

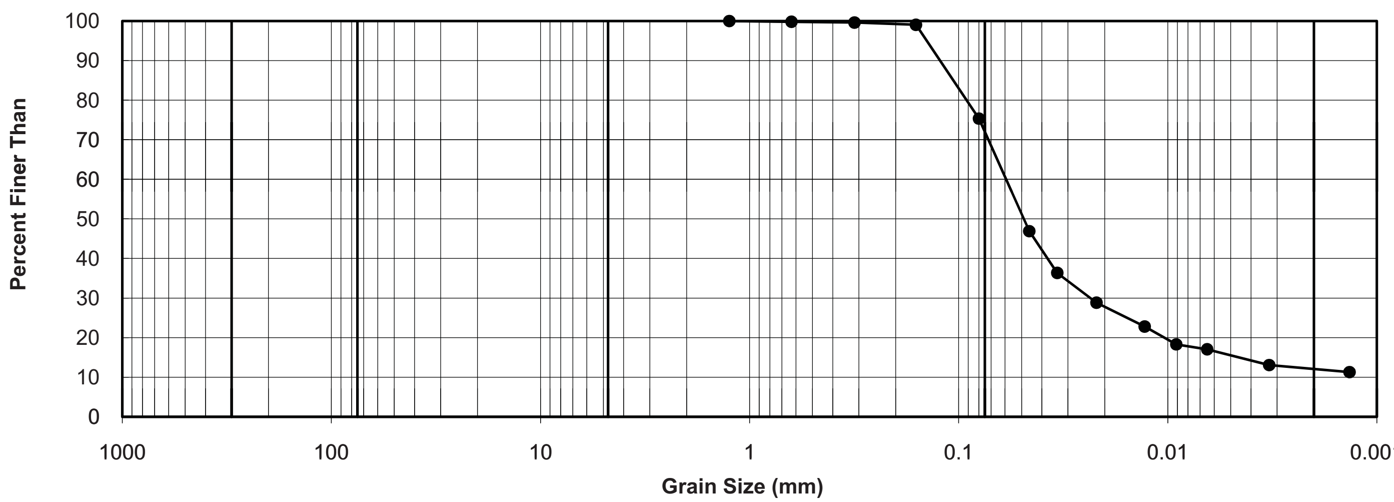
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	GAINT MINE				
Client:	AECOM	Date Sampled:	April 4, 2011		

Sample Number	GA11-T-01, SA5
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	27.4
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
1.25	100.0	Sieve
0.6	99.8	Sieve
0.32	99.6	Sieve
0.16	99.1	Sieve
0.080	75.3	Sieve
0.046	46.9	Hydrometer
0.034	36.4	Hydrometer
0.022	28.8	Hydrometer
0.013	22.8	Hydrometer
0.009	18.3	Hydrometer
0.006	17.0	Hydrometer
0.003	13.1	Hydrometer
0.001	11.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 29.7 Silt% 58.4 Clay% 11.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:47:54 -06'00'

Reviewed By:

Golder Associates

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	GAINT MINE				
Client:	AECOM	Date Sampled:	April 4, 2011		

Sample Number: GA11-T-01, SA7
Sample Location: GIANT MINE

Sampled By: 0.0

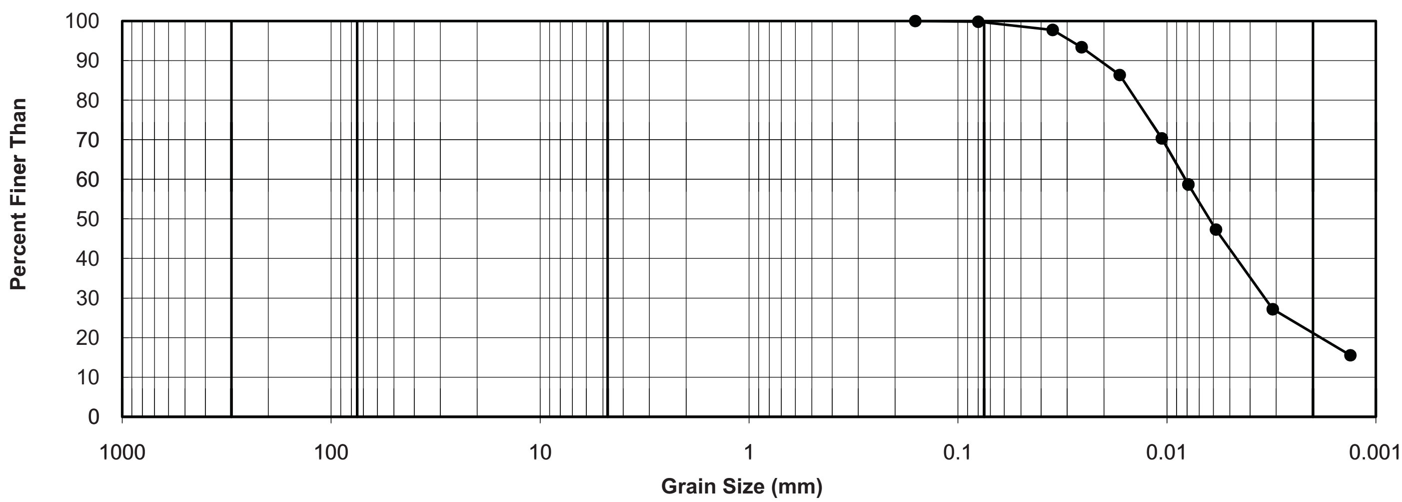
Source: INSITU
Sample Description: See Borehole Logs

In situ Water Content: 34.4
Date Tested: Tuesday, May 10, 2011
Tested By: RB

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.8	Sieve
0.035	97.7	Hydrometer
0.026	93.4	Hydrometer
0.017	86.4	Hydrometer
0.011	70.3	Hydrometer
0.008	58.7	Hydrometer
0.006	47.3	Hydrometer
0.003	27.2	Hydrometer
0.001	15.5	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.5	Silt%	79.6	Clay%	19.9

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:33:33 -06'00'

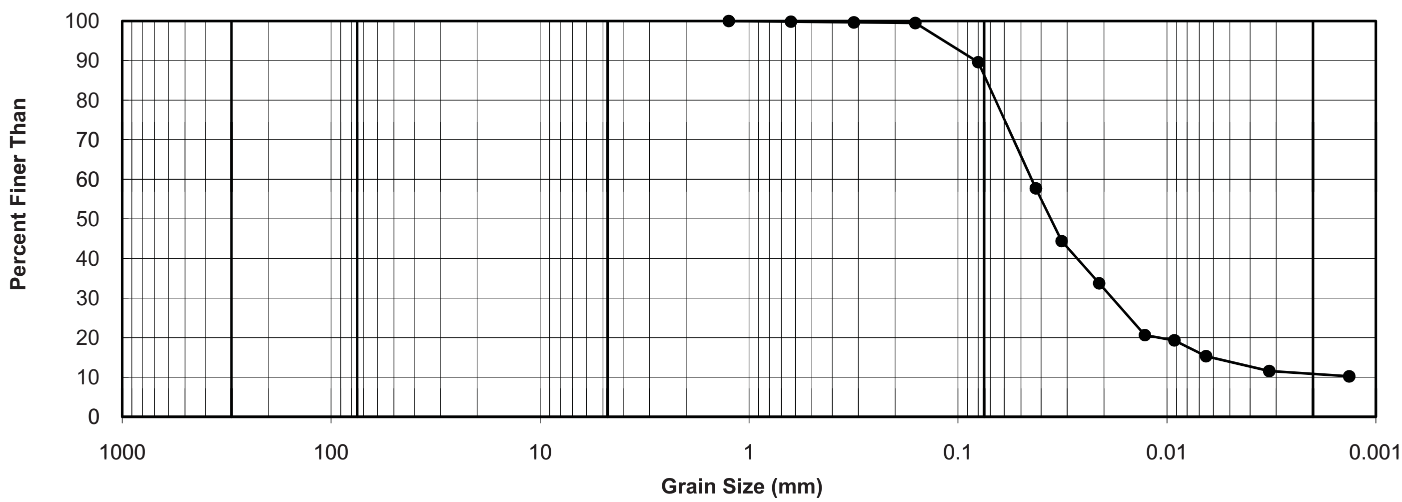
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #: 09-1427-0006 Phase: 2100 Report Number: A2615
Short Title: GAINT MINE
Client: AECOM Date Sampled: April 4, 2011

Sample Number	GA11-T-01, SA9
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	23.0
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
1.25	100.0	Sieve
0.6	99.8	Sieve
0.32	99.7	Sieve
0.16	99.5	Sieve
0.080	89.6	Sieve
0.042	57.7	Hydrometer
0.032	44.4	Hydrometer
0.021	33.7	Hydrometer
0.013	20.6	Hydrometer
0.009	19.3	Hydrometer
0.006	15.3	Hydrometer
0.003	11.6	Hydrometer
0.001	10.2	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	15.5	Silt%	73.8	Clay%	10.7

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:32:34 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Golder Associates

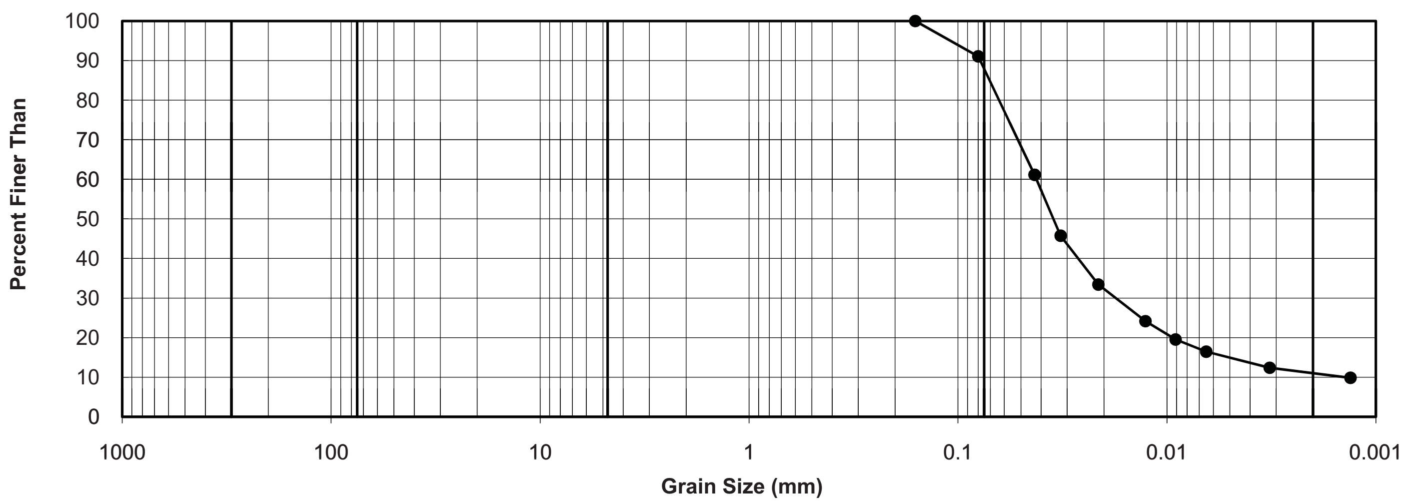
Project #:	09-1427-0006	Phase: 2100	Report Number: A2615
Short Title:	GAINT MINE		
Client:	AECOM	Date Sampled: April 4, 2011	

Sample Number	GA11-T-01, SA11
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	23.6
Date Tested	Tuesday, May 10, 2011
Tested By	RB

Remarks:

Distribution

	Gradation Size (mm)	Percent Passing
Sieve		
	0.16	100.0
	0.080	91.1
Hydrometer	0.043	61.1
	0.032	45.7
	0.021	33.4
	0.013	24.2
	0.009	19.5
	0.006	16.4
	0.003	12.4
	0.001	9.8



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	13.8	Silt%	75.5	Clay%	10.7

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:54:34 -06'00'

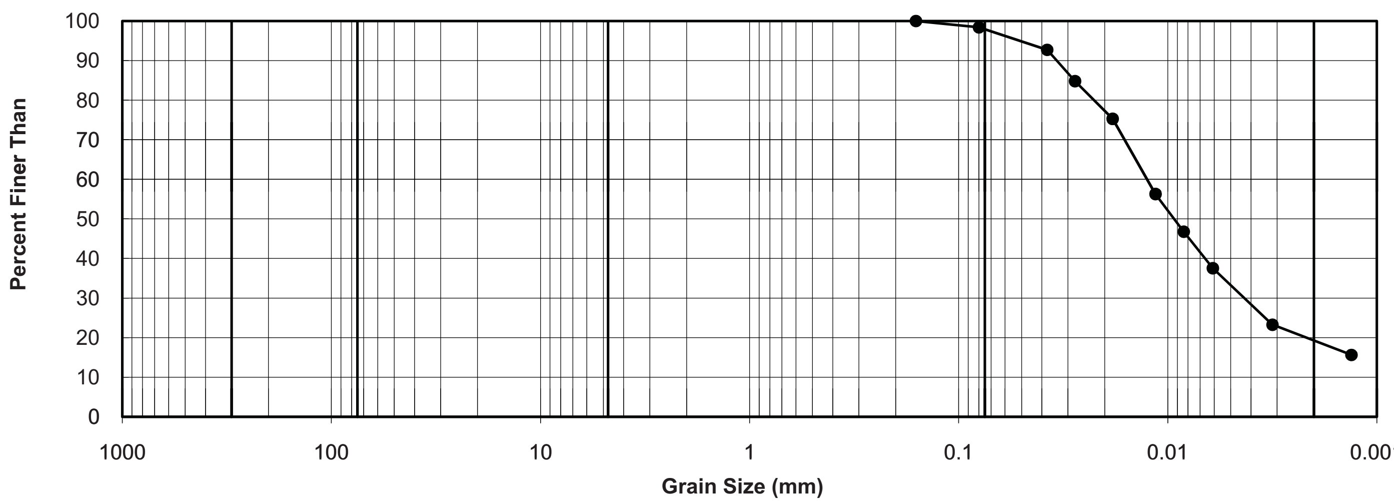
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	GAINT MINE				
Client:	AECOM	Date Sampled:	April 4, 2011		

Sample Number	GA11-T-01, SA13
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	25.7
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

	Gradation Size (mm)	Percent Passing
Sieve		
	0.16	100.0
	0.080	98.4
Hydrometer	0.038	92.7
	0.028	84.8
	0.018	75.3
	0.011	56.3
	0.008	46.7
	0.006	37.5
	0.003	23.3
	0.001	15.6



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 2.4 Silt% 79.2 Clay% 18.4

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:53:46 -06'00'

Reviewed By:

Golder Associates

Particle Size Analysis of Soils
ASTM D422

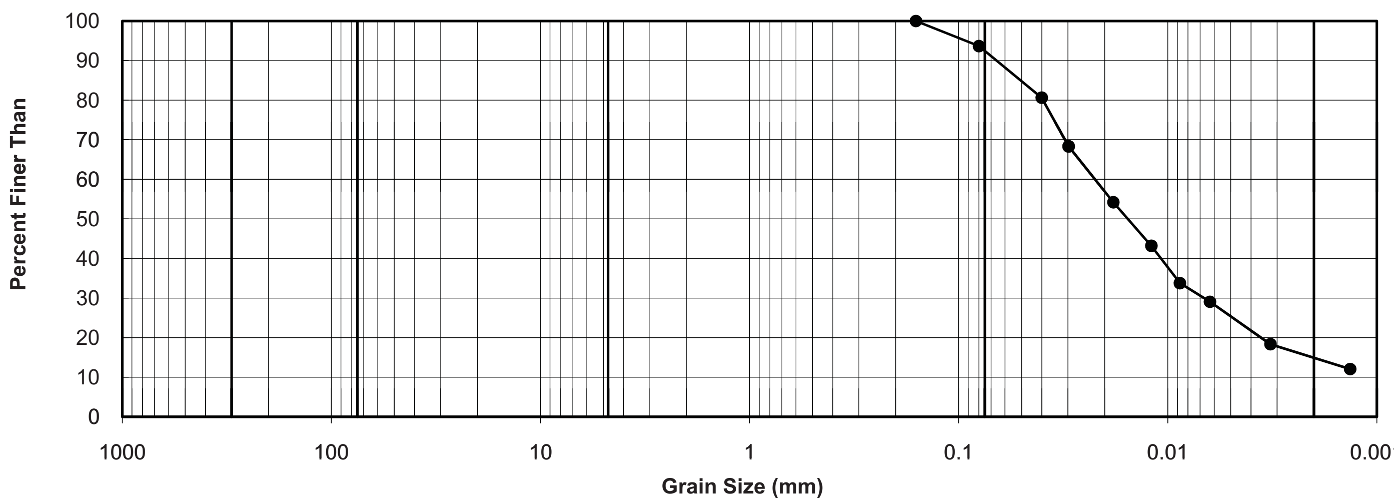
Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	GAINT MINE			
Client:	AECOM	Date Sampled:	April 4, 2011	

Sample Number	GA11-T-01, SA15
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	27.2
Date Tested	Tuesday, May 10, 2011
Tested By	RB

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	93.7	Sieve
0.040	80.6	Hydrometer
0.030	68.3	Hydrometer
0.018	54.2	Hydrometer
0.012	43.2	Hydrometer
0.009	33.8	Hydrometer
0.006	29.1	Hydrometer
0.003	18.3	Hydrometer
0.001	12.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 8.3 Silt% 77.5 Clay% 14.2

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:52:49 -06'00'

Reviewed By:

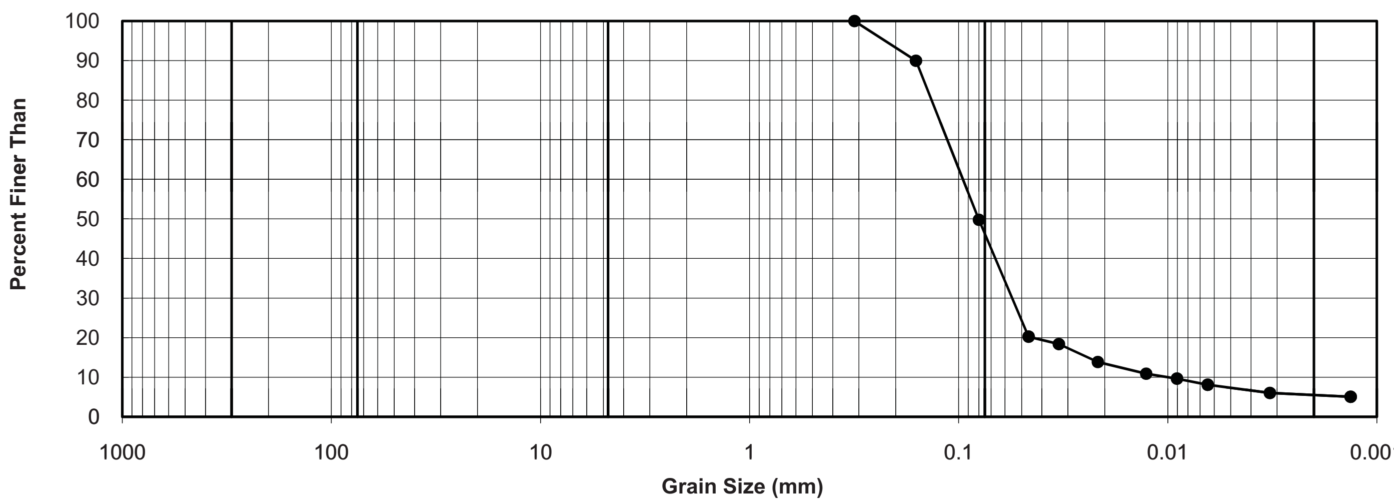
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-02, SA2
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	14.8
Date Tested	Wednesday, April 20, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	90.0	Sieve
0.080	49.8	Sieve
0.046	20.2	Hydrometer
0.033	18.4	Hydrometer
0.022	13.8	Hydrometer
0.013	10.9	Hydrometer
0.009	9.6	Hydrometer
0.006	8.1	Hydrometer
0.003	6.0	Hydrometer
0.001	5.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	55.5	Silt%	39.1	Clay%	5.4

Reviewed By: _______________

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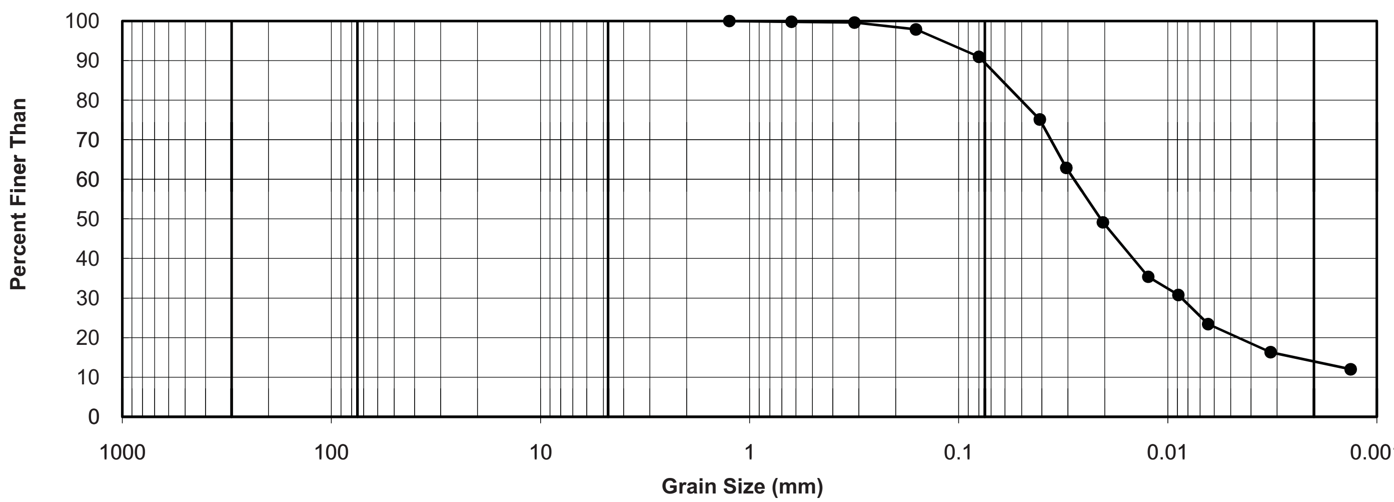
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:07:54 -06'00'

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	GAINT MINE				
Client:	AECOM	Date Sampled:	April 4, 2011		

Sample Number	GA11-T-02, SA5
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	21.0
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
1.25	100.0	Sieve
0.6	99.8	Sieve
0.32	99.6	Sieve
0.16	97.9	Sieve
0.080	91.0	Sieve
0.041	75.1	Hydrometer
0.031	62.9	Hydrometer
0.020	49.1	Hydrometer
0.012	35.4	Hydrometer
0.009	30.8	Hydrometer
0.006	23.4	Hydrometer
0.003	16.3	Hydrometer
0.001	12.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 11.5 Silt% 75.0 Clay% 13.5

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:31:50 -06'00'

Reviewed By:

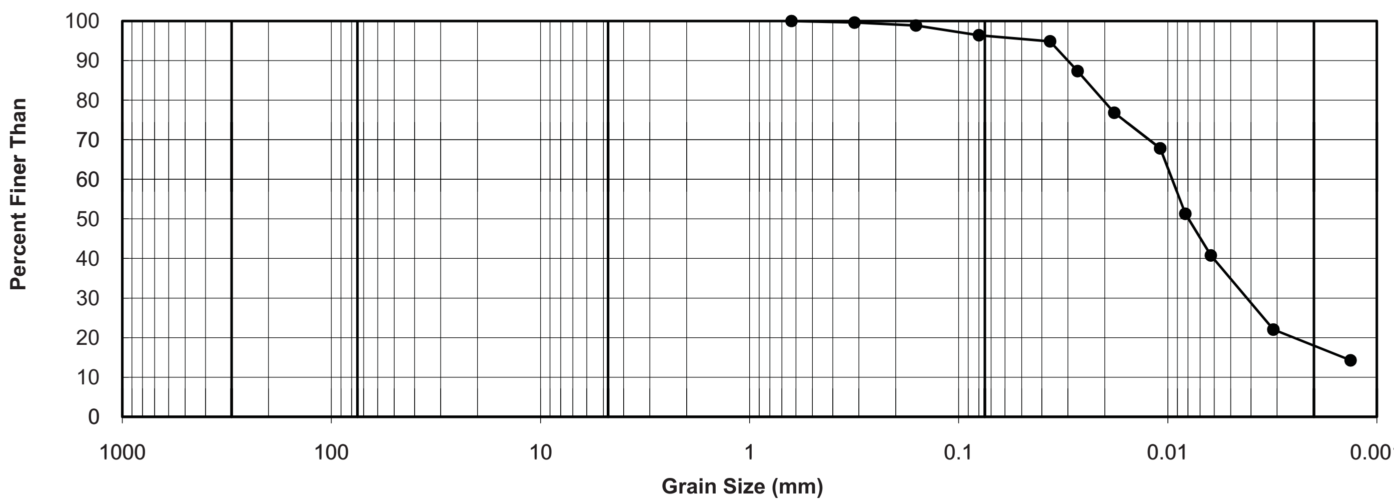
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	GAINT MINE			
Client:	AECOM	Date Sampled:	April 4, 2011	

Sample Number	GA11-T-02, SA7
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	32.0
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.6	Sieve
0.16	98.9	Sieve
0.080	96.4	Sieve
0.037	94.9	Hydrometer
0.027	87.4	Hydrometer
0.018	76.8	Hydrometer
0.011	67.8	Hydrometer
0.008	51.3	Hydrometer
0.006	40.8	Hydrometer
0.003	22.0	Hydrometer
0.001	14.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 3.8 Silt% 79.0 Clay% 17.2

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:30:54 -06'00'

Reviewed By: ______________________

Particle Size Analysis of Soils
ASTM D422

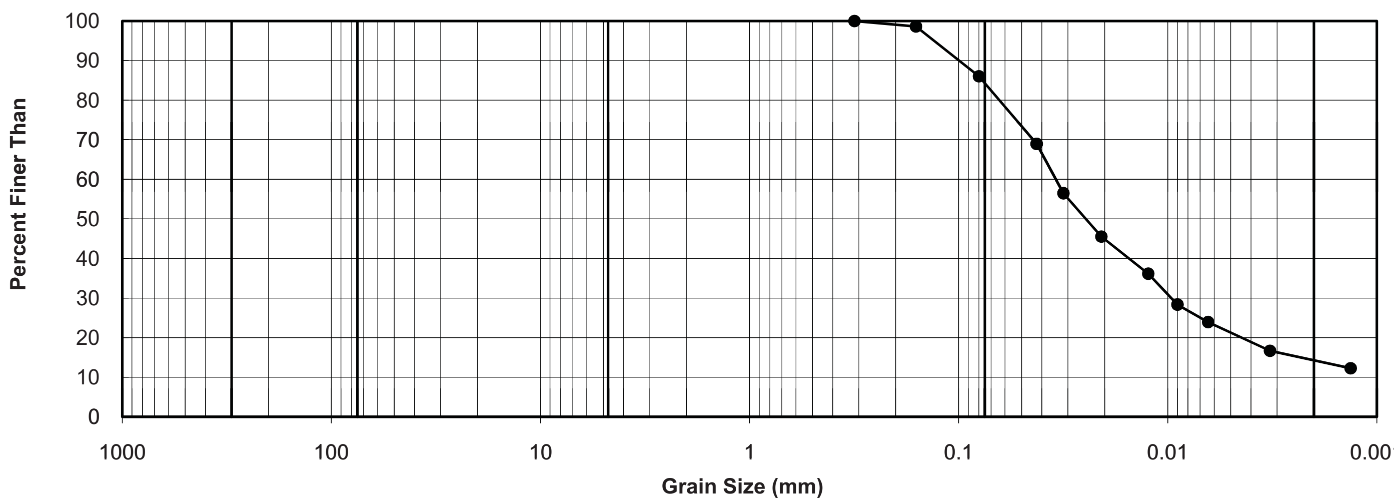
Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	GAINT MINE				
Client:	AECOM	Date Sampled:	April 4, 2011		

Sample Number	GA11-T-02, SA9
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	29.0
Date Tested	Tuesday, May 10, 2011
Tested By	RB

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.6	Sieve
0.080	86.0	Sieve
0.042	69.0	Hydrometer
0.032	56.5	Hydrometer
0.021	45.5	Hydrometer
0.012	36.1	Hydrometer
0.009	28.3	Hydrometer
0.006	23.9	Hydrometer
0.003	16.7	Hydrometer
0.001	12.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	16.7	Silt%	69.5	Clay%	13.8

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:29:43 -06'00'

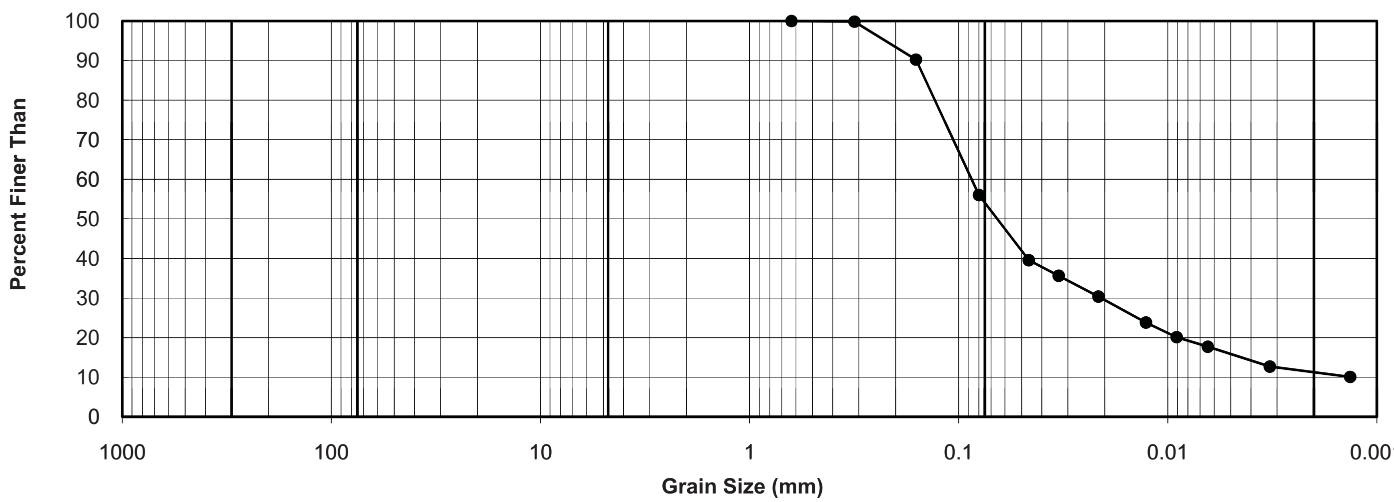
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #: 09-1427-0006 Phase: 2100 Report Number: A2615
Short Title: GAINT MINE
Client: AECOM Date Sampled: April 4, 2011

Sample Number	GA11-T-02, SA11
Sample Location	GIANT MINE
Sampled By	0.0
Source	INSITU
Sample Description	See Borehole Logs
In situ Water Content	22.0
Date Tested	Tuesday, May 10, 2011
Tested By	RB
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.8	Sieve
0.16	90.2	Sieve
0.080	56.0	Sieve
0.046	39.6	Hydrometer
0.033	35.6	Hydrometer
0.021	30.4	Hydrometer
0.013	23.8	Hydrometer
0.009	20.1	Hydrometer
0.006	17.7	Hydrometer
0.003	12.7	Hydrometer
0.001	10.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 46.9 Silt% 42.1 Clay% 11.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.05.12 11:28:49 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number GA11-T-04, SA5
Sample Location Giant Mine

Sampled By JB

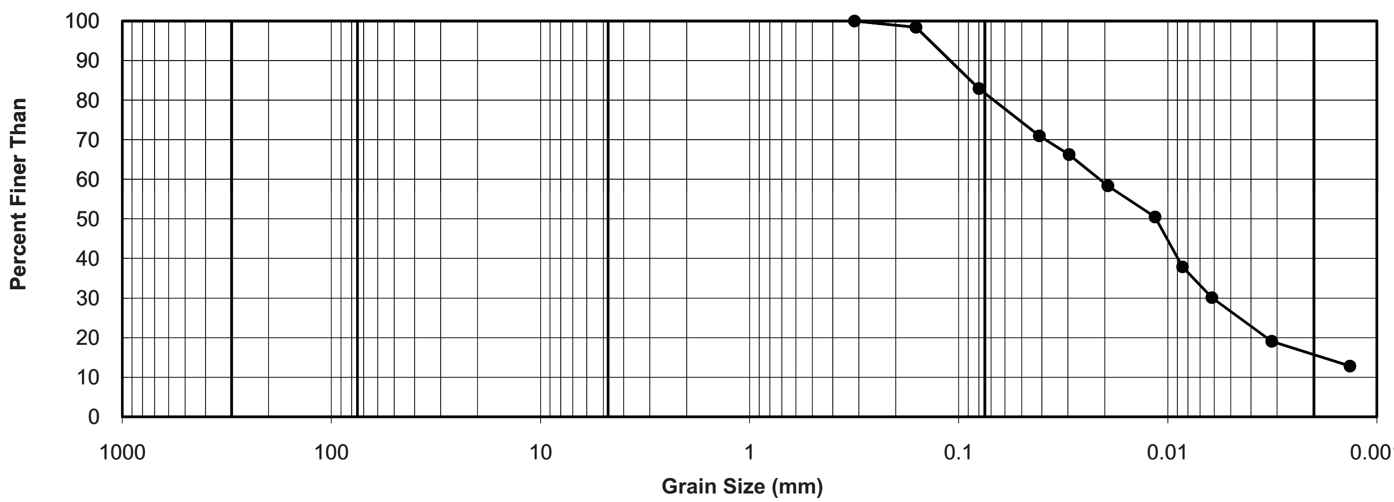
Source
Sample Description

In situ Water Content 31.0
Date Tested Friday, April 08, 2011
Tested By AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.4	Sieve
0.080	82.9	Sieve
0.041	71.0	Hydrometer
0.030	66.3	Hydrometer
0.019	58.4	Hydrometer
0.012	50.5	Hydrometer
0.009	37.9	Hydrometer
0.006	30.1	Hydrometer
0.003	19.1	Hydrometer
0.001	12.8	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 18.9 Silt% 66.0 Clay% 15.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:41:39 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number: GA11-T-04, SA6
Sample Location: Giant Mine

Sampled By: JB

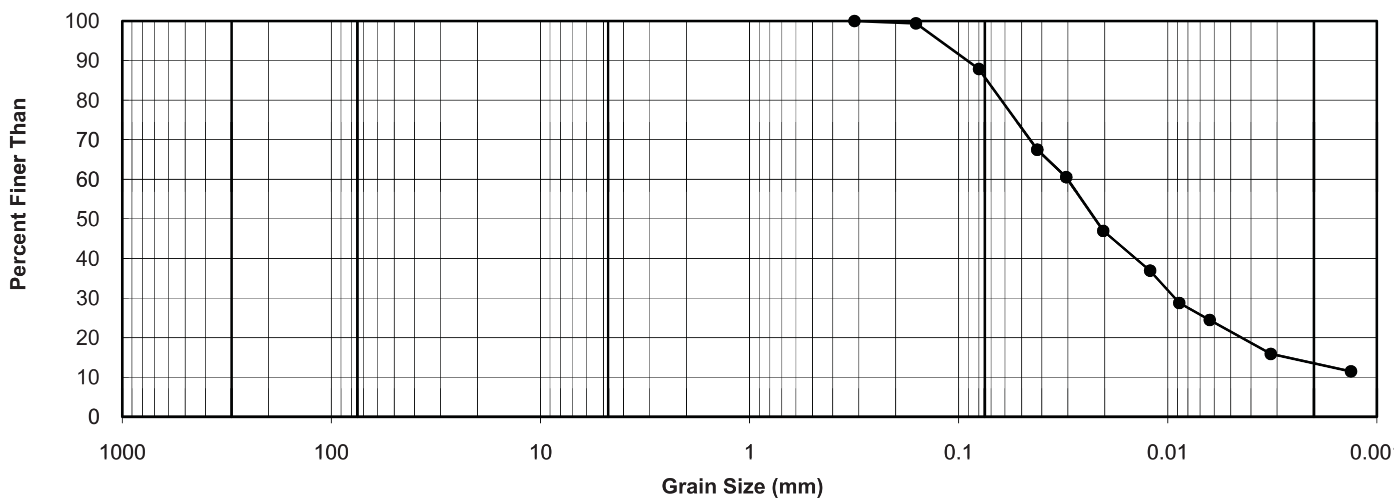
Source:
Sample Description:

In situ Water Content: 25.4
Date Tested: Wednesday, April 20, 2011
Tested By: AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	99.4	Sieve
0.080	87.9	Sieve
0.042	67.5	Hydrometer
0.031	60.5	Hydrometer
0.020	47.0	Hydrometer
0.012	36.9	Hydrometer
0.009	28.8	Hydrometer
0.006	24.4	Hydrometer
0.003	15.9	Hydrometer
0.001	11.5	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 15.4 Silt% 71.6 Clay% 13.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:11:35 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

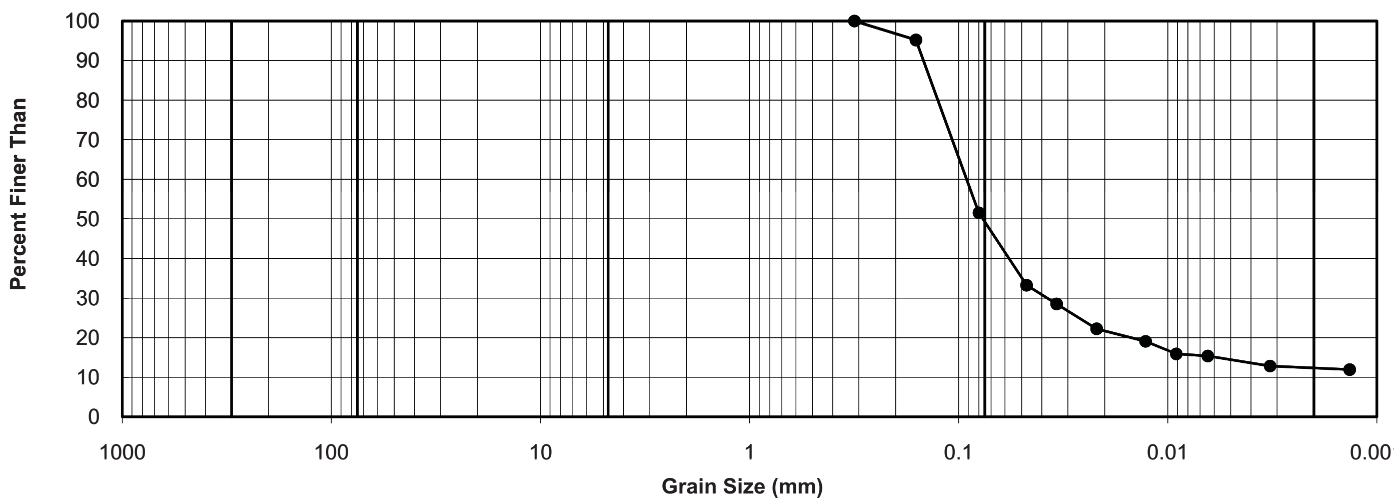
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number	GA11-T-04, SA8
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	24.9
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	95.2	Sieve
0.080	51.5	Sieve
0.047	33.3	Hydrometer
0.034	28.5	Hydrometer
0.022	22.2	Hydrometer
0.013	19.1	Hydrometer
0.009	15.9	Hydrometer
0.006	15.4	Hydrometer
0.003	12.8	Hydrometer
0.001	11.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 51.8 Silt% 35.9 Clay% 12.2

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.04.18 09:35:20 -06'00'

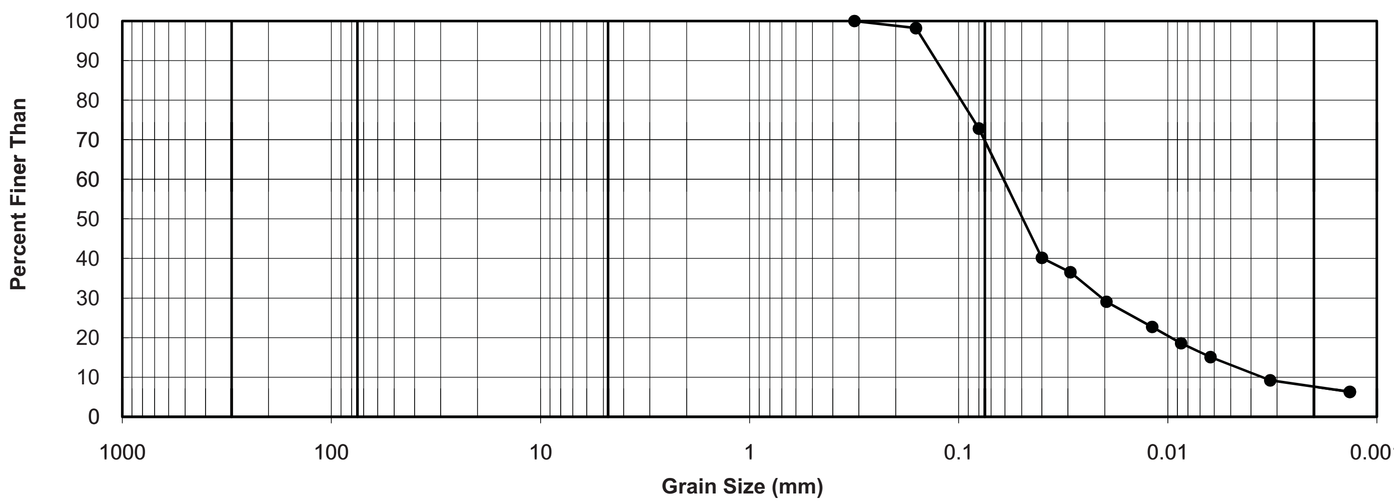
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-4 SA10
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	21.6
Date Tested	Wednesday, April 13, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.2	Sieve
0.080	72.8	Sieve
0.040	40.2	Hydrometer
0.029	36.5	Hydrometer
0.020	29.0	Hydrometer
0.012	22.7	Hydrometer
0.009	18.6	Hydrometer
0.006	15.1	Hydrometer
0.003	9.2	Hydrometer
0.001	6.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 32.1 Silt% 60.6 Clay% 7.3

Reviewed By: Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.04.27 15:22:37 -06'00'

Particle Size Analysis of Soils
ASTM D422

Project #: 09-1427-0006 Phase: 2100 Report Number: A2615
Short Title: Giant Mine
Client: AECOM Date Sampled:

Sample Number GA11-T-04, SA12
Sample Location Giant Mine

Sampled By JB

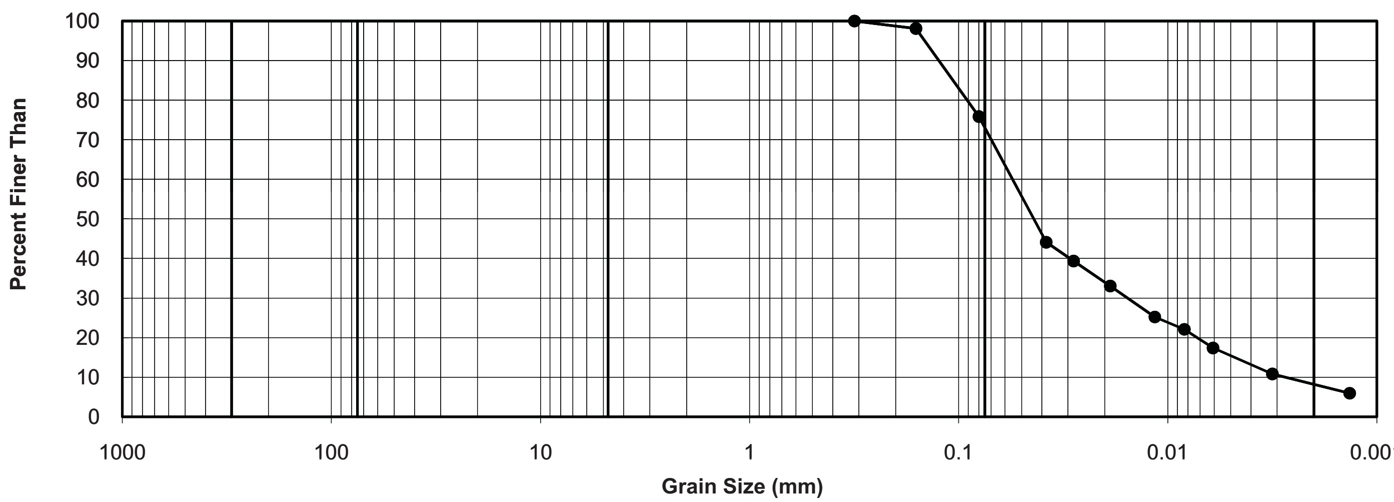
Source
Sample Description

In situ Water Content 24.3
Date Tested Friday, April 08, 2011
Tested By AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.1	Sieve
0.080	75.9	Sieve
0.038	44.1	Hydrometer
0.028	39.4	Hydrometer
0.019	33.0	Hydrometer
0.012	25.2	Hydrometer
0.008	22.1	Hydrometer
0.006	17.4	Hydrometer
0.003	10.8	Hydrometer
0.001	5.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 28.7 Silt% 63.6 Clay% 7.7

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.18 09:34:48 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number: GA11-T-04, 15
Sample Location: Giant Mine

Sampled By: JB

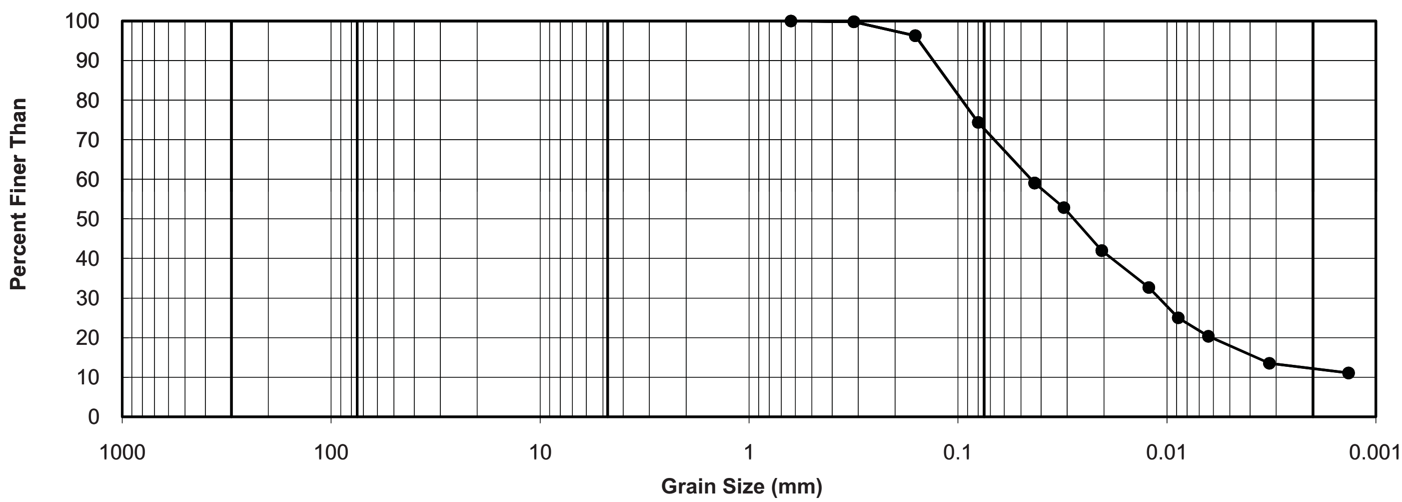
Source
Sample Description

In situ Water Content: 21.3
Date Tested: Friday, April 08, 2011
Tested By: AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.8	Sieve
0.16	96.3	Sieve
0.080	74.4	Sieve
0.043	59.1	Hydrometer
0.031	52.8	Hydrometer
0.020	42.0	Hydrometer
0.012	32.7	Hydrometer
0.009	25.0	Hydrometer
0.006	20.3	Hydrometer
0.003	13.5	Hydrometer
0.001	11.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	28.1	Silt%	60.0	Clay%	11.9

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:40:55 -06'00'

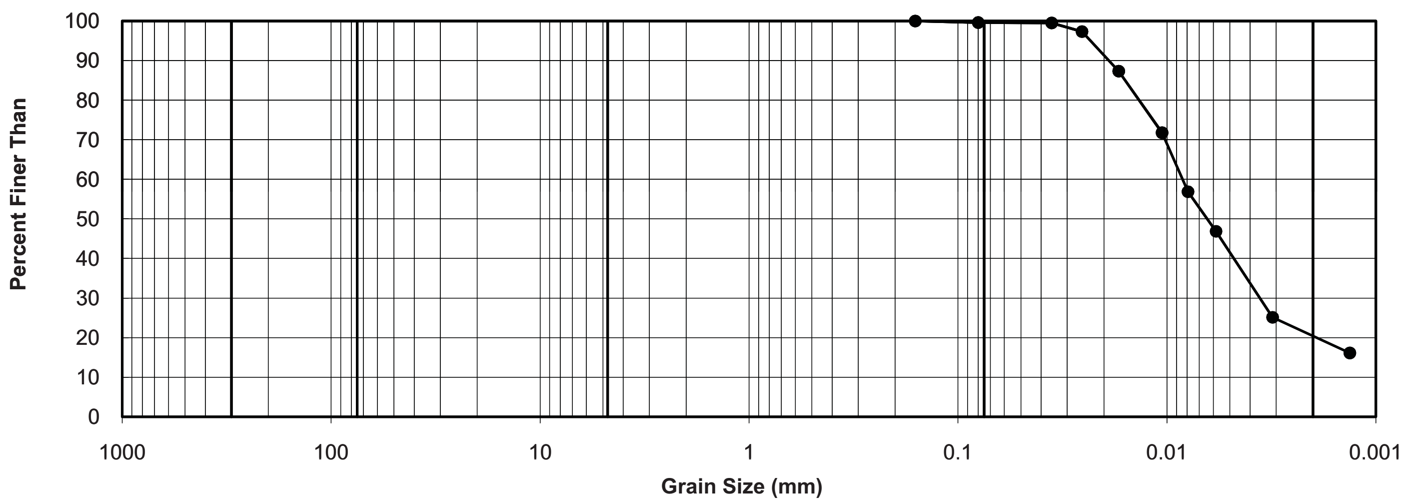
Reviewed By: ________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-04, SA18
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	30.8
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.6	Sieve
0.036	99.5	Hydrometer
0.025	97.3	Hydrometer
0.017	87.3	Hydrometer
0.011	71.8	Hydrometer
0.008	56.9	Hydrometer
0.006	46.9	Hydrometer
0.003	25.1	Hydrometer
0.001	16.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.4 Silt% 80.1 Clay% 19.5

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.18 09:34:12 -06'00'

Reviewed By:

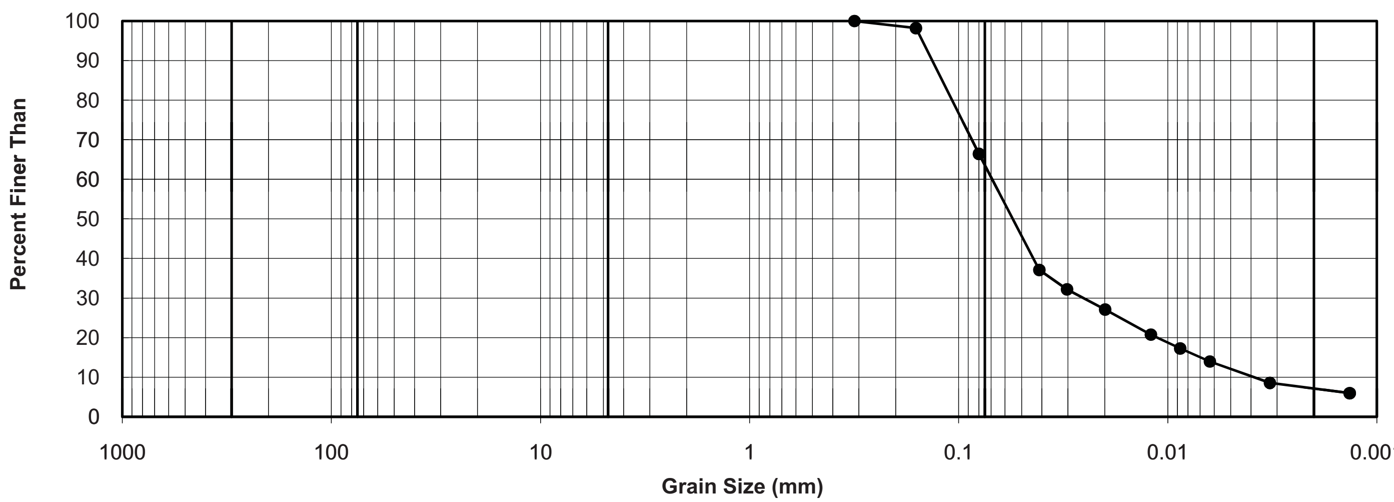
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Tailings Pond				
Client:	AECOM	Date Sampled:	January 0, 1900		

Sample Number	GA11-T-6 SA7
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	23.0
Date Tested	Wednesday, April 13, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.2	Sieve
0.080	66.4	Sieve
0.041	37.1	Hydrometer
0.030	32.2	Hydrometer
0.020	27.1	Hydrometer
0.012	20.8	Hydrometer
0.009	17.3	Hydrometer
0.006	14.0	Hydrometer
0.003	8.6	Hydrometer
0.001	6.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	38.1	Silt%	55.0	Clay%	6.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 10:59:25 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

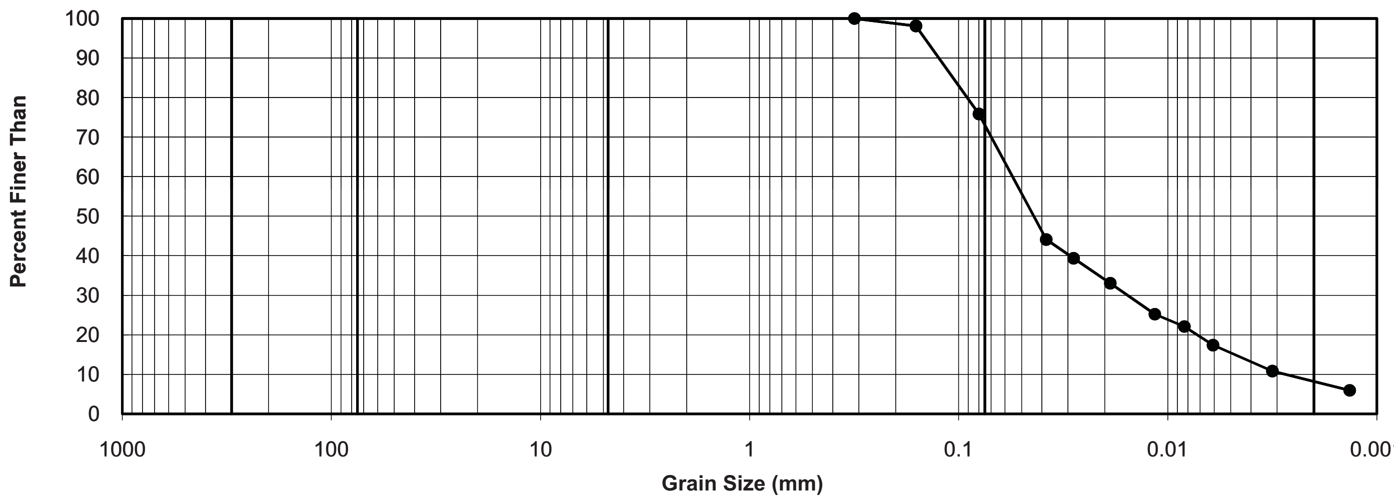
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number	GA11-T-06, SA09
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	26.3
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.9	100.0	Sieve
0.43	99.9	Sieve
0.15	99.8	Sieve
0.075	88.9	Sieve
0.036	60.2	Hydrometer
0.023	53.9	Hydrometer
0.014	41.2	Hydrometer
0.010	28.6	Hydrometer
0.007	22.3	Hydrometer
0.005	15.0	Hydrometer
0.004	7.6	Hydrometer
0.002	3.2	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	11.1	Silt%	85.7	Clay%	3.2

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 11:11:07 -06'00'

Reviewed By:

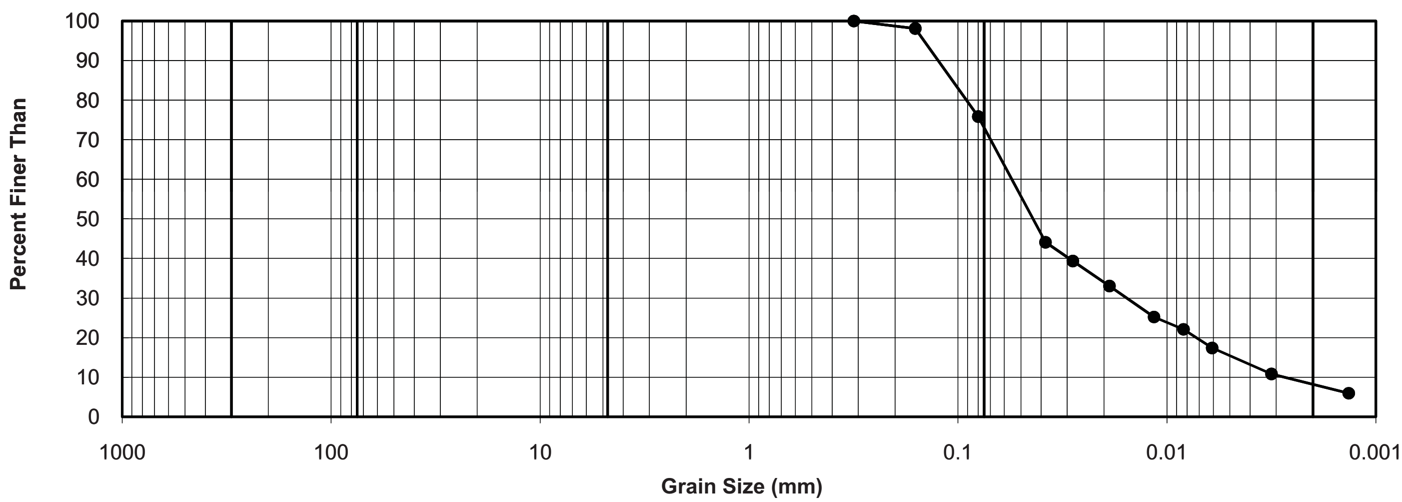
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-06, SA11
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	24.0
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
0.43	100.0	
0.15	98.9	
0.075	72.8	
0.038	50.8	Hydrometer
0.024	43.6	
0.015	32.7	
0.011	22.0	
0.008	16.0	
0.005	13.5	
0.004	5.1	
0.002	1.3	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	27.2	Silt%	71.5	Clay%	1.3

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 15:34:33 -06'00'

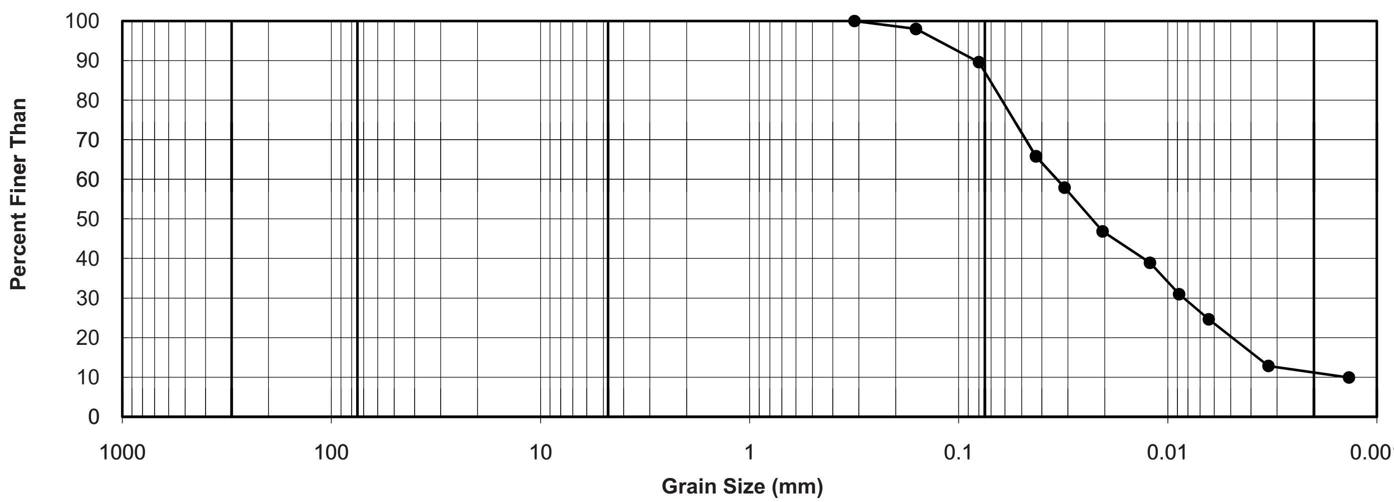
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-06 SA12
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	29.3
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.0	Sieve
0.080	89.6	Sieve
0.043	65.8	Hydrometer
0.031	57.9	Hydrometer
0.020	46.8	Hydrometer
0.012	38.9	Hydrometer
0.009	31.0	Hydrometer
0.006	24.6	Hydrometer
0.003	12.8	Hydrometer
0.001	9.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	14.2	Silt%	74.9	Clay%	10.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:21:58 -06'00'

Reviewed By: ______________________

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #: 09-1427-0006 | Phase: 2100 | Report Number: A2615
Short Title: Tailings Pond
Client: AECOM | Date Sampled: January 0, 1900

Sample Number: GA11-T-6 SA15
Sample Location: Giant Mine

Sampled By: 0.0

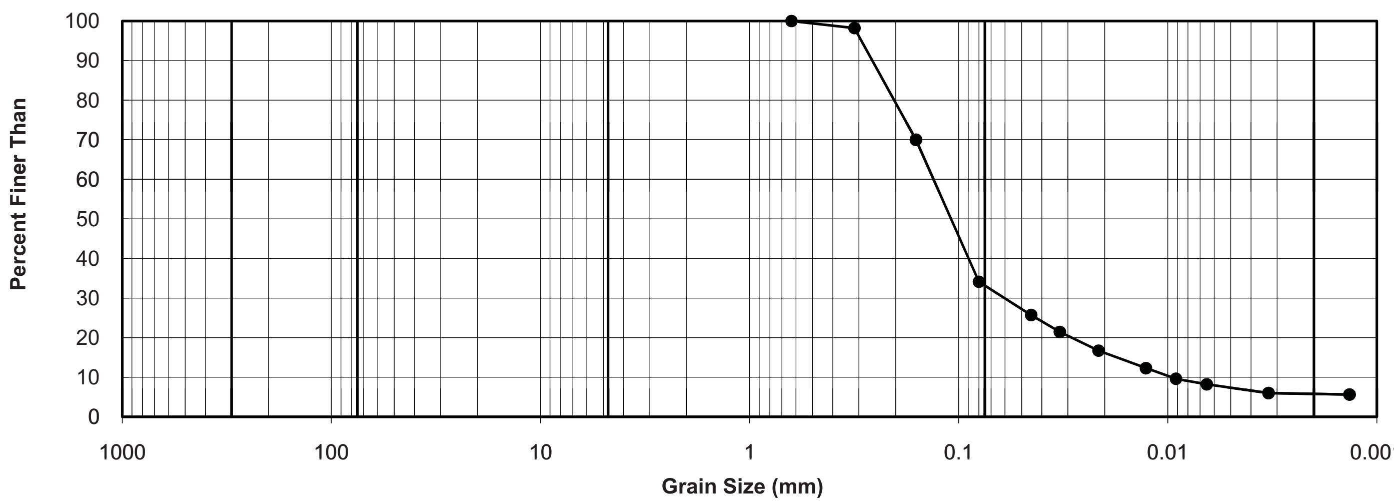
Source: 0.0
Sample Description: 0

In situ Water Content: 26.3
Date Tested: Wednesday, April 13, 2011
Tested By: AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	98.2	Sieve
0.16	70.0	Sieve
0.080	34.1	Sieve
0.045	25.7	Hydrometer
0.033	21.4	Hydrometer
0.021	16.7	Hydrometer
0.013	12.3	Hydrometer
0.009	9.6	Hydrometer
0.007	8.2	Hydrometer
0.003	6.0	Hydrometer
0.001	5.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 67.3 Silt% 26.9 Clay% 5.8

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 10:58:16 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

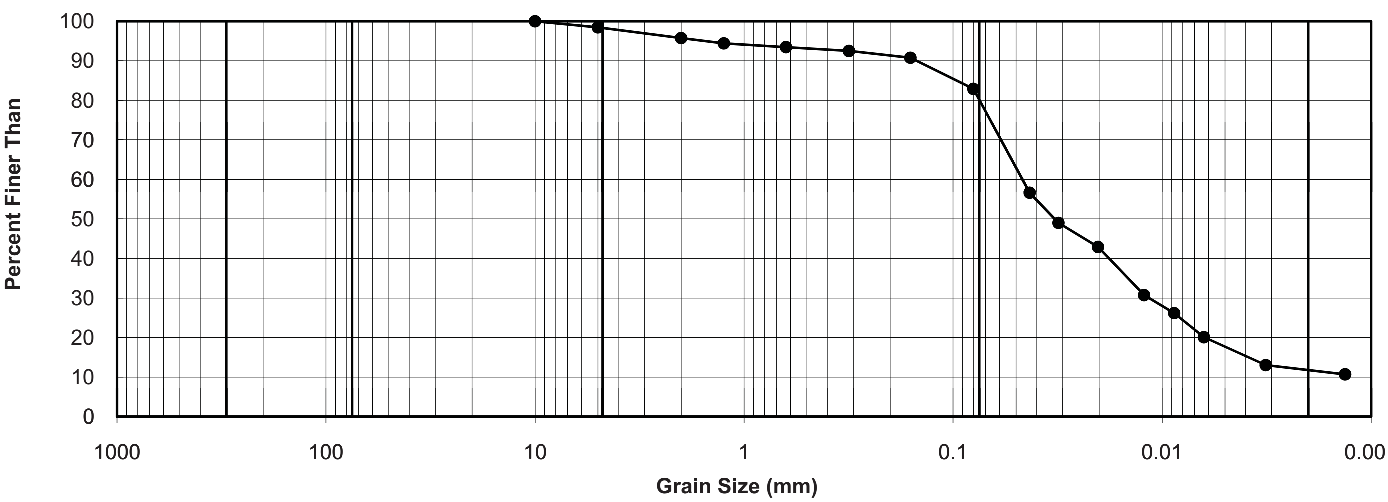
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA3
Sample Location	GA11-T-08
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	27.1
Date Tested	Friday, May 27, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
10	100.0	Sieve
5	98.5	Sieve
2.0	95.7	Sieve
1.25	94.4	Sieve
0.6	93.4	Sieve
0.32	92.5	Sieve
0.16	90.8	Sieve
0.080	82.9	Sieve
0.043	56.6	Hydrometer
0.031	49.0	Hydrometer
0.020	42.9	Hydrometer
0.012	30.7	Hydrometer
0.009	26.2	Hydrometer
0.006	20.1	Hydrometer
0.003	13.0	Hydrometer
0.001	10.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 1.5 Sand % 19.8 Silt% 67.1 Clay% 11.5

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 15:03:34 -06'00'

Reviewed By: ______

Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number SA5
Sample Location GA11-T-08

Sampled By JB

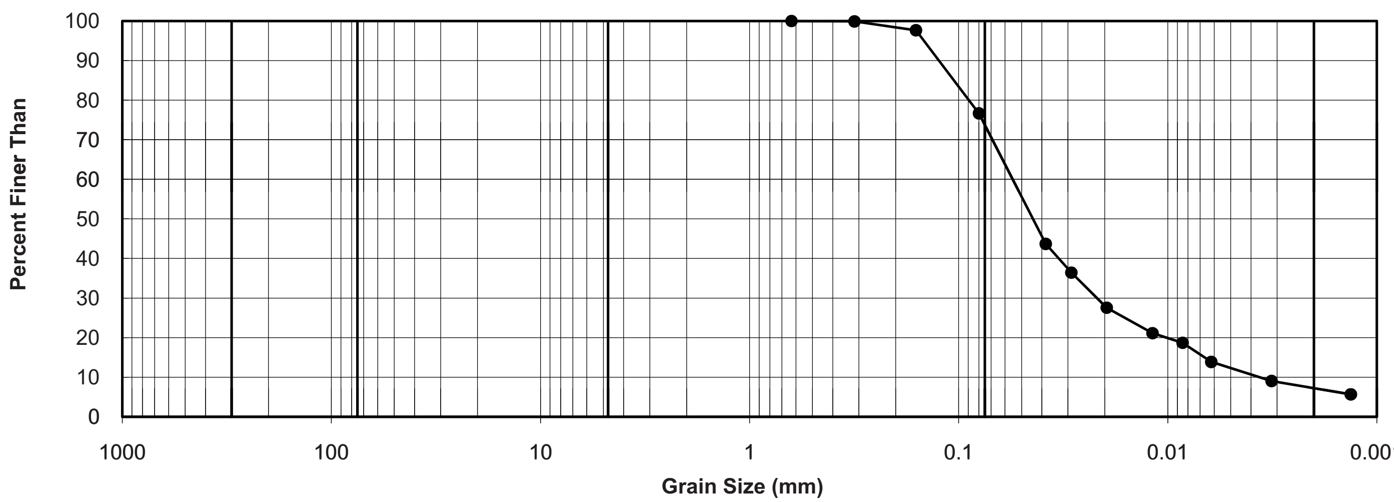
Source Insitu
Sample Description See bore logs

In situ Water Content 22.4
Date Tested Friday, May 27, 2011
Tested By HVD

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.9	Sieve
0.16	97.7	Sieve
0.080	76.7	Sieve
0.038	43.7	Hydrometer
0.029	36.4	Hydrometer
0.020	27.6	Hydrometer
0.012	21.1	Hydrometer
0.008	18.7	Hydrometer
0.006	13.9	Hydrometer
0.003	9.0	Hydrometer
0.001	5.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 28.1 Silt% 65.0 Clay% 6.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 15:14:05 -06'00'

Reviewed By: ____________________

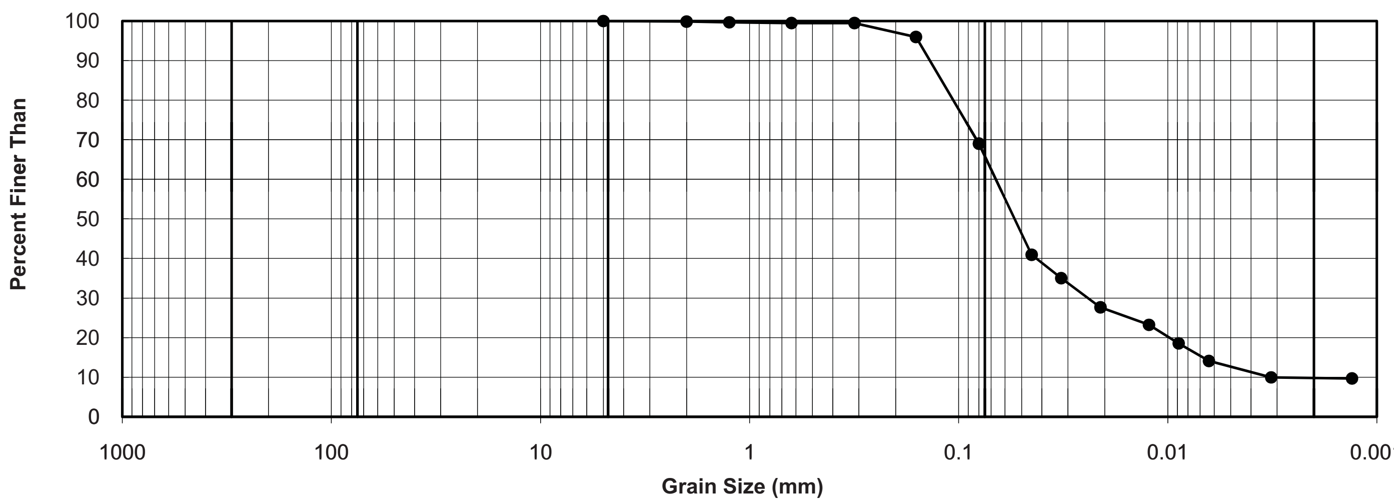
Golder Associates

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA7
Sample Location	GA11-T-08
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	21.5
Date Tested	Friday, May 27, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
5	100.0	Sieve
2.0	99.9	Sieve
1.25	99.7	Sieve
0.6	99.5	Sieve
0.32	99.5	Sieve
0.16	96.0	Sieve
0.080	69.0	Sieve
0.045	40.9	Hydrometer
0.032	35.0	Hydrometer
0.021	27.7	Hydrometer
0.012	23.2	Hydrometer
0.009	18.5	Hydrometer
0.006	14.1	Hydrometer
0.003	9.9	Hydrometer
0.001	9.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 35.8 Silt% 54.5 Clay% 9.8

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 15:12:33 -06'00'

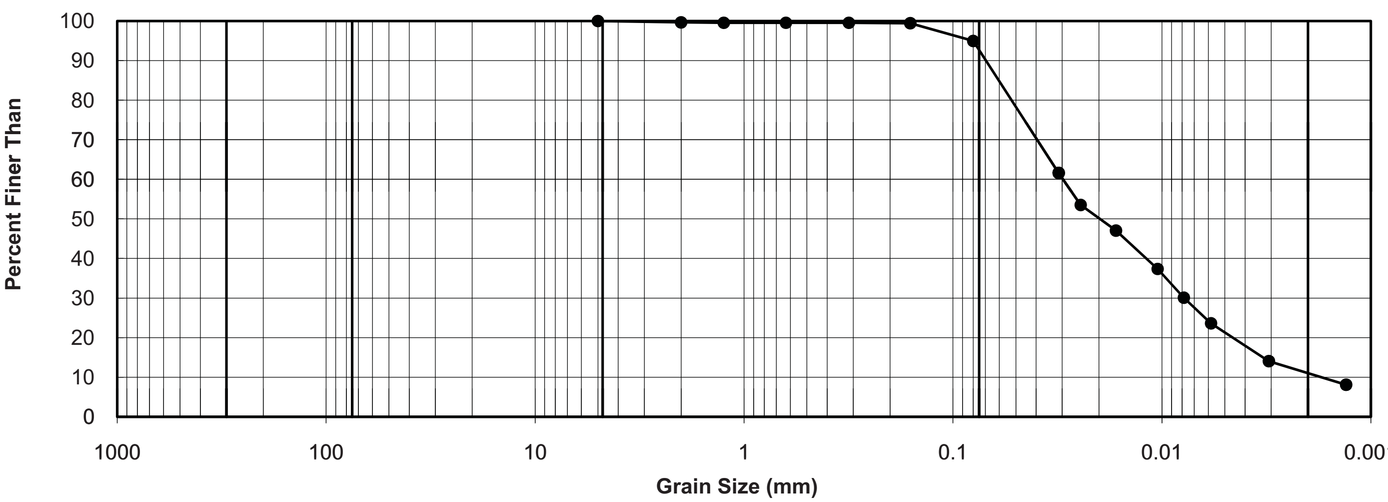
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	9A
Sample Location	GA11-T-08
Sampled By	0.0
Source	Insitu
Sample Description	See bore logs
In situ Water Content	29.1
Date Tested	Friday, May 27, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
5	100.0	
2.0	99.7	
1.25	99.6	
0.6	99.6	
0.32	99.5	
0.16	99.4	
0.080	95.0	
0.031	61.6	Hydrometer
0.024	53.5	
0.017	47.0	
0.010	37.3	
0.008	30.1	
0.006	23.6	
0.003	14.1	
0.001	8.1	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 9.1 Silt% 80.5 Clay% 10.4

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 15:01:15 -06'00'

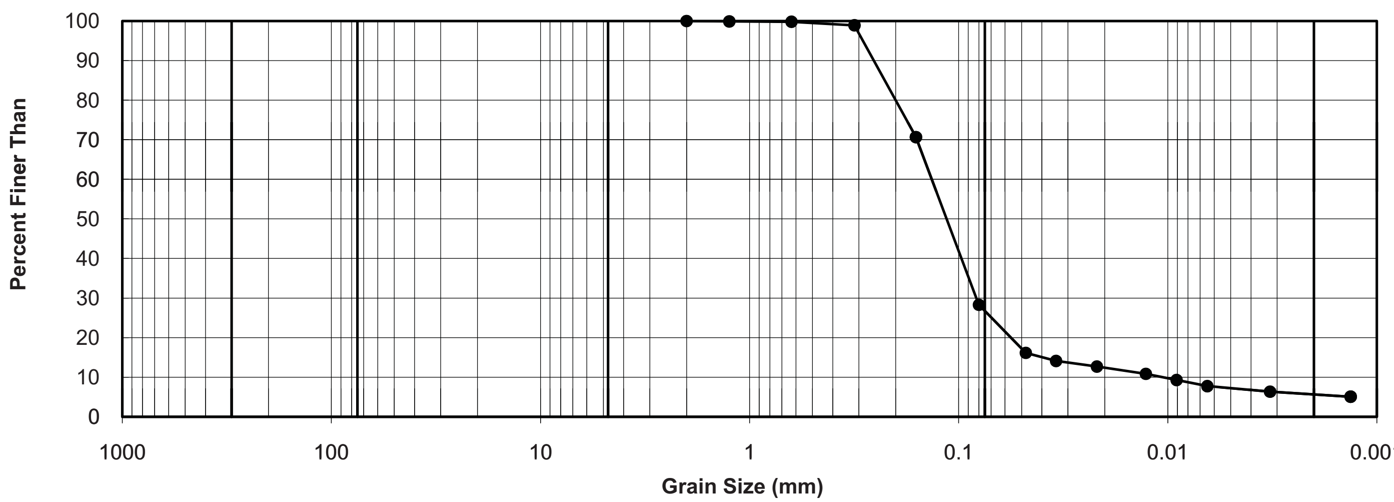
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-09, SA2
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	17.9
Date Tested	Wednesday, April 20, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
2.0	100.0	Sieve
1.25	99.9	Sieve
0.6	99.8	Sieve
0.32	98.9	Sieve
0.16	70.7	Sieve
0.080	28.3	Sieve
0.048	16.1	Hydrometer
0.034	14.1	Hydrometer
0.022	12.7	Hydrometer
0.013	10.8	Hydrometer
0.009	9.3	Hydrometer
0.006	7.8	Hydrometer
0.003	6.4	Hydrometer
0.001	5.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 74.0 Silt% 20.5 Clay% 5.5

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:06:59 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

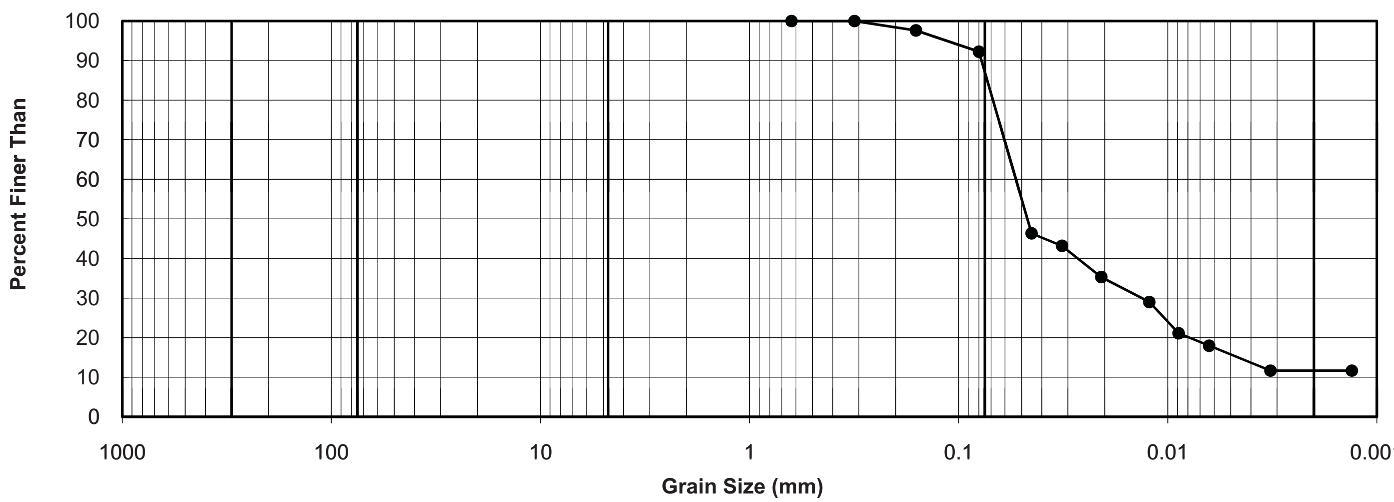
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA3
Sample Location	GA11-T-09
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	21.2
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	100.0	Sieve
0.16	97.6	Sieve
0.080	92.3	Sieve
0.045	46.3	Hydrometer
0.032	43.2	Hydrometer
0.021	35.3	Hydrometer
0.012	29.0	Hydrometer
0.009	21.1	Hydrometer
0.006	18.0	Hydrometer
0.003	11.6	Hydrometer
0.001	11.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	15.6	Silt%	72.8	Clay%	11.6

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Date: 2011.06.09 10:10:13 -06'00'

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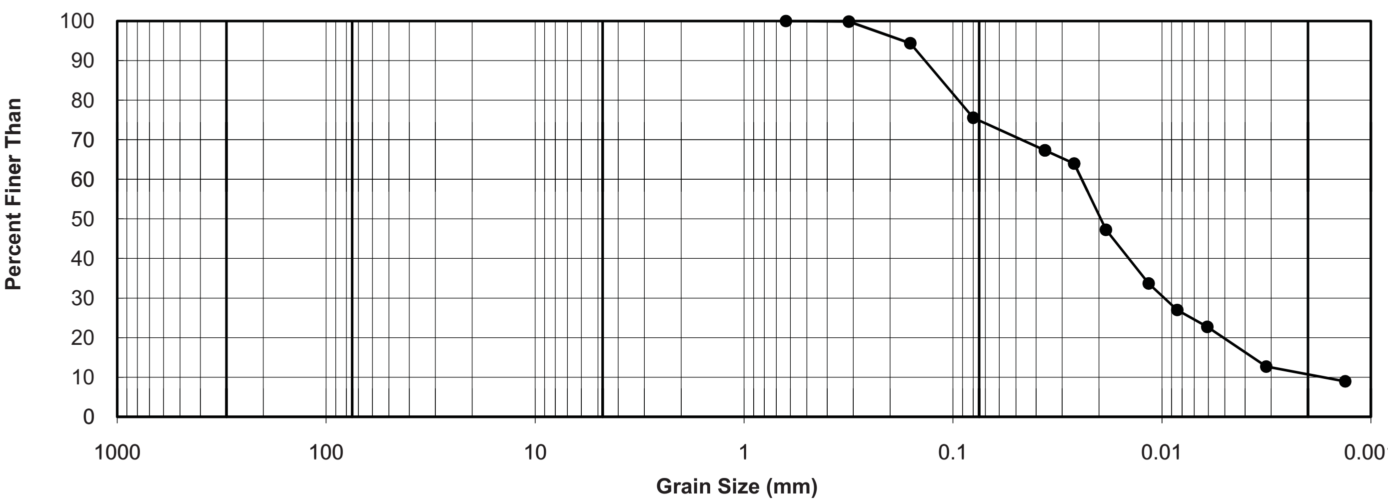
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA5
Sample Location	GA11-T-09
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	26.8
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.9	Sieve
0.16	94.4	Sieve
0.080	75.6	Sieve
0.036	67.3	Hydrometer
0.026	64.0	Hydrometer
0.019	47.3	Hydrometer
0.012	33.7	Hydrometer
0.008	27.0	Hydrometer
0.006	22.7	Hydrometer
0.003	12.7	Hydrometer
0.001	8.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 25.6 Silt% 64.1 Clay% 10.3

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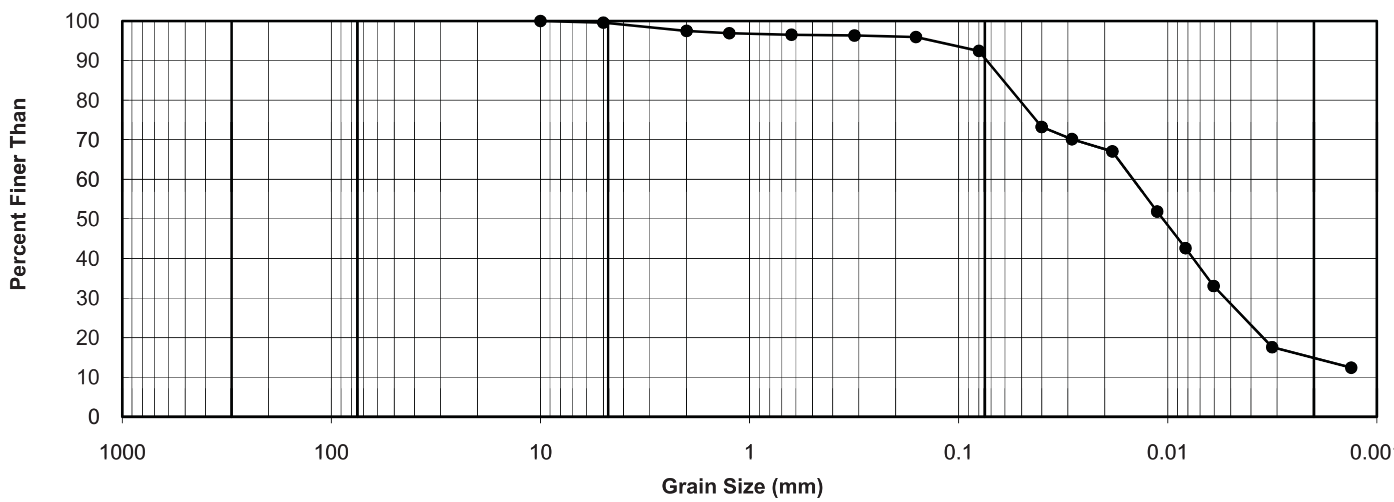
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA9
Sample Location	GA11-T-09
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	20.9
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
10	100.0	Sieve
5	99.6	Sieve
2.0	97.5	Sieve
1.25	96.9	Sieve
0.6	96.5	Sieve
0.32	96.3	Sieve
0.16	95.9	Sieve
0.080	92.4	Sieve
0.040	73.2	Hydrometer
0.029	70.1	Hydrometer
0.018	67.0	Hydrometer
0.011	51.9	Hydrometer
0.008	42.6	Hydrometer
0.006	33.0	Hydrometer
0.003	17.6	Hydrometer
0.001	12.4	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.4	Sand %	10.0	Silt%	75.3	Clay%	14.3

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Date: 2011.06.09 10:04:08 -06'00'

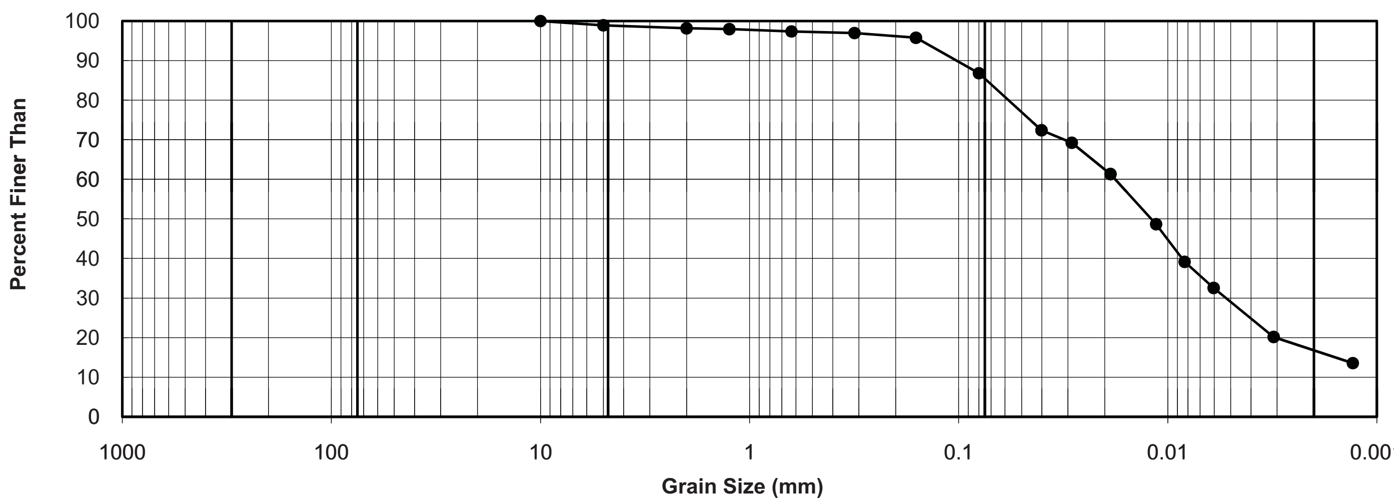
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:	January 0, 1900	

Sample Number	SA10
Sample Location	GA11-T-09
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	23.0
Date Tested	Tuesday, May 31, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
10	100.0	Sieve
5	98.9	Sieve
2.0	98.2	Sieve
1.25	98.0	Sieve
0.6	97.4	Sieve
0.32	97.0	Sieve
0.16	95.8	Sieve
0.080	86.8	Sieve
0.040	72.4	Hydrometer
0.029	69.2	Hydrometer
0.019	61.3	Hydrometer
0.011	48.7	Hydrometer
0.008	39.2	Hydrometer
0.006	32.5	Hydrometer
0.003	20.2	Hydrometer
0.001	13.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 1.1 Sand % 14.3 Silt% 68.5 Clay% 16.1

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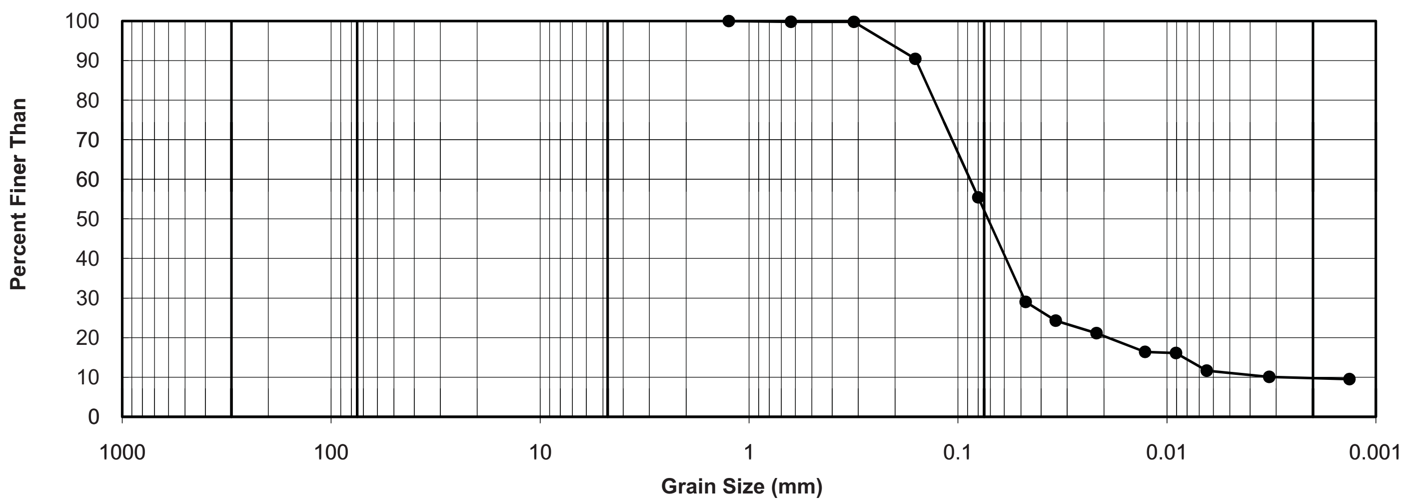
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA2
Sample Location	GA11-T-10
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	22.2
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
1.25	100.0	Sieve
0.6	99.8	Sieve
0.32	99.8	Sieve
0.16	90.5	Sieve
0.080	55.4	Sieve
0.047	29.0	Hydrometer
0.034	24.3	Hydrometer
0.022	21.1	Hydrometer
0.013	16.4	Hydrometer
0.009	16.1	Hydrometer
0.006	11.7	Hydrometer
0.003	10.1	Hydrometer
0.001	9.5	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	49.4	Silt%	40.9	Clay%	9.7

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Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

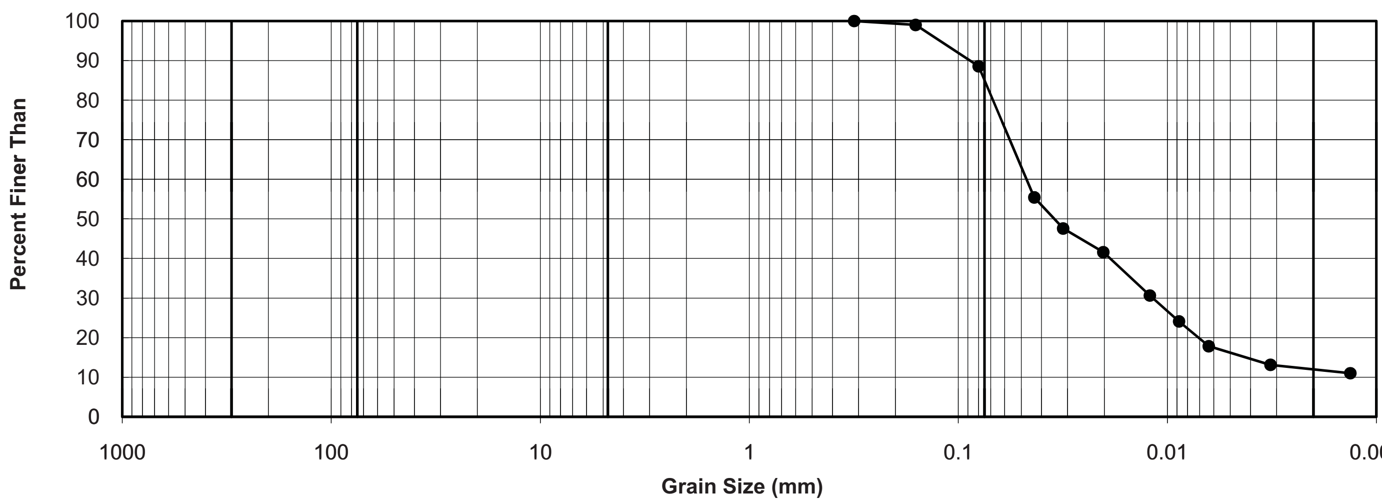
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA6
Sample Location	GA11-T-10
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	26.4
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	99.0	Sieve
0.080	88.6	Sieve
0.043	55.4	Hydrometer
0.032	47.6	Hydrometer
0.020	41.6	Hydrometer
0.012	30.6	Hydrometer
0.009	24.1	Hydrometer
0.006	17.8	Hydrometer
0.003	13.1	Hydrometer
0.001	11.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 16.9 Silt% 71.4 Clay% 11.8

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Date: 2011.06.09 10:01:53 -06'00'

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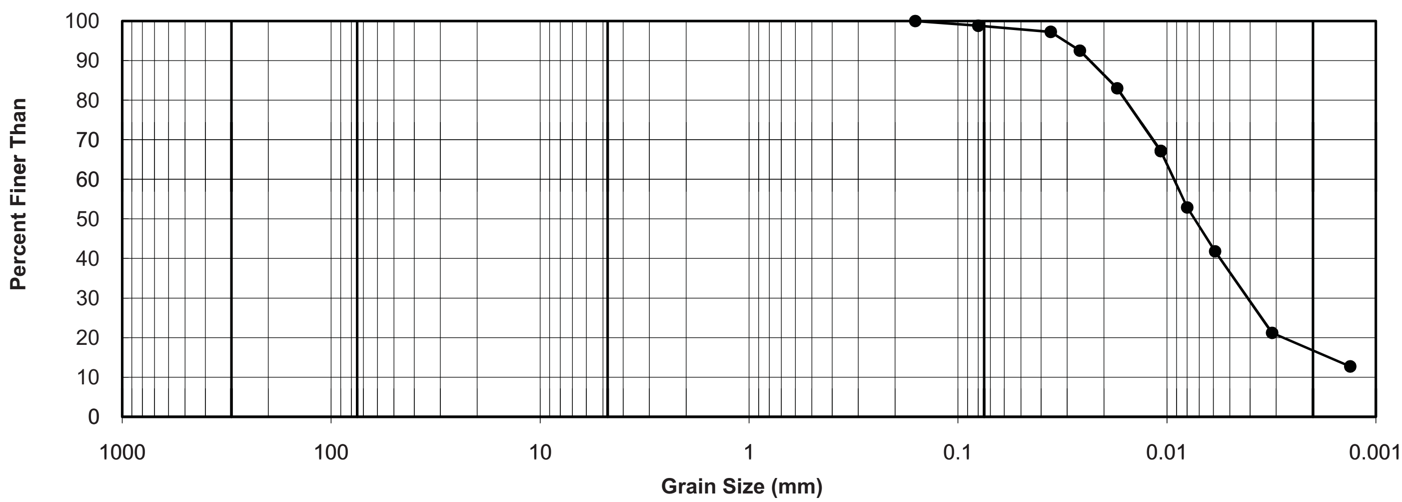
Golder Associates

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA10
Sample Location	GA11-T-10
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	38.9
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	98.8	Sieve
0.036	97.3	Hydrometer
0.026	92.5	Hydrometer
0.017	83.0	Hydrometer
0.011	67.2	Hydrometer
0.008	52.9	Hydrometer
0.006	41.8	Hydrometer
0.003	21.2	Hydrometer
0.001	12.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 1.4 Silt% 82.7 Clay% 15.9

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Date: 2011.06.09 09:59:54 -06'00'

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number: GA11-T-11, SA3
Sample Location: Giant Mine

Sampled By: JB

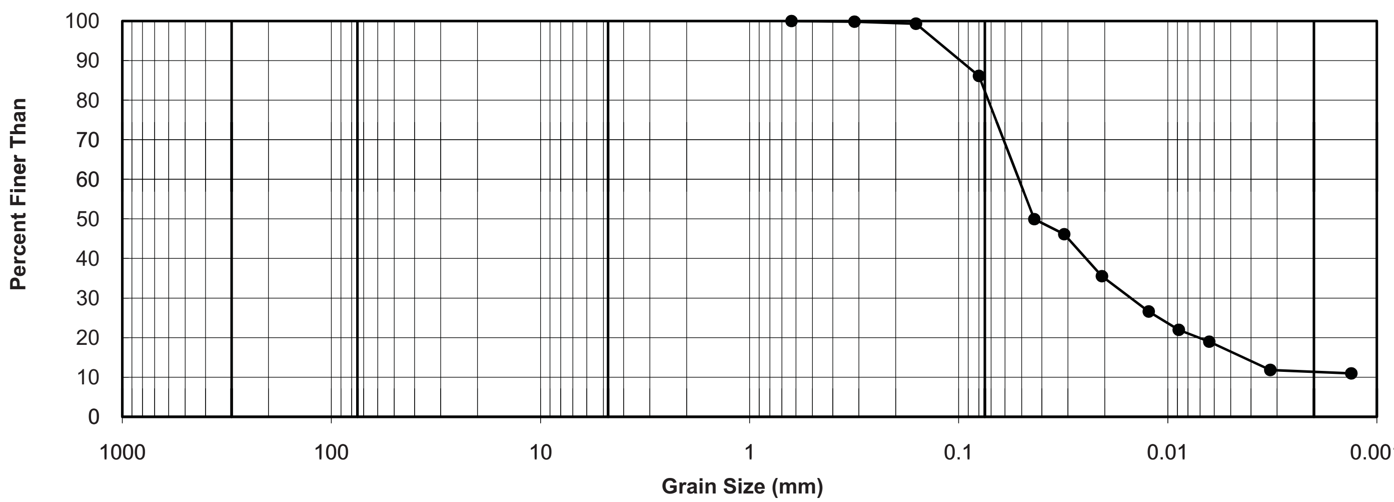
Source
Sample Description

In situ Water Content: 14.1
Date Tested: Wednesday, April 20, 2011
Tested By: AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.8	Sieve
0.16	99.3	Sieve
0.080	86.1	Sieve
0.043	49.9	Hydrometer
0.031	46.1	Hydrometer
0.021	35.5	Hydrometer
0.012	26.6	Hydrometer
0.009	22.0	Hydrometer
0.006	19.0	Hydrometer
0.003	11.8	Hydrometer
0.001	11.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 19.8 Silt% 68.9 Clay% 11.3

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Date: 2011.04.27 11:06:22 -06'00'

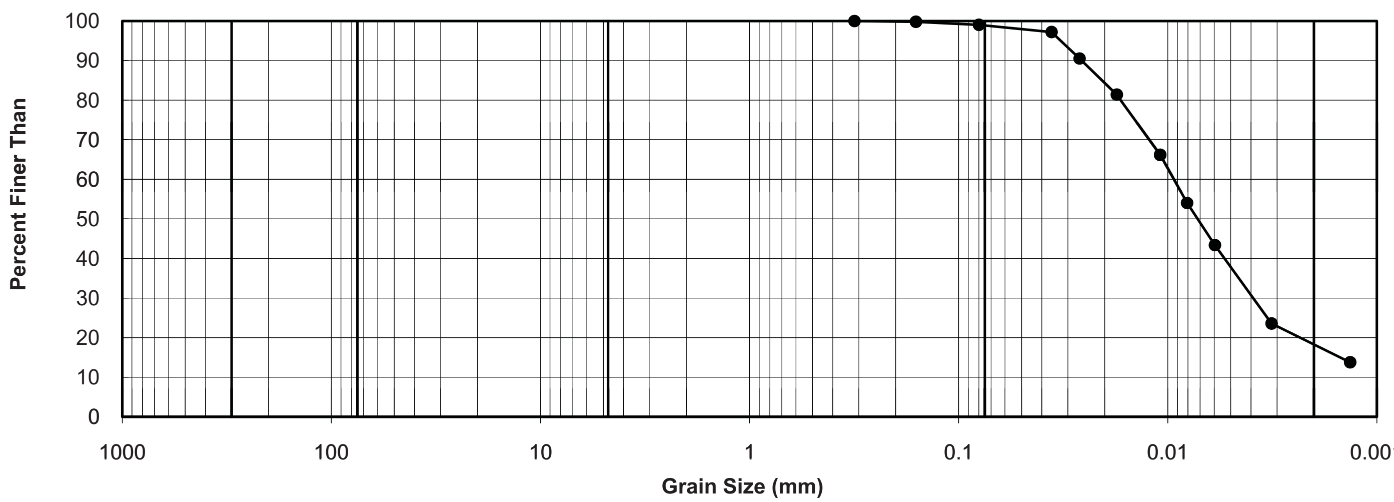
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Tailings Pond				
Client:	AECOM	Date Sampled:			

Sample Number	GA11-T-11 SA5
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	32.4
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	99.8	Sieve
0.080	99.0	Sieve
0.036	97.2	Hydrometer
0.026	90.5	Hydrometer
0.018	81.4	Hydrometer
0.011	66.2	Hydrometer
0.008	54.0	Hydrometer
0.006	43.4	Hydrometer
0.003	23.6	Hydrometer
0.001	13.8	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	1.2	Silt%	81.5	Clay%	17.3

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Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

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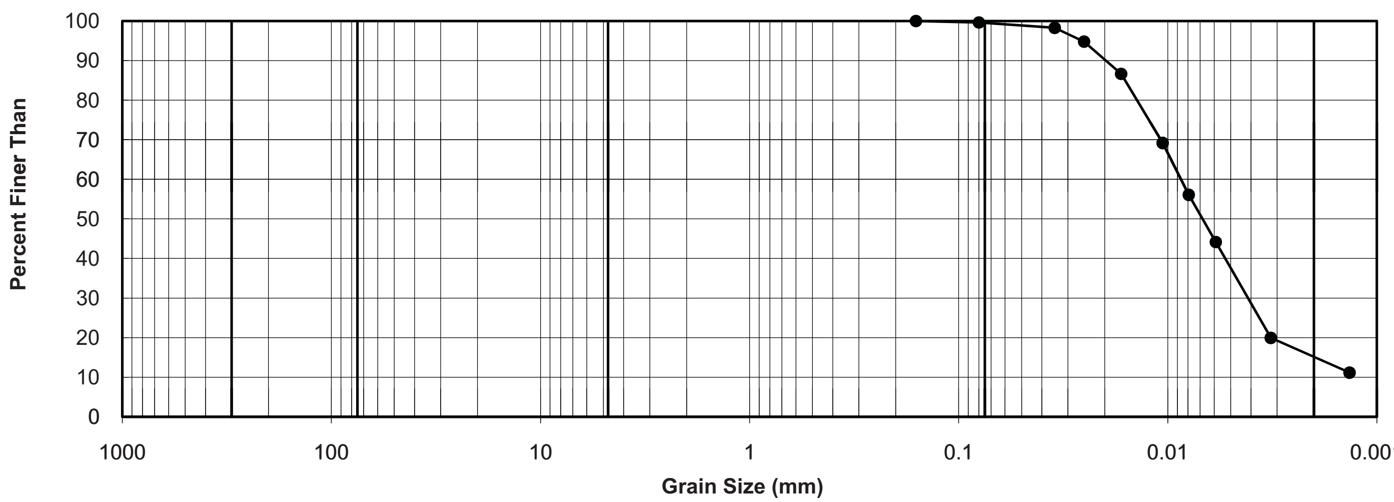
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-11 SA7
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	40.6
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.6	Sieve
0.035	98.3	Hydrometer
0.025	94.8	Hydrometer
0.017	86.6	Hydrometer
0.011	69.2	Hydrometer
0.008	56.1	Hydrometer
0.006	44.1	Hydrometer
0.003	19.9	Hydrometer
0.001	11.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.5 Silt% 85.2 Clay% 14.2

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:19:28 -06'00'

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Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number: GA11-T-11 SA9
Sample Location: Giant Mine

Sampled By: 0.0

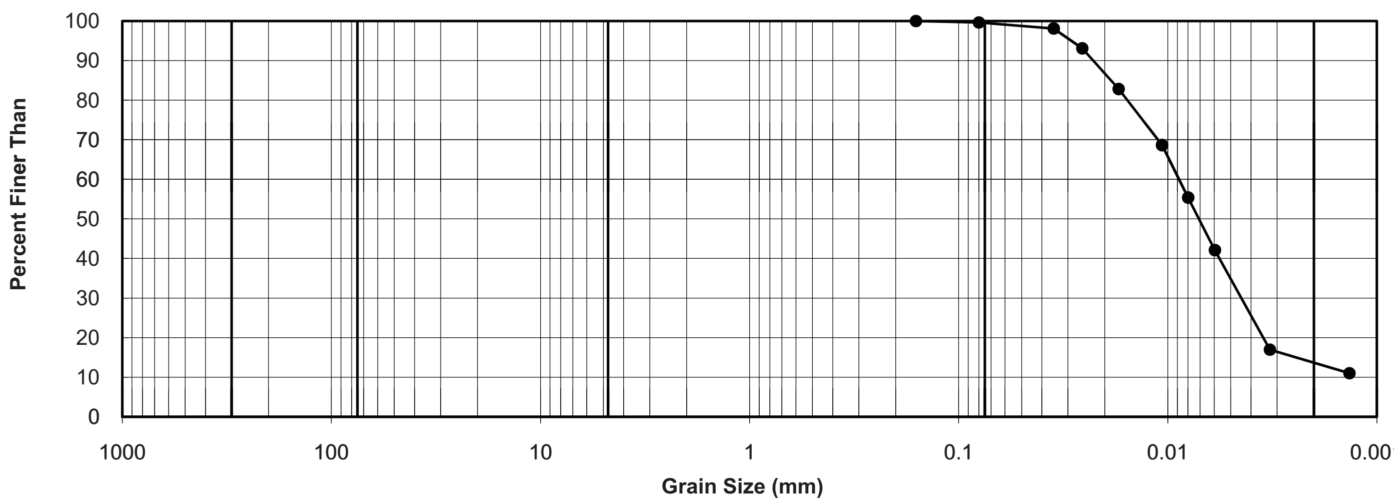
Source
Sample Description

In situ Water Content: 33.3
Date Tested: Wednesday, April 13, 2011
Tested By: AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.6	Sieve
0.035	98.1	Hydrometer
0.026	93.1	Hydrometer
0.017	82.8	Hydrometer
0.011	68.7	Hydrometer
0.008	55.4	Hydrometer
0.006	42.1	Hydrometer
0.003	17.0	Hydrometer
0.001	11.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.6 Silt% 86.4 Clay% 13.0

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:22:19 -06'00'

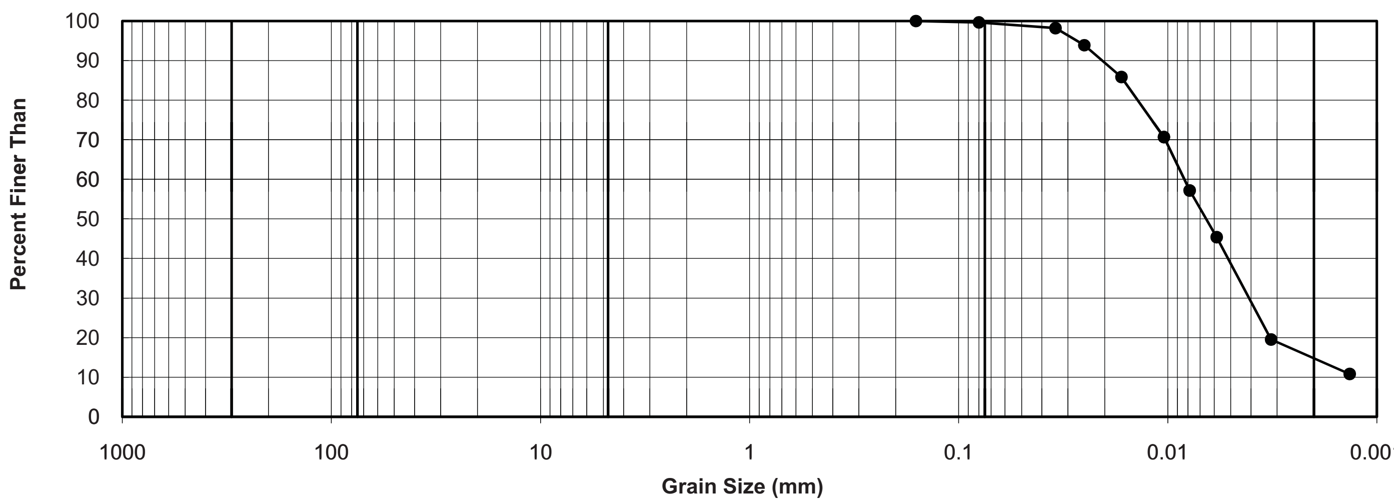
Reviewed By: ______________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-11 SA11
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	39.1
Date Tested	Wednesday, April 13, 2011
Tested By	AC
Remarks:	
Distribution	

	Gradation Size (mm)	Percent Passing
Sieve		
	0.16	100.0
	0.080	99.6
Hydrometer	0.034	98.2
	0.025	93.9
	0.017	85.8
	0.010	70.7
	0.008	57.2
	0.006	45.4
	0.003	19.5
	0.001	10.8



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.6 Silt% 85.6 Clay% 13.9

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:23:16 -06'00'

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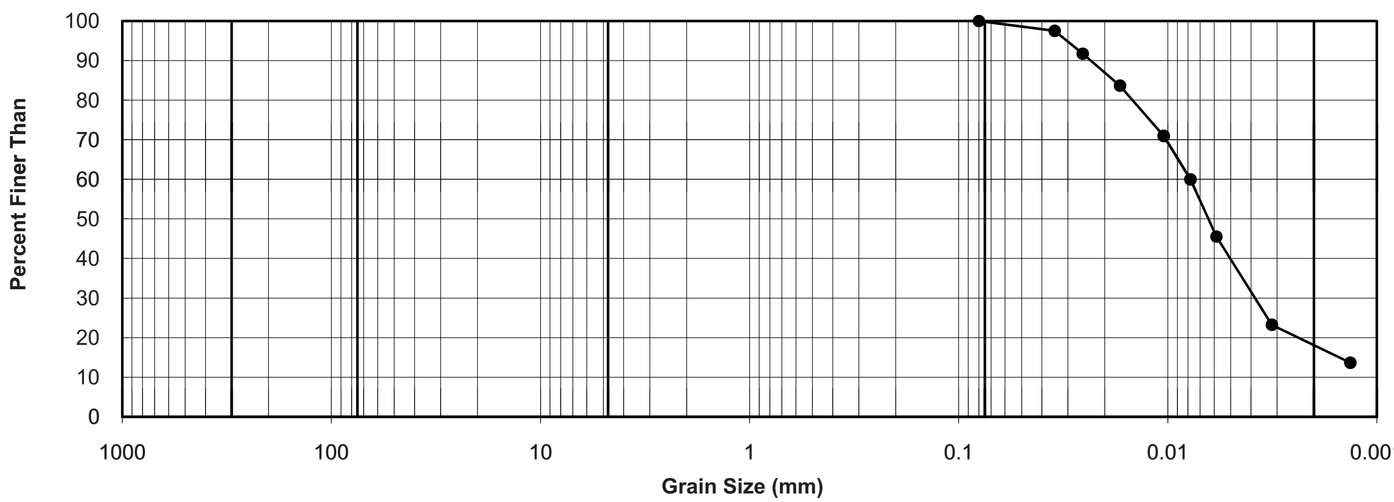
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase: 2100	Report Number: A2615
Short Title:	Tailings Pond		
Client:	AECOM	Date Sampled:	

Sample Number	GA11-T-11 SA13
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	35.1
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
0.080	100.0	
0.035	97.5	Hydrometer
0.025	91.7	
0.017	83.7	
0.010	70.9	
0.008	60.0	
0.006	45.5	
0.003	23.2	
0.001	13.7	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.3	Silt%	82.6	Clay%	17.1

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:21:13 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

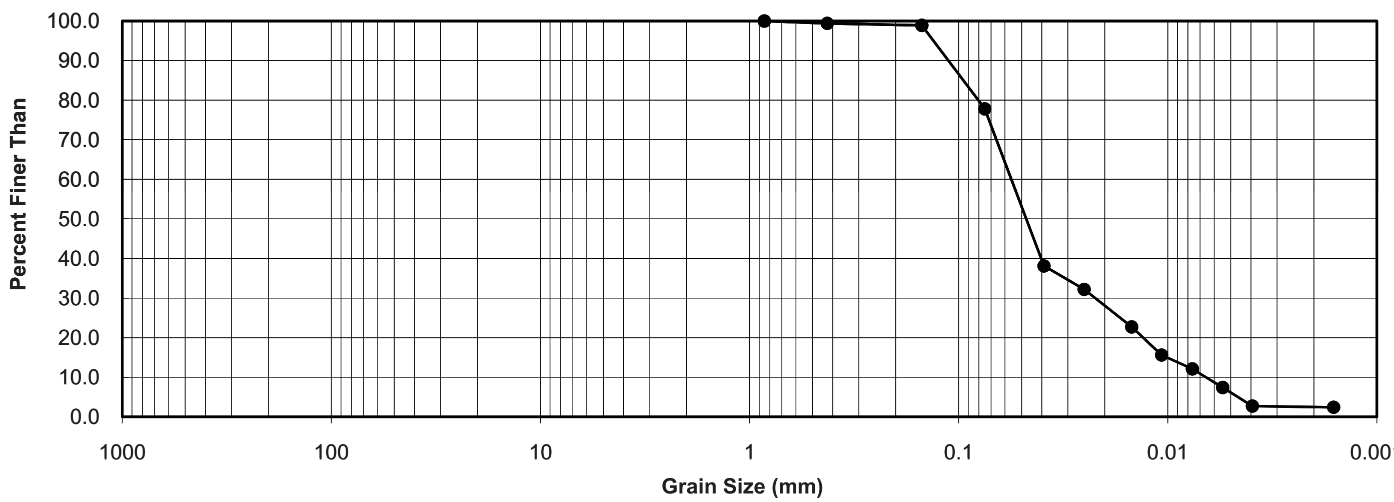
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	Report Number: A2615
Short Title:	Giant Mine Tailings Pond		
Client:	AECOM	Date Sampled:	

Sample Number	GA11-T-12, SA6
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	28.9
Date Tested	Tuesday, April 05, 2011
Tested By	JF/AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.9	100.0	Sieve
0.43	99.4	Sieve
0.15	98.9	Sieve
0.075	77.8	Sieve
0.039	38.1	Hydrometer
0.025	32.2	Hydrometer
0.015	22.7	Hydrometer
0.011	15.6	Hydrometer
0.008	12.1	Hydrometer
0.005	7.4	Hydrometer
0.004	2.7	Hydrometer
0.002	2.4	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	22.2	Silt%	75.4	Clay%	2.4

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 08:33:51 -06'00'

Reviewed By: ______________________

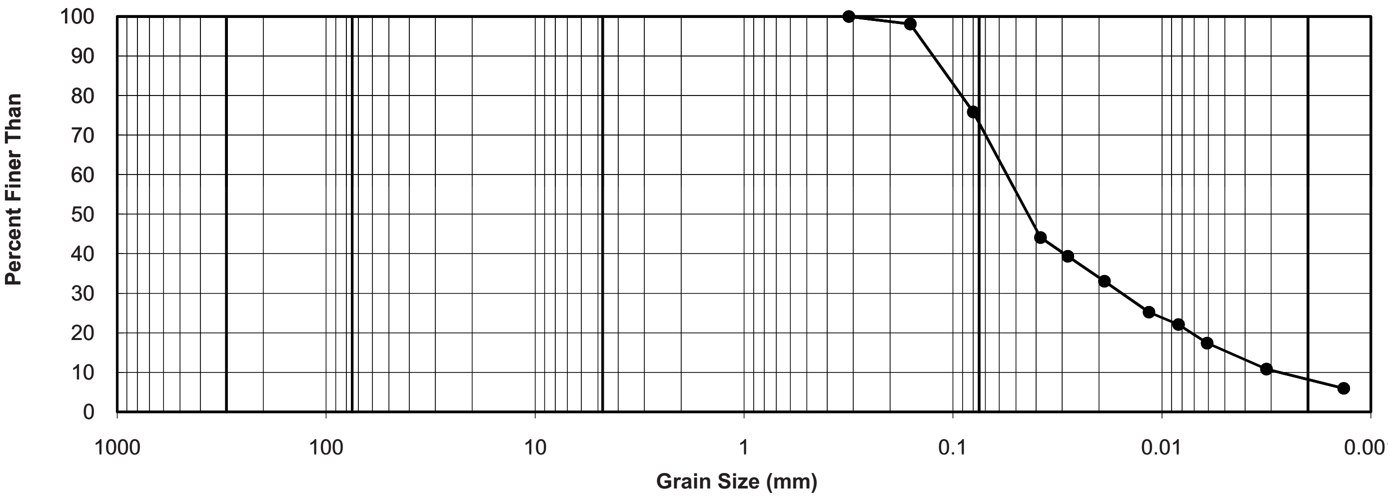
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-12, SA8
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	30.7
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.9	100.0	Sieve
0.43	99.8	Sieve
0.15	99.1	Sieve
0.075	98.0	Sieve
0.032	95.6	Hydrometer
0.021	86.5	Hydrometer
0.012	77.4	Hydrometer
0.009	70.6	Hydrometer
0.007	54.7	Hydrometer
0.005	38.9	Hydrometer
0.004	18.5	Hydrometer
0.002	6.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	2.0	Silt%	91.1	Clay%	6.9

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:32:39 -06'00'

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Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase: 2100		Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number: GA11-T-12, SA10
Sample Location: Giant Mine

Sampled By: JB

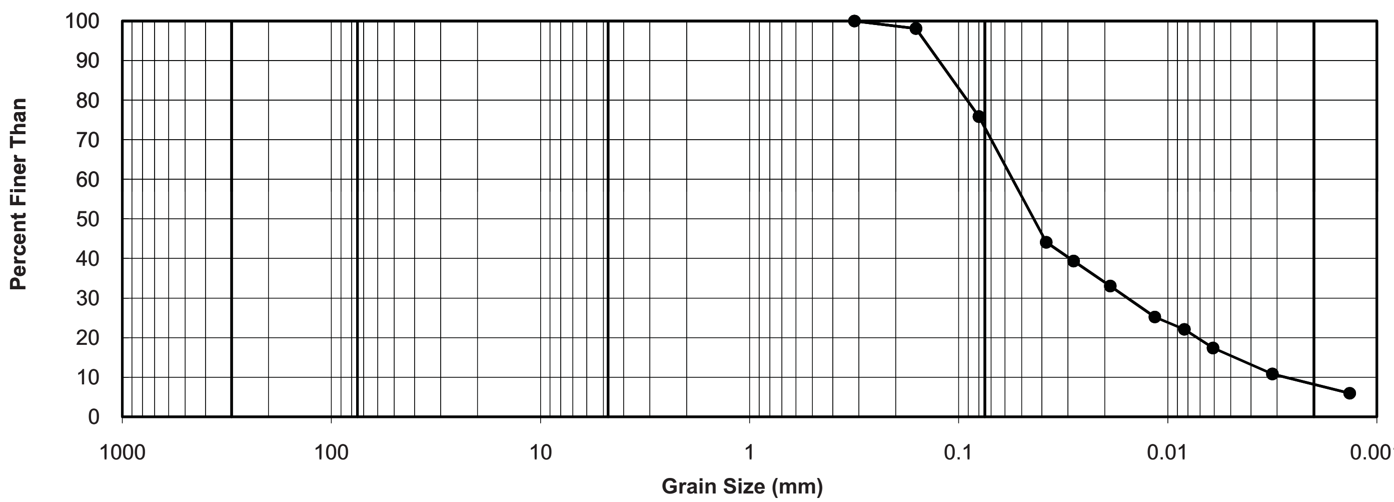
Source
Sample Description

In situ Water Content: 32.4
Date Tested: Friday, April 08, 2011
Tested By: AC/JF

Remarks:

Distribution

	Gradation Size (mm)	Percent Passing
Sieve		
	0.43	100.0
	0.15	99.1
	0.075	96.8
Hydrometer	0.032	90.6
	0.020	86.3
	0.012	79.8
	0.009	65.9
	0.007	54.0
	0.005	41.1
	0.004	17.5
	0.002	7.6



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 3.2 Silt% 89.2 Clay% 7.6

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:36:53 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number: GA11-T-12, SA13
Sample Location: Giant Mine

Sampled By: JB

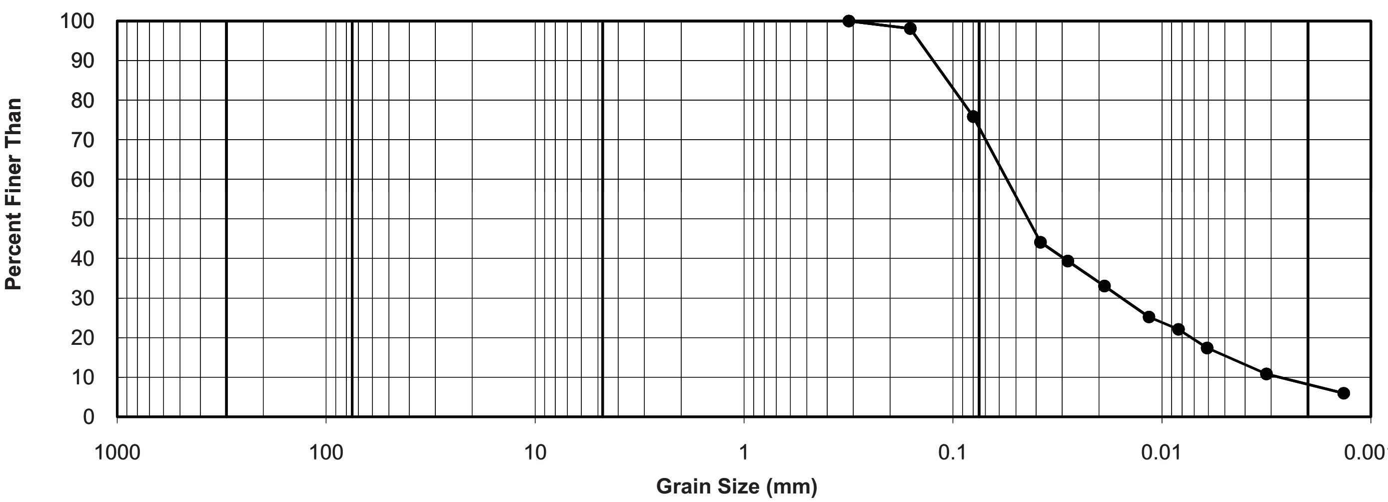
Source
Sample Description

In situ Water Content: 19.2
Date Tested: Friday, April 08, 2011
Tested By: AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
0.43	100.0	
0.15	94.7	
0.075	69.7	
0.037	45.1	Hydrometer
0.024	38.3	
0.014	28.6	
0.010	21.7	
0.007	18.9	
0.005	13.0	
0.004	4.2	
0.002	2.0	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 30.3 Silt% 67.7 Clay% 2.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:06:44 -06'00'

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Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine- Tailing pond				
Client:	AECOM	Date Sampled:			

Sample Number GA11-T-12, SA15
Sample Location Giant Mine

Sampled By 0.0

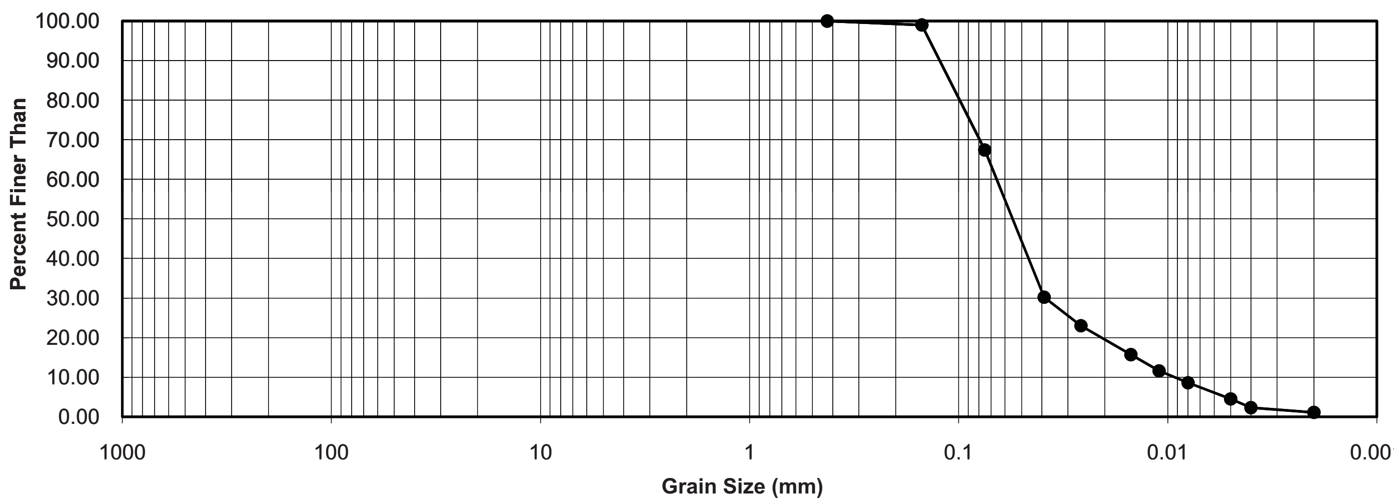
Source
Sample Description

In situ Water Content 21.0
Date Tested Tuesday, April 05, 2011
Tested By AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.43	100.0	Sieve
0.15	99.0	Sieve
0.075	67.4	Sieve
0.039	30.2	Hydrometer
0.026	23.0	Hydrometer
0.015	15.7	Hydrometer
0.011	11.6	Hydrometer
0.008	8.6	Hydrometer
0.005	4.5	Hydrometer
0.004	2.3	Hydrometer
0.002	1.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 32.6 Silt% 47.4 Clay% 20.0

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Date: 2011.04.18 09:58:29 -06'00'

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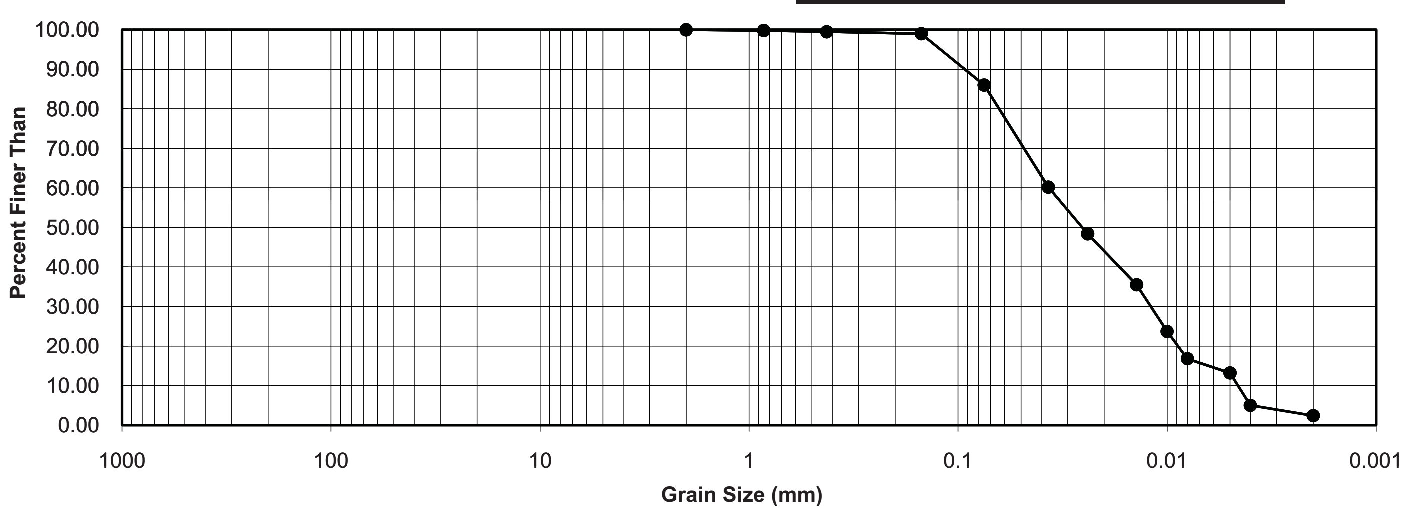
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine- Tailing pond				
Client:	AECOM	Date Sampled:			

Sample Number	GA11-T-12, SA17
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	26.3
Date Tested	Tuesday, April 05, 2011
Tested By	AC/JF
Remarks:	2.4
Distribution	

	Gradation Size (mm)	Percent Passing
Sieve		
	2.00	100.0
	0.85	99.8
	0.43	99.5
	0.15	99.0
	0.075	86.0
Hydrometer	0.037	60.2
	0.024	48.4
	0.014	35.5
	0.010	23.7
	0.008	16.8
	0.005	13.2
	0.004	5.0
	0.002	2.4



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	14.0	Silt%	83.6	Clay%	2.4

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Date: 2011.04.19 08:29:33 -06'00'

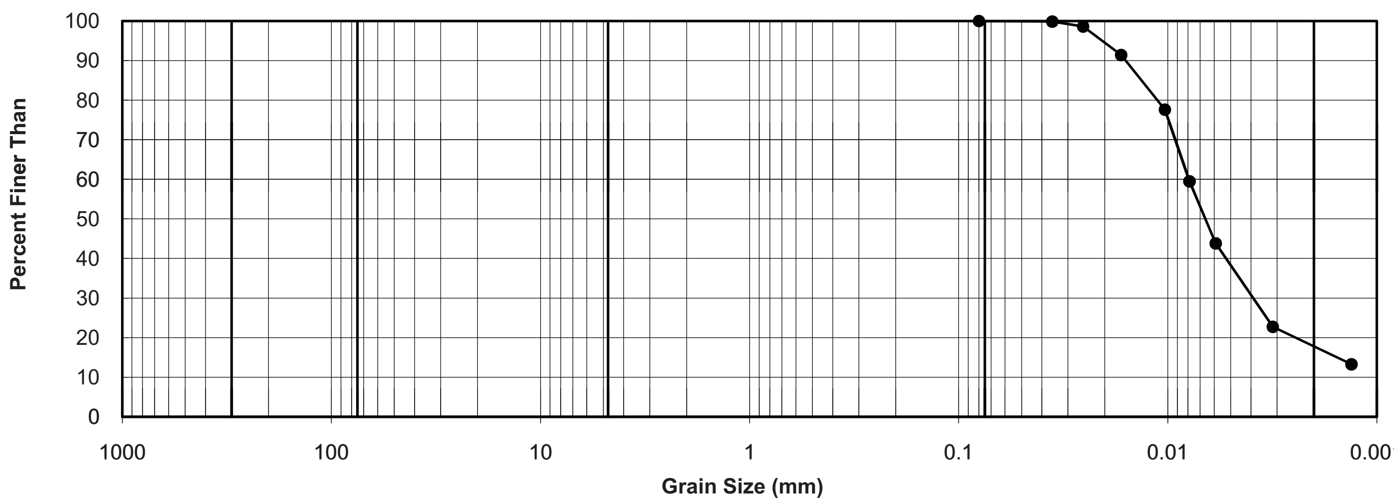
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2622
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-13, SA3
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	40.5
Date Tested	Wednesday, April 20, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.080	100.0	Sieve
0.036	99.9	Hydrometer
0.025	98.6	Hydrometer
0.017	91.4	Hydrometer
0.010	77.6	Hydrometer
0.008	59.5	Hydrometer
0.006	43.8	Hydrometer
0.003	22.7	Hydrometer
0.001	13.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.0	Silt%	83.2	Clay%	16.8

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Date: 2011.04.27 11:05:25 -06'00'

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Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

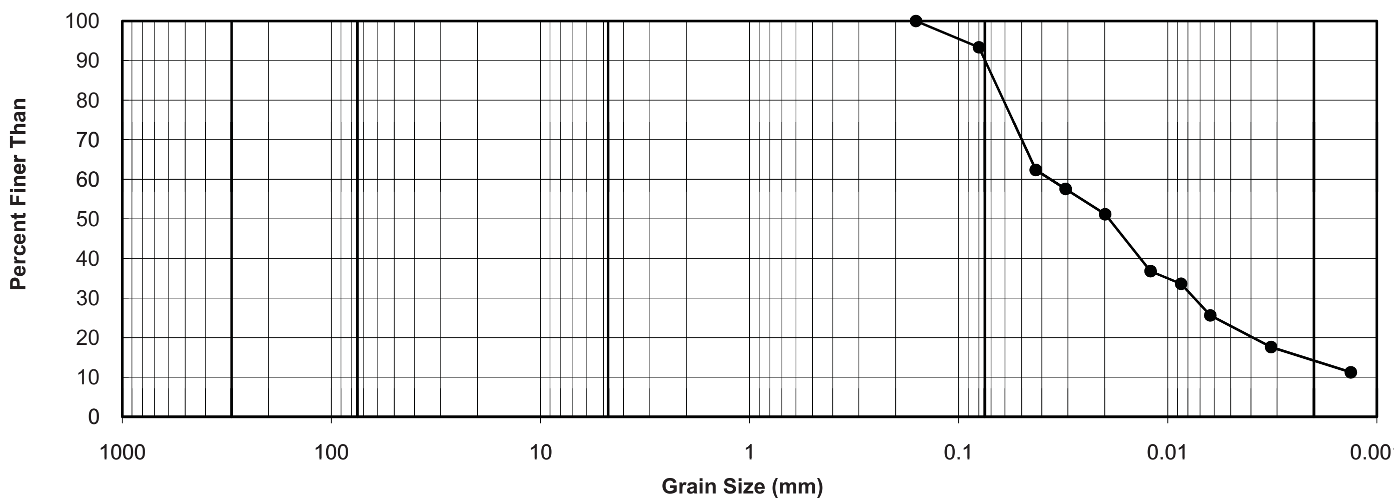
Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase: 2100	Report Number: A2615
Short Title:	Giant Mine		
Client:	AECOM Canada	Date Sampled:	

Sample Number	SA06
Sample Location	GA11-T-13
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	25.1
Date Tested	Wednesday, June 08, 2011
Tested By	TR
Remarks:	
Distribution	

	Gradation Size (mm)	Percent Passing
Sieve		
	0.16	100.0
	0.080	93.4
Hydrometer	0.043	62.4
	0.031	57.6
	0.020	51.2
	0.012	36.8
	0.009	33.6
	0.006	25.6
	0.003	17.6
	0.001	11.2



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 11.6 Silt% 74.9 Clay% 13.5

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 15:20:35 -06'00'

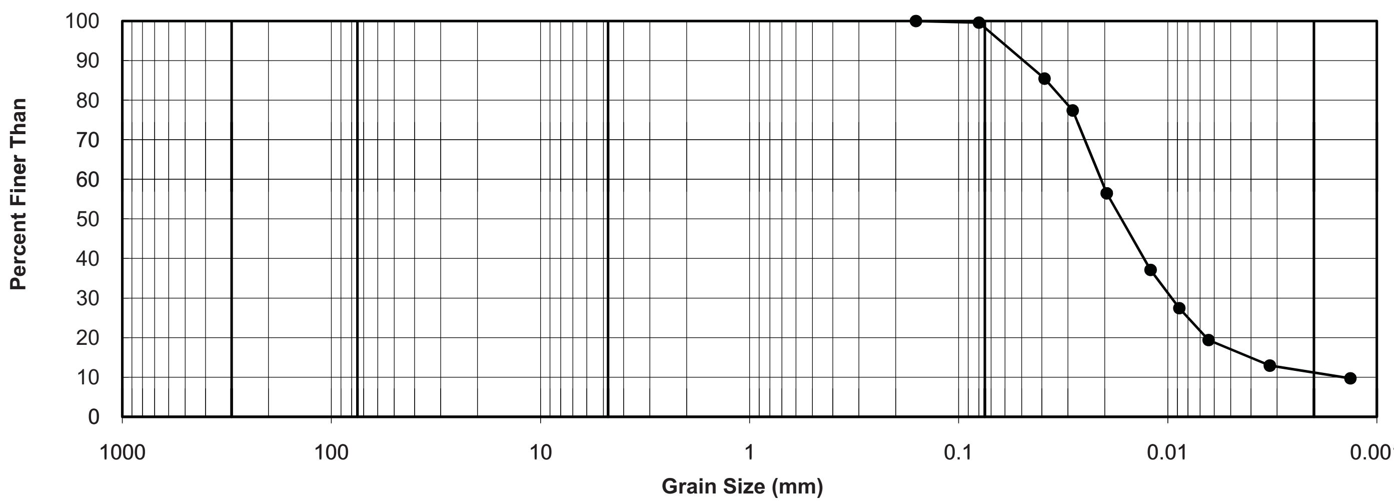
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA08
Sample Location	GA11-T-13
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	24.4
Date Tested	Wednesday, June 08, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.6	Sieve
0.039	85.5	Hydrometer
0.028	77.4	Hydrometer
0.020	56.4	Hydrometer
0.012	37.1	Hydrometer
0.009	27.4	Hydrometer
0.006	19.4	Hydrometer
0.003	12.9	Hydrometer
0.001	9.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 2.5 Silt% 86.7 Clay% 10.8

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 15:19:39 -06'00'

Reviewed By: ____________________

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

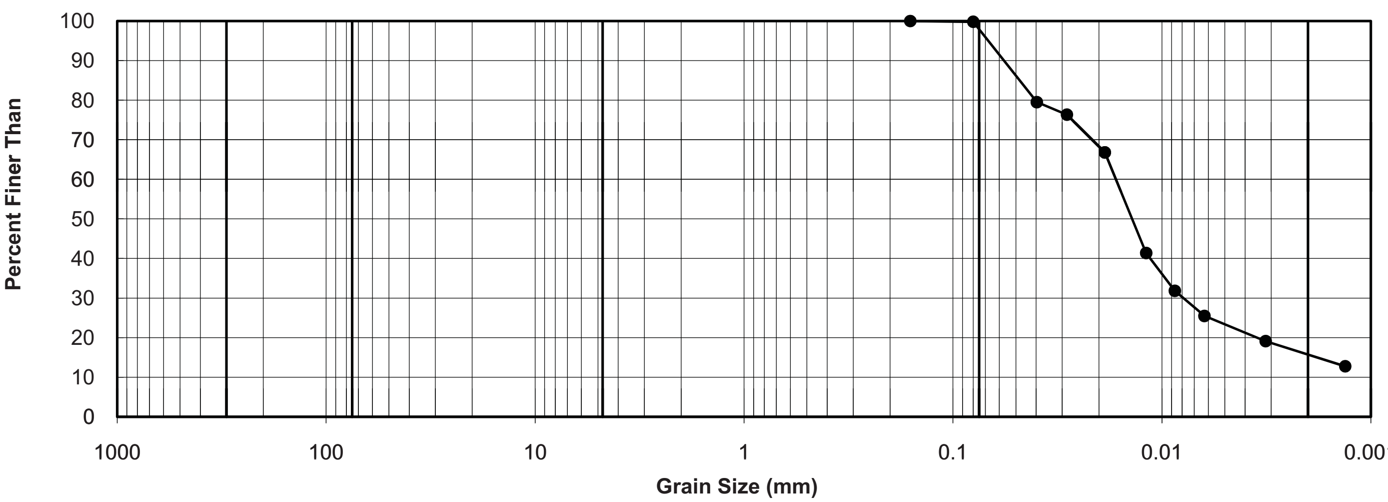
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number: SA10
Sample Location: GA11-T-13
Sampled By: JB
Source: Insitu
Sample Description: See bore logs
In situ Water Content: 26.6
Date Tested: Wednesday, June 08, 2011
Tested By: TR
Remarks:
Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.8	Sieve
0.040	79.5	Hydrometer
0.028	76.3	Hydrometer
0.019	66.8	Hydrometer
0.012	41.4	Hydrometer
0.009	31.8	Hydrometer
0.006	25.5	Hydrometer
0.003	19.1	Hydrometer
0.001	12.8	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 3.2 Silt% 81.7 Clay% 15.1

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 15:18:38 -06'00'

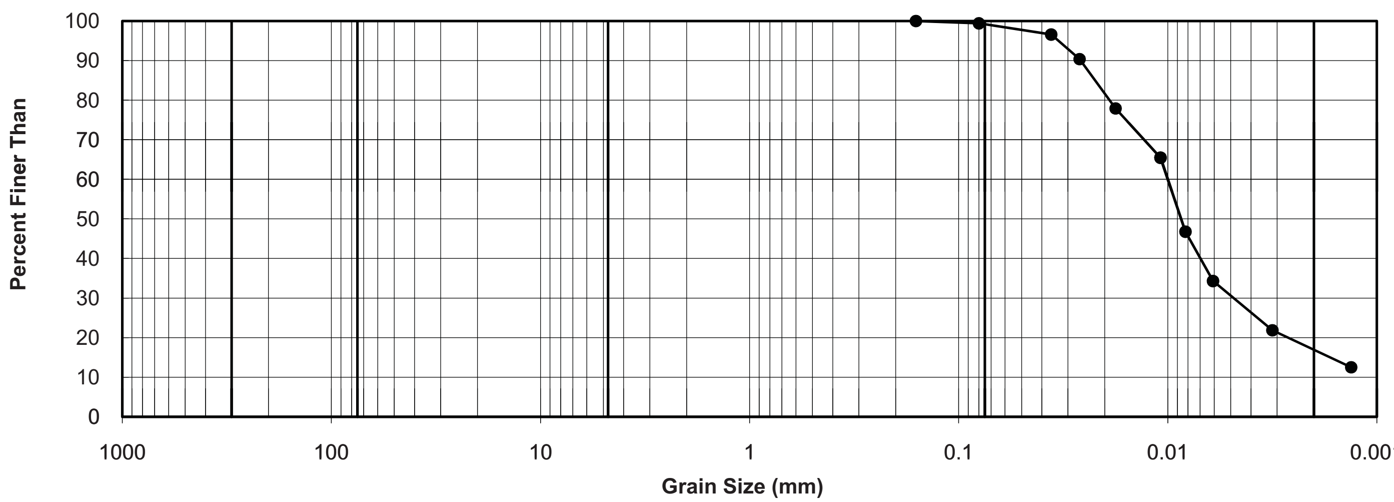
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA12
Sample Location	GA11-T-13
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	31.4
Date Tested	Wednesday, June 08, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.4	Sieve
0.036	96.6	Hydrometer
0.026	90.4	Hydrometer
0.018	77.9	Hydrometer
0.011	65.4	Hydrometer
0.008	46.8	Hydrometer
0.006	34.3	Hydrometer
0.003	21.8	Hydrometer
0.001	12.5	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 1.0 Silt% 83.1 Clay% 15.9

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 15:17:38 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

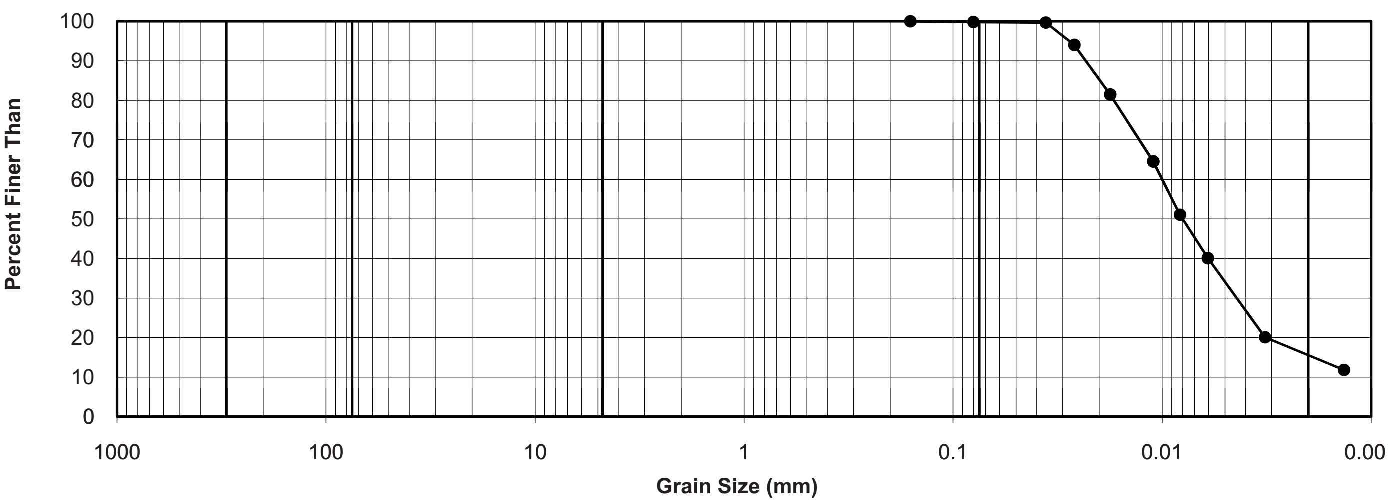
Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Tailings Pond				
Client:	AECOM	Date Sampled:	January 0, 1900		

Sample Number	GA11-T-14 SA6
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	31.1
Date Tested	Wednesday, April 13, 2011
Tested By	AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
0.16	100.0	
0.080	99.8	
0.036	99.7	Hydrometer
0.026	94.0	
0.018	81.5	
0.011	64.5	
0.008	51.1	
0.006	40.1	
0.003	20.1	
0.001	11.8	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.2	Silt%	85.1	Clay%	14.7

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 10:59:56 -06'00'

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Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

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Particle Size Analysis of Soils
ASTM D422

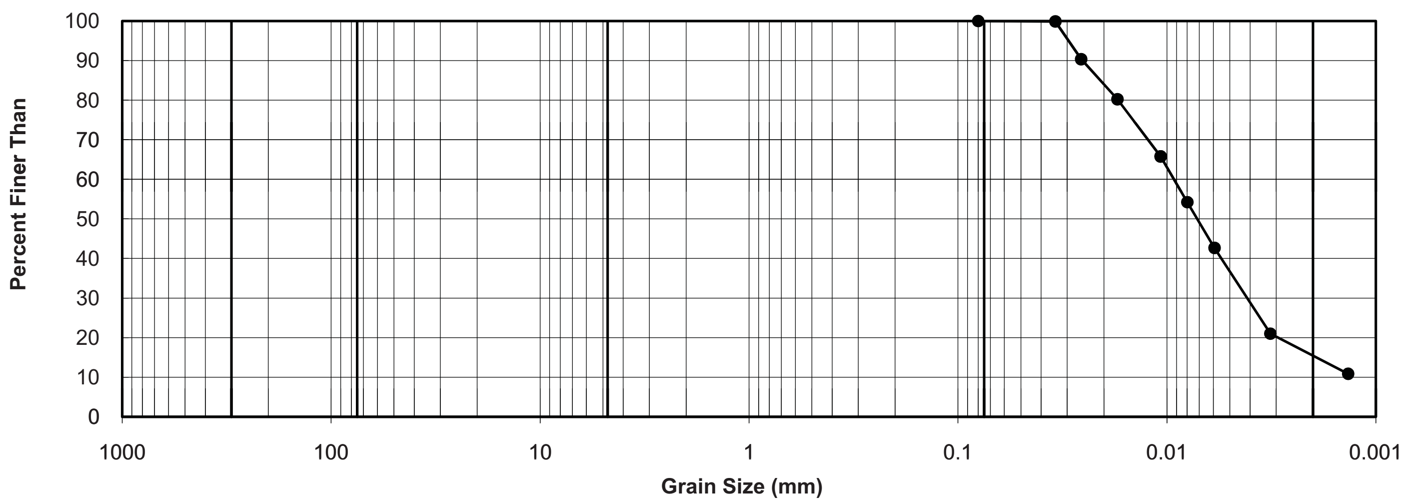
Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Tailings Pond				
Client:	AECOM	Date Sampled:	January 0, 1900		

Sample Number	GA11-T-14 SA8
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	32.9
Date Tested	Friday, April 15, 2011
Tested By	AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
0.080	100.0	
0.034	99.9	Hydrometer
0.026	90.4	
0.017	80.2	
0.011	65.8	
0.008	54.2	
0.006	42.7	
0.003	21.0	
0.001	10.9	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	0.0	Silt%	85.6	Clay%	14.4

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 10:56:45 -06'00'

Reviewed By:

Golder Associates Ltd

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Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Golder Associates

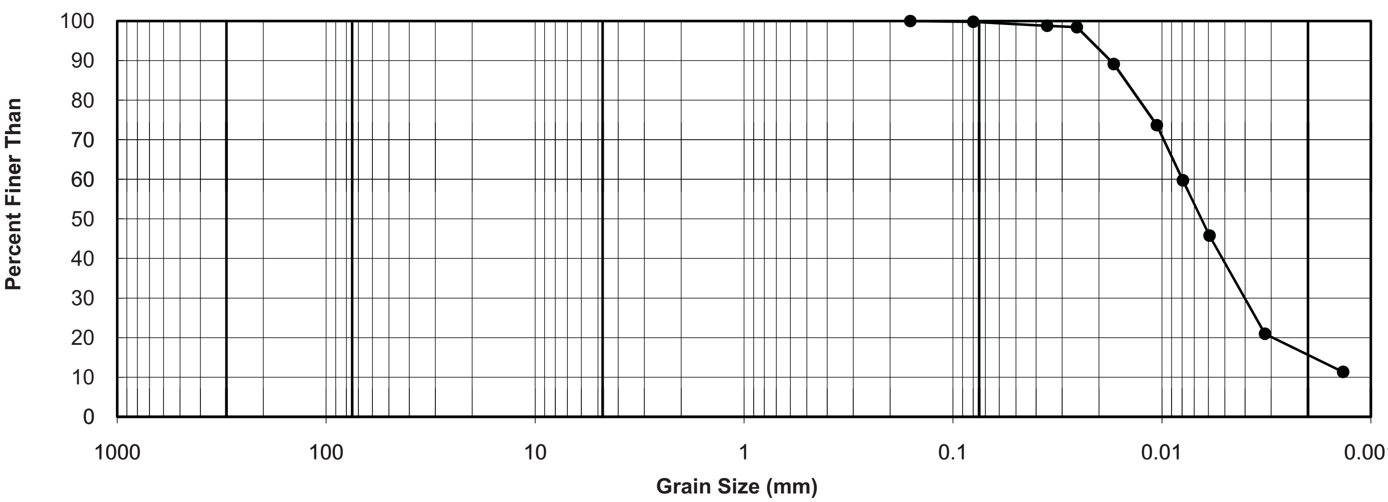
Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:	January 0, 1900	

Sample Number	GA11-T-14 SA10
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	36.4
Date Tested	Friday, April 15, 2011
Tested By	AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.8	Sieve
0.035	98.8	Hydrometer
0.026	98.4	Hydrometer
0.017	89.1	Hydrometer
0.011	73.7	Hydrometer
0.008	59.7	Hydrometer
0.006	45.8	Hydrometer
0.003	21.0	Hydrometer
0.001	11.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.3 Silt% 85.0 Clay% 14.7

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 10:55:49 -06'00'

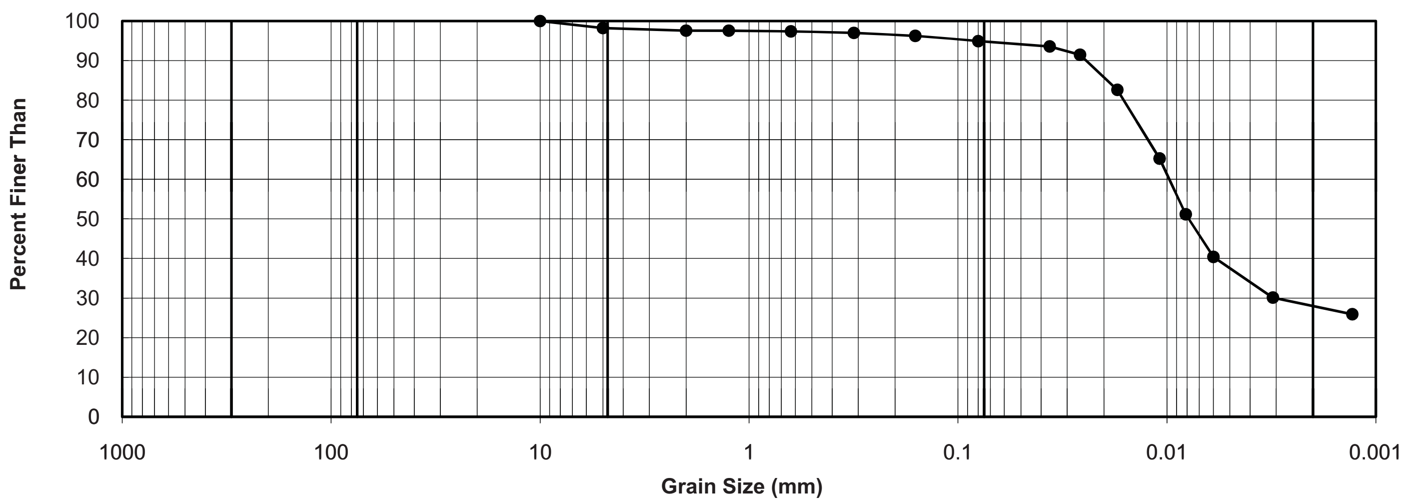
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-14, SA12
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	26.3
Date Tested	Friday, April 15, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
10	100.0	Sieve
5	98.2	Sieve
2.0	97.6	Sieve
1.25	97.6	Sieve
0.6	97.4	Sieve
0.32	97.0	Sieve
0.16	96.2	Sieve
0.080	94.9	Sieve
0.036	93.6	Hydrometer
0.026	91.5	Hydrometer
0.017	82.6	Hydrometer
0.011	65.2	Hydrometer
0.008	51.2	Hydrometer
0.006	40.4	Hydrometer
0.003	30.1	Hydrometer
0.001	25.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 1.8 Sand % 3.5 Silt% 67.2 Clay% 27.5

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:04:26 -06'00'

Reviewed By: ____________________

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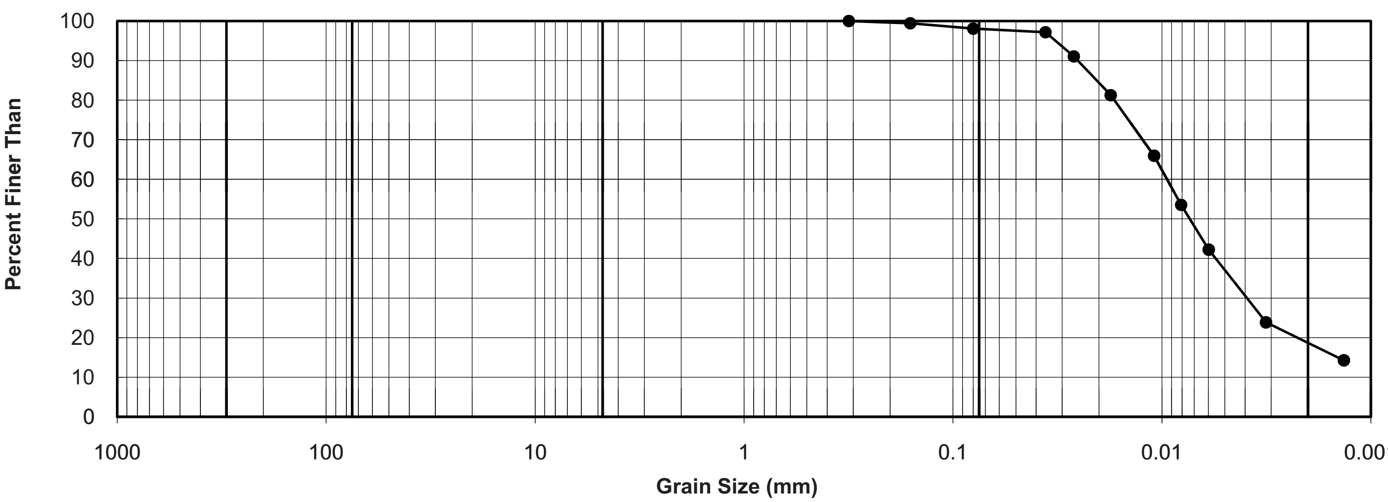
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:	January 0, 1900	

Sample Number	GA11-T-14 SA14
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	32.1
Date Tested	Friday, April 15, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	99.4	Sieve
0.080	98.1	Sieve
0.036	97.2	Hydrometer
0.026	91.0	Hydrometer
0.018	81.3	Hydrometer
0.011	66.0	Hydrometer
0.008	53.5	Hydrometer
0.006	42.2	Hydrometer
0.003	23.9	Hydrometer
0.001	14.2	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	2.1	Silt%	80.3	Clay%	17.7

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:09:17 -06'00'

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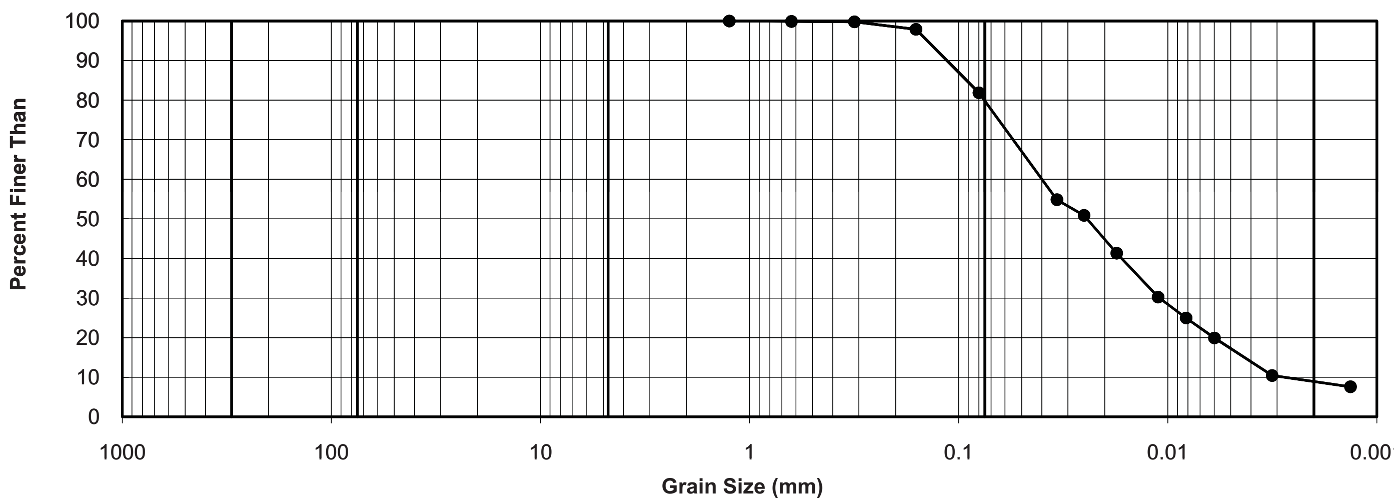
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-15, SA3
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	21.9
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
1.25	100.0	Sieve
0.6	99.9	Sieve
0.32	99.8	Sieve
0.16	97.9	Sieve
0.080	81.9	Sieve
0.034	54.9	Hydrometer
0.025	50.9	Hydrometer
0.018	41.3	Hydrometer
0.011	30.2	Hydrometer
0.008	25.0	Hydrometer
0.006	19.9	Hydrometer
0.003	10.4	Hydrometer
0.001	7.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 21.6 Silt% 69.7 Clay% 8.6

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DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.18 09:35:36 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

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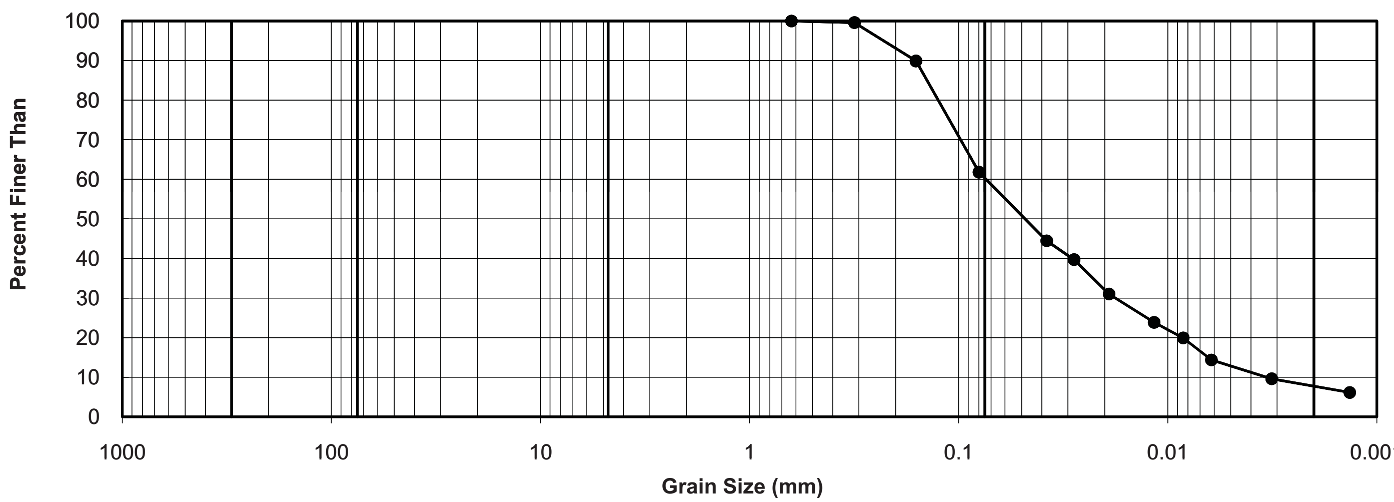
Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-15, SA5
Sample Location	Giant Mine
Sampled By	JB
Source	
Sample Description	
In situ Water Content	18.2
Date Tested	Friday, April 08, 2011
Tested By	AC/JF
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.6	Sieve
0.16	89.9	Sieve
0.080	61.8	Sieve
0.038	44.5	Hydrometer
0.028	39.7	Hydrometer
0.019	31.0	Hydrometer
0.012	23.9	Hydrometer
0.008	19.9	Hydrometer
0.006	14.4	Hydrometer
0.003	9.6	Hydrometer
0.001	6.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 40.7 Silt% 52.0 Clay% 7.4

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.19 16:42:39 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM	Date Sampled:			

Sample Number GA11-T-15, 7A
Sample Location Giant Mine

Sampled By JB

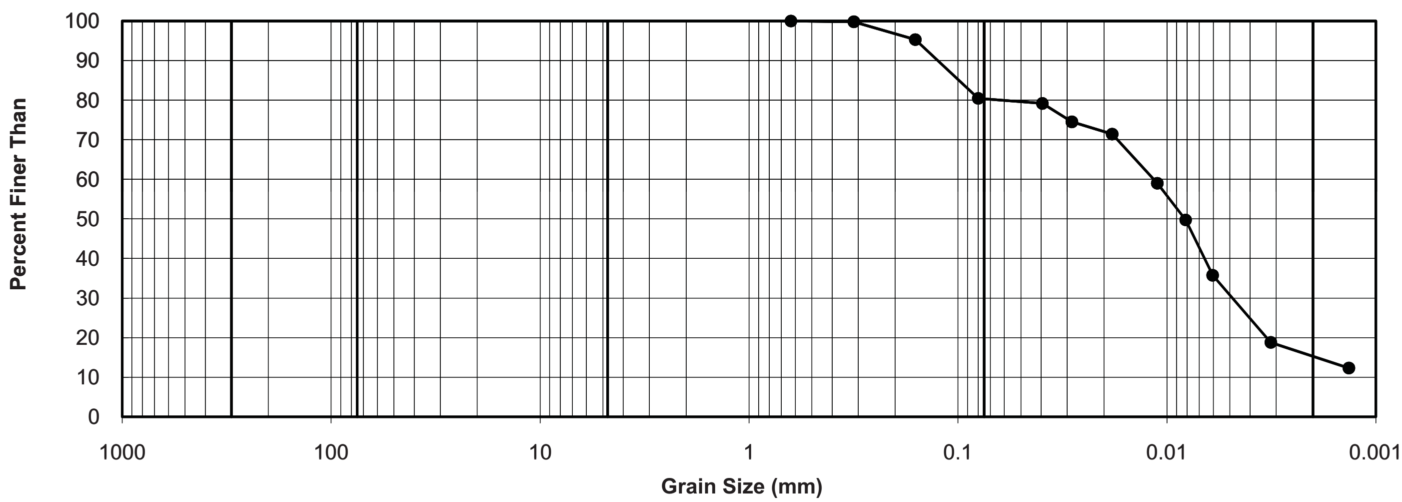
Source
Sample Description

In situ Water Content 31.3
Date Tested Friday, April 08, 2011
Tested By AC/JF

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.8	Sieve
0.16	95.3	Sieve
0.080	80.4	Sieve
0.039	79.2	Hydrometer
0.029	74.5	Hydrometer
0.018	71.4	Hydrometer
0.011	59.0	Hydrometer
0.008	49.7	Hydrometer
0.006	35.8	Hydrometer
0.003	18.8	Hydrometer
0.001	12.3	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 19.7 Silt% 65.6 Clay% 14.6

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.18 09:35:50 -06'00'

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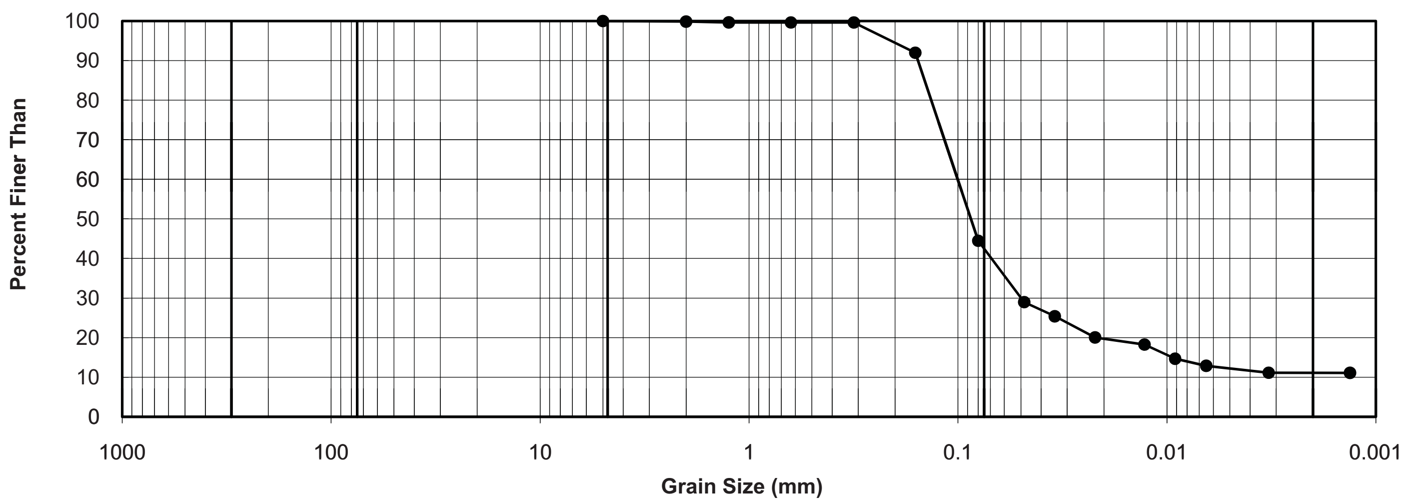
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA3
Sample Location	GA11-T-16
Sampled By	JB
Source	Insitu
Sample Description	See Bore Logs
In situ Water Content	24.4
Date Tested	Monday, May 30, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
5	100.0	Sieve
2.0	99.9	Sieve
1.25	99.6	Sieve
0.6	99.6	Sieve
0.32	99.6	Sieve
0.16	92.0	Sieve
0.080	44.5	Sieve
0.048	29.0	Hydrometer
0.034	25.4	Hydrometer
0.022	20.0	Hydrometer
0.013	18.2	Hydrometer
0.009	14.7	Hydrometer
0.006	12.9	Hydrometer
0.003	11.1	Hydrometer
0.001	11.1	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	58.5	Silt%	30.4	Clay%	11.1

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 14:47:31 -06'00'

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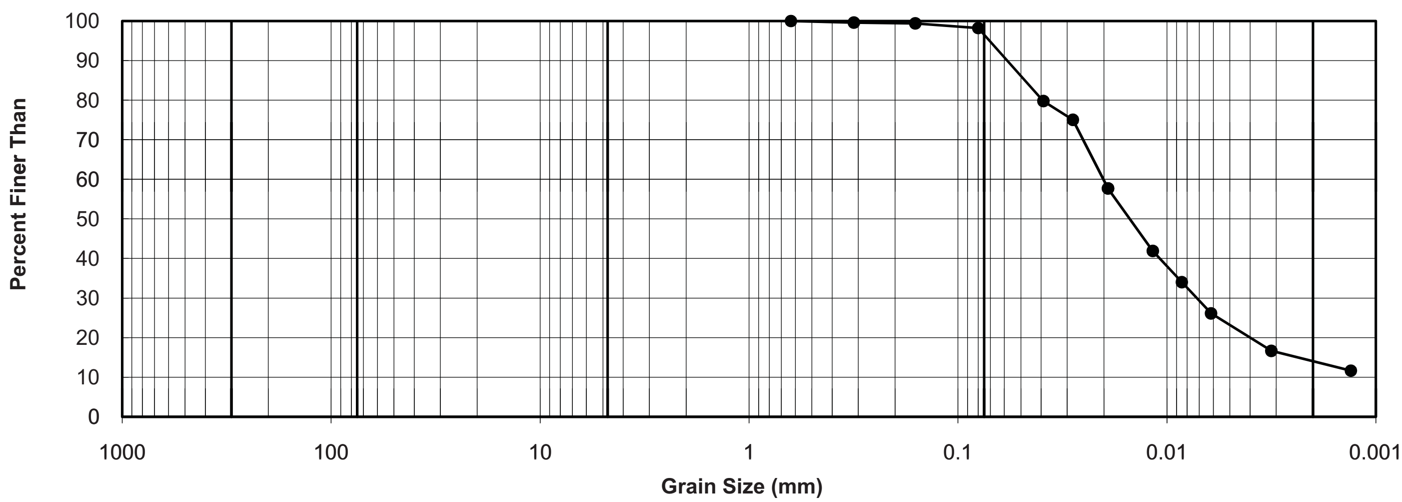
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA6
Sample Location	GA11-T-16
Sampled By	JB
Source	Insitu
Sample Description	See Bore Logs
In situ Water Content	49.7
Date Tested	Tuesday, May 31, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	99.6	Sieve
0.16	99.4	Sieve
0.080	98.2	Sieve
0.039	79.8	Hydrometer
0.028	75.0	Hydrometer
0.019	57.7	Hydrometer
0.012	41.9	Hydrometer
0.008	34.0	Hydrometer
0.006	26.1	Hydrometer
0.003	16.7	Hydrometer
0.001	11.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 4.5 Silt% 82.0 Clay% 13.5

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 13:38:33 -06'00'

Reviewed By:

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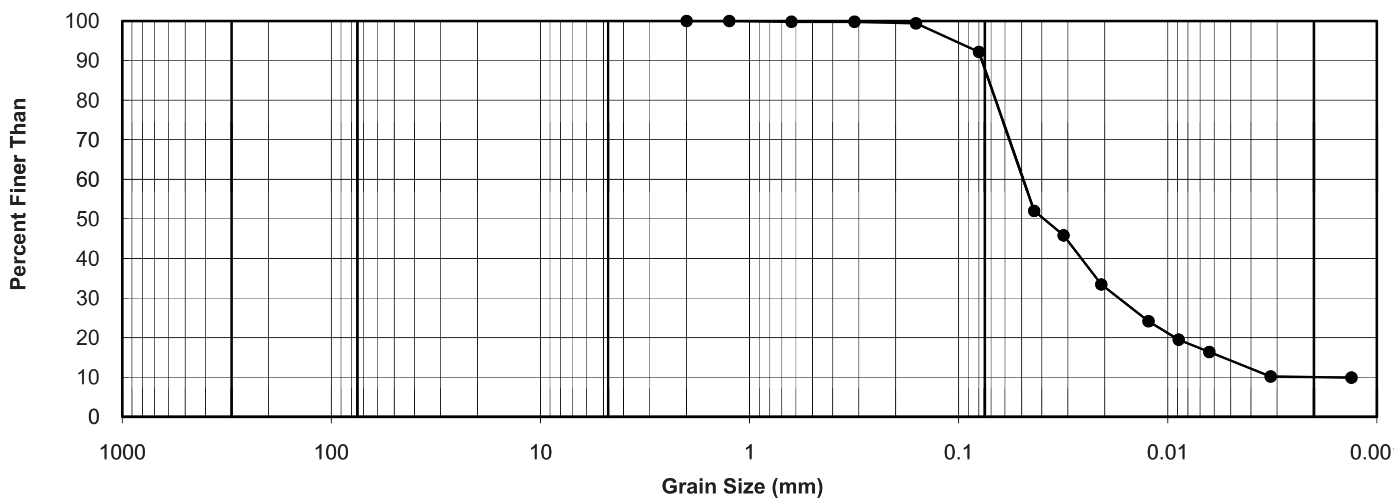
Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number	SA8
Sample Location	GA11-T-16
Sampled By	JB
Source	Insitu
Sample Description	See Bore Logs
In situ Water Content	24.4
Date Tested	Tuesday, May 31, 2011
Tested By	HVD
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
2.0	100.0	Sieve
1.25	100.0	Sieve
0.6	99.8	Sieve
0.32	99.8	Sieve
0.16	99.4	Sieve
0.080	92.2	Sieve
0.044	52.0	Hydrometer
0.031	45.8	Hydrometer
0.021	33.4	Hydrometer
0.012	24.1	Hydrometer
0.009	19.5	Hydrometer
0.006	16.4	Hydrometer
0.003	10.2	Hydrometer
0.001	9.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 14.4 Silt% 75.6 Clay% 10.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.03 15:34:40 -06'00'

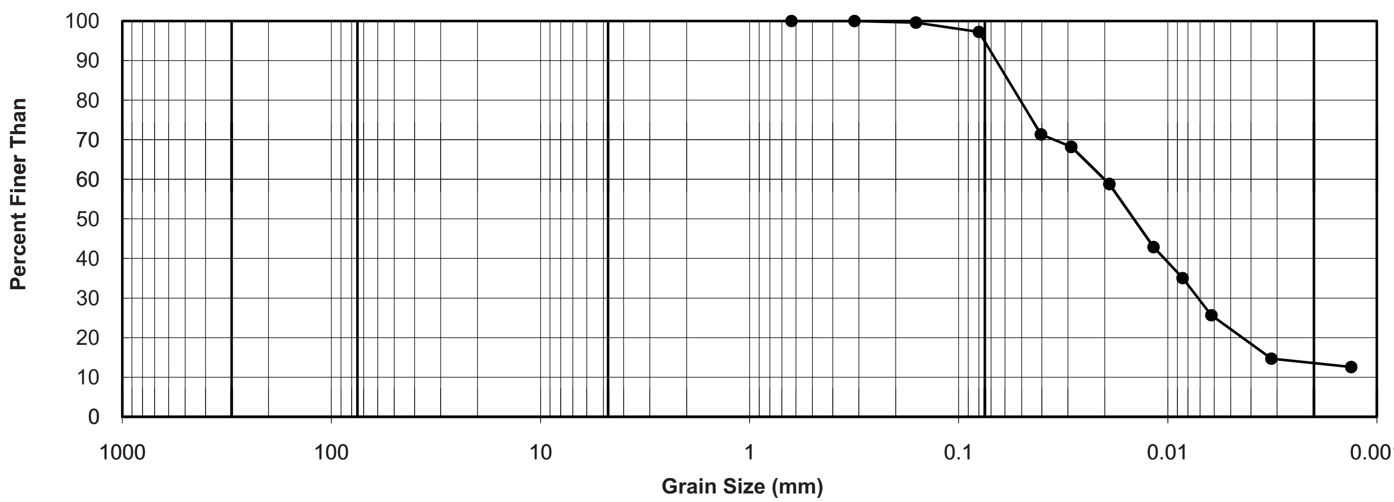
Reviewed By: ____________________

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Giant Mine			
Client:	AECOM Canada	Date Sampled:		

Sample Number	SA10
Sample Location	GA11-T-16
Sampled By	JB
Source	Insitu
Sample Description	See bore logs
In situ Water Content	29.4
Date Tested	Tuesday, June 07, 2011
Tested By	TR
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.6	100.0	Sieve
0.32	100.0	Sieve
0.16	99.6	Sieve
0.080	97.2	Sieve
0.040	71.3	Hydrometer
0.029	68.2	Hydrometer
0.019	58.8	Hydrometer
0.012	42.9	Hydrometer
0.008	35.0	Hydrometer
0.006	25.7	Hydrometer
0.003	14.7	Hydrometer
0.001	12.6	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 6.7 Silt% 80.0 Clay% 13.3

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 09:58:22 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Giant Mine				
Client:	AECOM Canada	Date Sampled:			

Sample Number SA12
Sample Location GA11-T-16

Sampled By JB

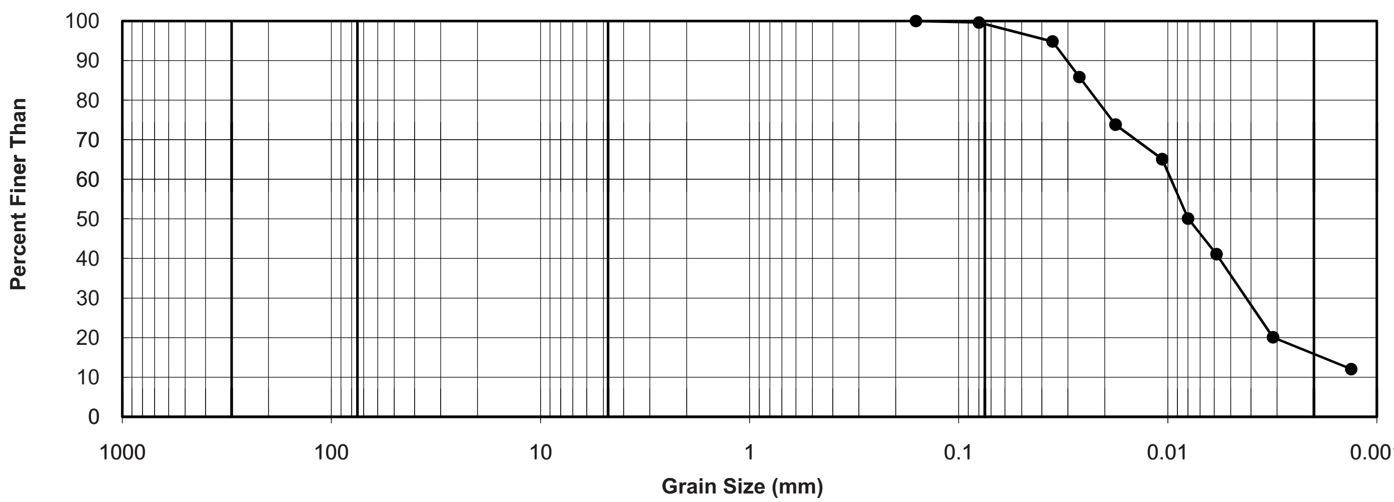
Source Insitu
Sample Description See bore logs

In situ Water Content 39.3
Date Tested Tuesday, June 07, 2011
Tested By TR

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	99.6	Sieve
0.036	94.8	Hydrometer
0.026	85.8	Hydrometer
0.018	73.8	Hydrometer
0.011	65.1	Hydrometer
0.008	50.1	Hydrometer
0.006	41.1	Hydrometer
0.003	20.1	Hydrometer
0.001	12.0	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 1.0 Silt% 83.9 Clay% 15.0

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.06.09 09:47:26 -06'00'

Reviewed By:

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#300 10525 170th Street, Edmonton Alberta T5P 4W2

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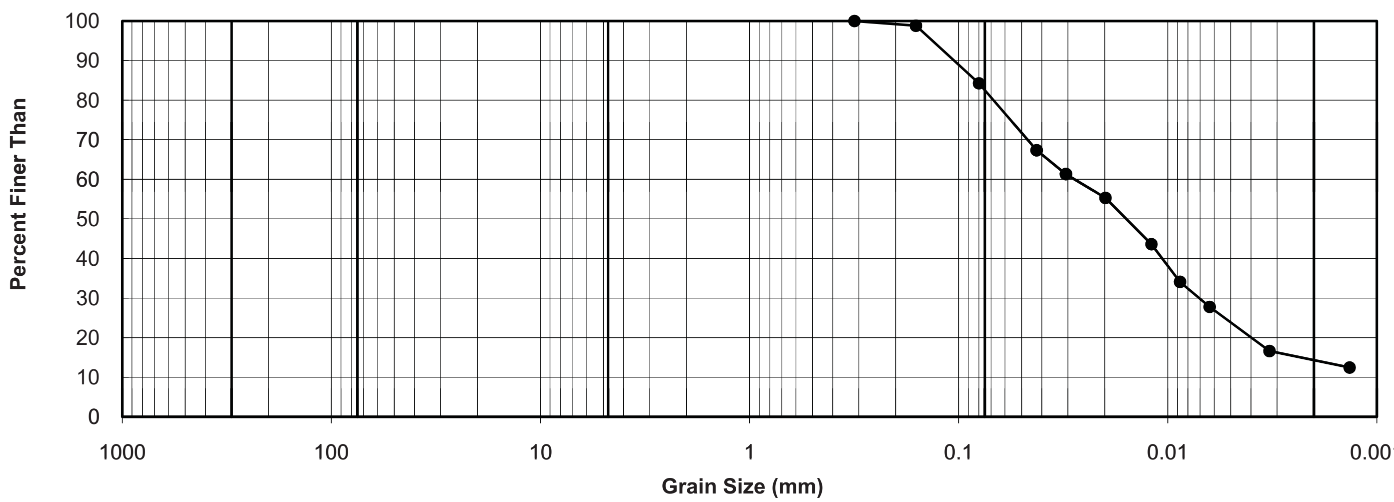
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-17 SA3
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	27.5
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	98.8	Sieve
0.080	84.2	Sieve
0.042	67.3	Hydrometer
0.031	61.3	Hydrometer
0.020	55.3	Hydrometer
0.012	43.6	Hydrometer
0.009	34.1	Hydrometer
0.006	27.8	Hydrometer
0.003	16.6	Hydrometer
0.001	12.4	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 18.4 Silt% 67.7 Clay% 13.9

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DN: cn=Dave McDonald, o=Golder Associates Ltd., ou=, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:20:17 -06'00'

Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number:	A2615
Short Title:	Tailings Pond				
Client:	AECOM	Date Sampled:			

Sample Number: GA11-T-17 SA5
Sample Location: Giant Mine

Sampled By: 0.0

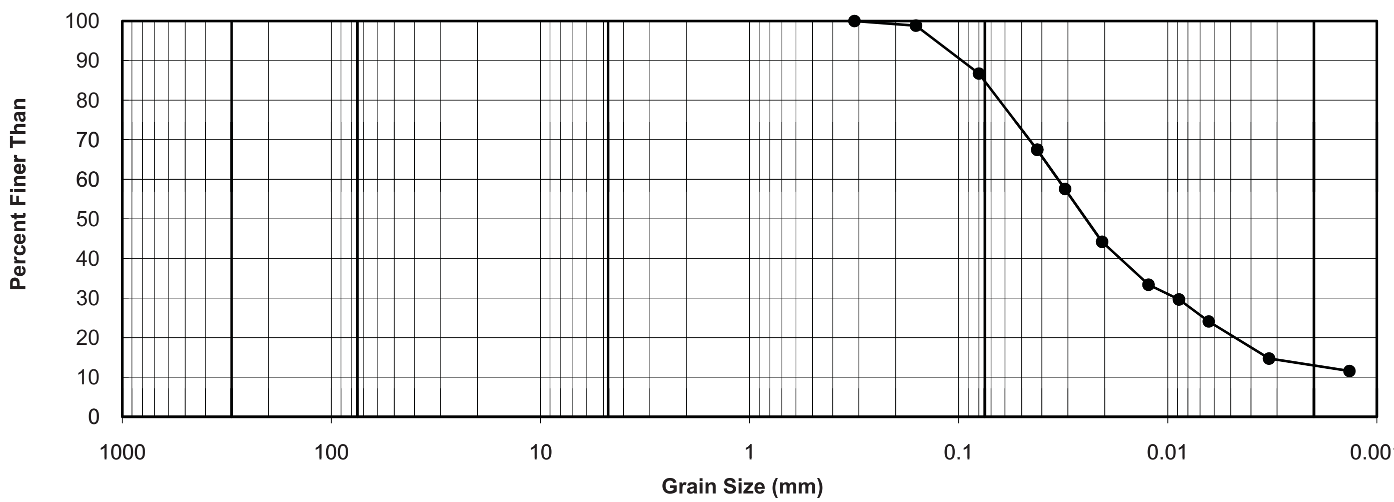
Source
Sample Description

In situ Water Content: 21.5
Date Tested: Thursday, April 14, 2011
Tested By: AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
0.32	100.0	
0.16	98.8	
0.080	86.7	
0.042	67.5	Hydrometer
0.031	57.6	
0.021	44.2	
0.012	33.4	
0.009	29.7	
0.006	24.1	
0.003	14.7	
0.001	11.6	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 16.3 Silt% 71.1 Clay% 12.6

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:20:40 -06'00'

Reviewed By:

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#300 10525 170th Street, Edmonton Alberta T5P 4W2

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Particle Size Analysis of Soils
ASTM D422

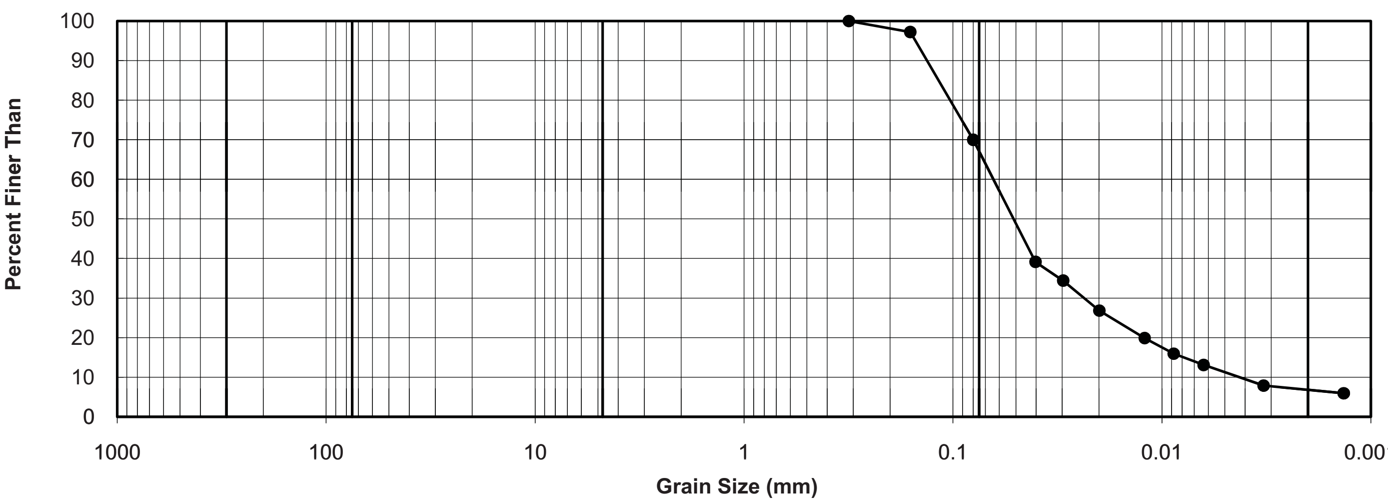
Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:	January 0, 1900	

Sample Number	GA11-T-17 SA7
Sample Location	Giant Mine
Sampled By	0.0
Source	0.0
Sample Description	0
In situ Water Content	26.6
Date Tested	Wednesday, April 13, 2011
Tested By	AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.32	100.0	Sieve
0.16	97.2	Sieve
0.080	70.0	Sieve
0.040	39.1	Hydrometer
0.030	34.4	Hydrometer
0.020	26.8	Hydrometer
0.012	19.9	Hydrometer
0.009	15.9	Hydrometer
0.006	13.1	Hydrometer
0.003	7.9	Hydrometer
0.001	5.9	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	34.7	Silt%	58.7	Clay%	6.6

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 11:03:19 -06'00'

Reviewed By:

Golder Associates Ltd

#300 10525 170th Street, Edmonton Alberta T5P 4W2

Tel (780) 483-3499 Fax (780) 483-1574 www.golder.com

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number GA11-T-17 SA9
Sample Location Giant Mine

Sampled By 0.0

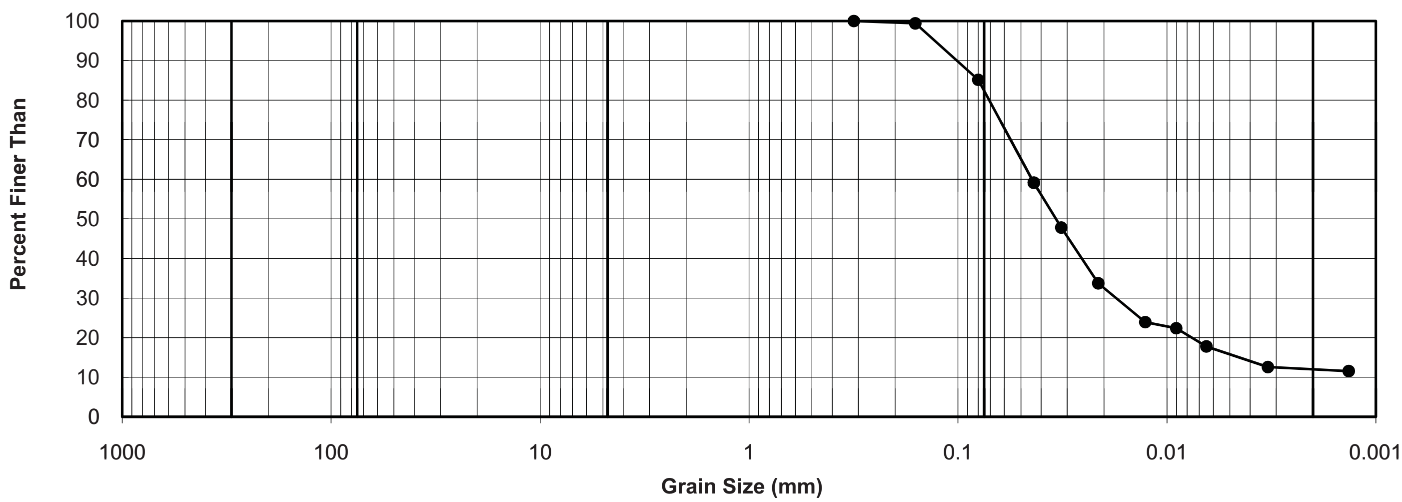
Source
Sample Description

In situ Water Content 22.4
Date Tested Wednesday, April 13, 2011
Tested By AC

Remarks:

Distribution

Gradation Size (mm)	Percent Passing	
		Sieve
0.32	100.0	
0.16	99.4	
0.080	85.1	
0.043	59.2	Hydrometer
0.032	47.8	
0.021	33.7	
0.013	23.9	
0.009	22.4	
0.006	17.8	
0.003	12.6	
0.001	11.5	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 19.1 Silt% 69.0 Clay% 11.9

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:22:57 -06'00'

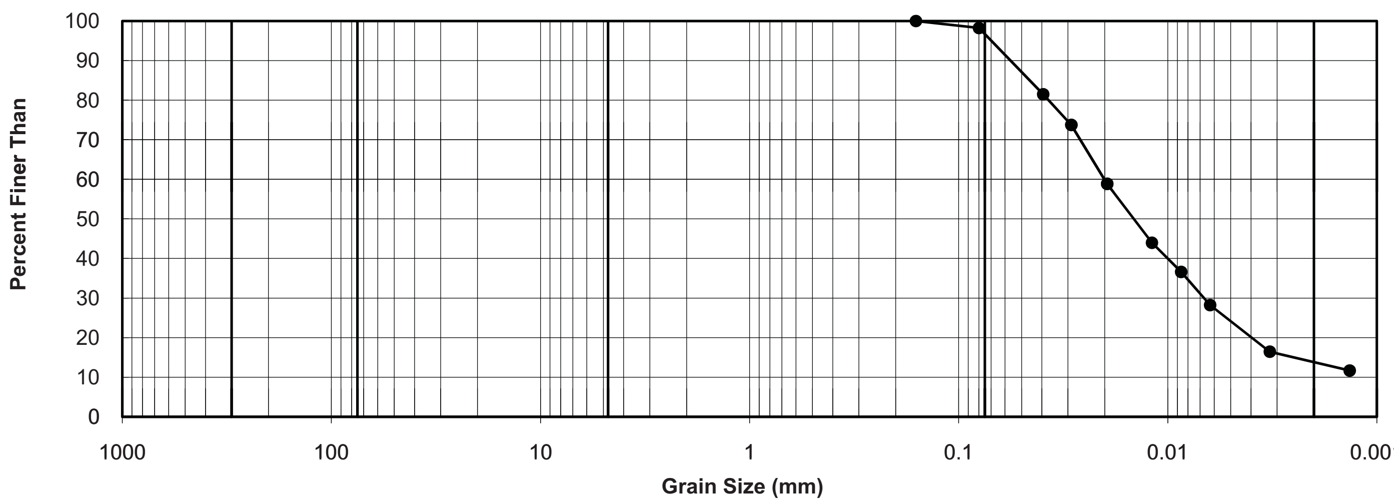
Reviewed By:

Particle Size Analysis of Soils
ASTM D422

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-17 SA10a
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	26.7
Date Tested	Wednesday, April 13, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
		Sieve
0.16	100.0	Sieve
0.080	98.2	Sieve
0.039	81.5	Hydrometer
0.029	73.7	Hydrometer
0.019	58.9	Hydrometer
0.012	44.0	Hydrometer
0.009	36.6	Hydrometer
0.006	28.2	Hydrometer
0.003	16.4	Hydrometer
0.001	11.7	Hydrometer



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel %	0.0	Sand %	4.2	Silt%	82.5	Clay%	13.3

Digitally signed by Dave
DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA
Date: 2011.04.27 15:23:35 -06'00'

Reviewed By:

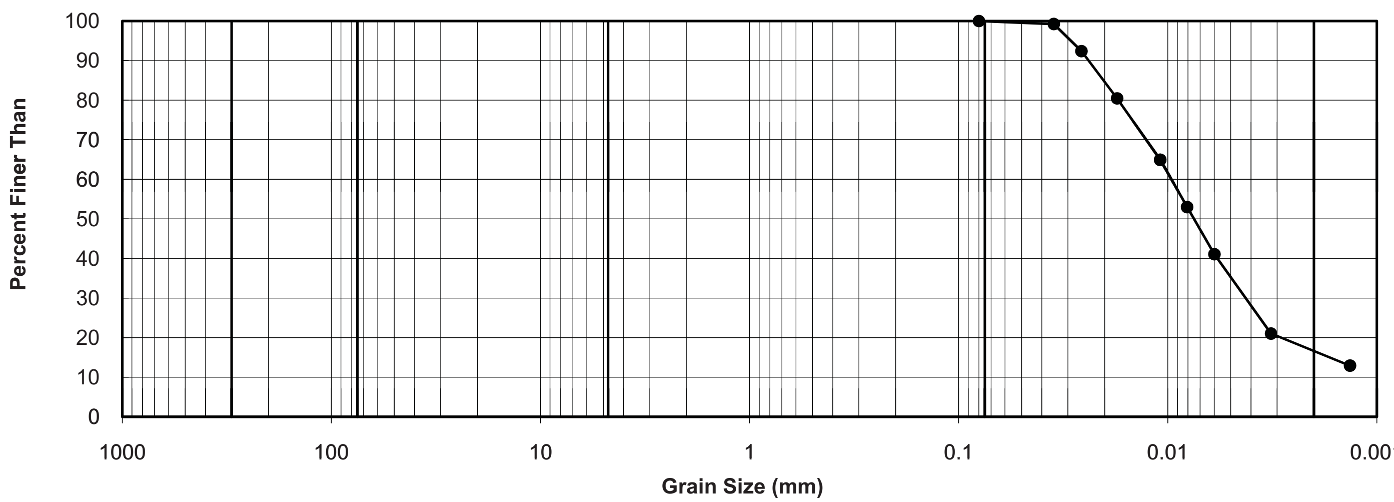
Particle Size Analysis of Soils
ASTM D422

Golder Associates

Project #:	09-1427-0006	Phase:	2100	Report Number: A2615
Short Title:	Tailings Pond			
Client:	AECOM	Date Sampled:		

Sample Number	GA11-T-17 SA12
Sample Location	Giant Mine
Sampled By	0.0
Source	
Sample Description	
In situ Water Content	35.1
Date Tested	Thursday, April 14, 2011
Tested By	AC
Remarks:	
Distribution	

Gradation Size (mm)	Percent Passing	
		Sieve
0.080	100.0	
0.035	99.2	Hydrometer
0.026	92.4	
0.017	80.4	
0.011	64.9	
0.008	53.0	
0.006	41.1	
0.003	21.0	
0.001	12.9	



Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		

Gravel % 0.0 Sand % 0.1 Silt% 84.1 Clay% 15.8

Digitally signed by Dave DN: cn=Dave, o=Golder Associates Ltd., ou=McDonald, email=Dave_McDonald@Golder.com, c=CA Date: 2011.04.27 15:21:34 -06'00'

Reviewed By:

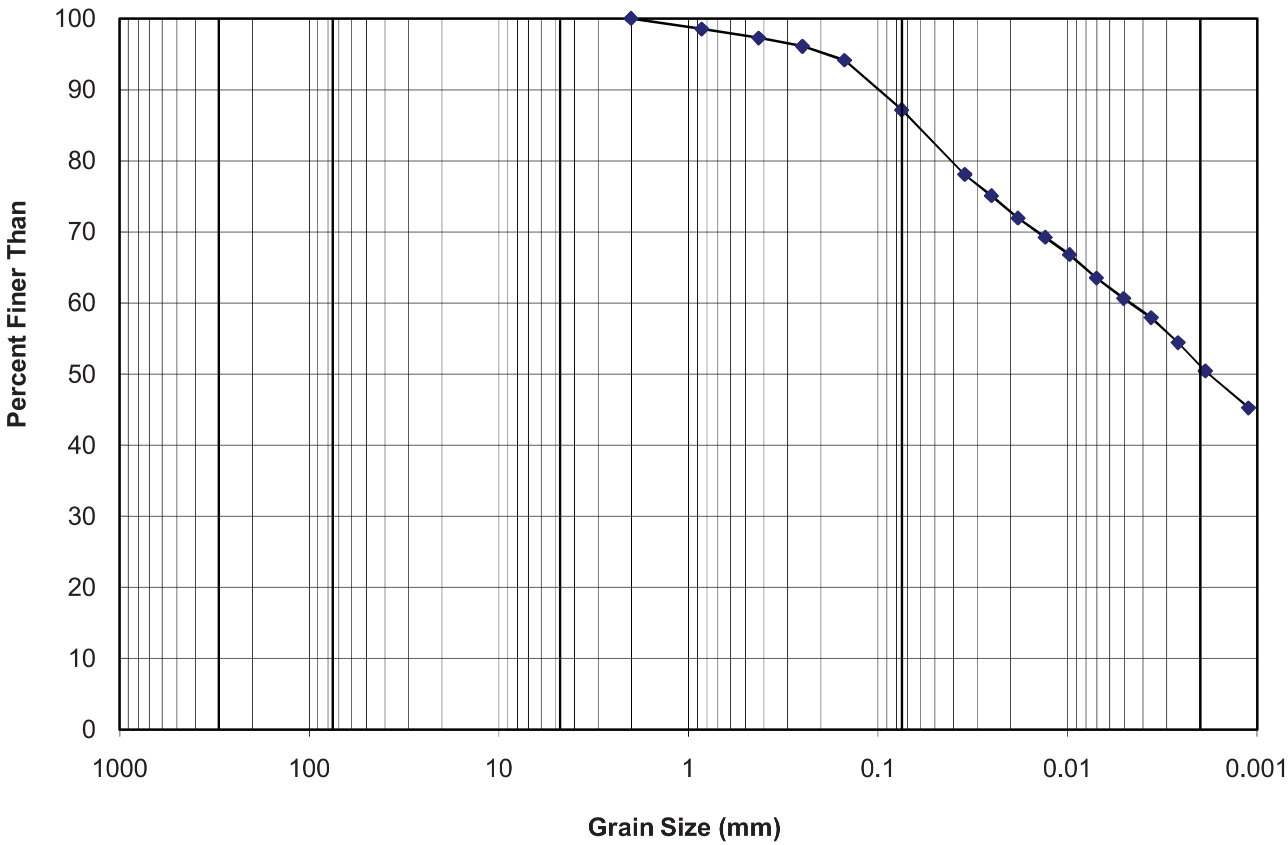
GRAIN SIZE ANALYSIS - ASTM D422
(Mechanical & Hydrometer)

Golder Associates

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 25, 2011

Borehole #: GA11-B-11 Sample #: SA3,4
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	99
0.425	97
0.250	96
0.150	94
0.075	87
0.035	78
0.025	75
0.018	72
0.013	69
0.010	67
0.007	63
0.005	61
0.004	58
0.003	54
0.002	50
0.001	45

Comments:
Samples GA11-B-11 SA3 and SA4 were mixed together before testing.

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

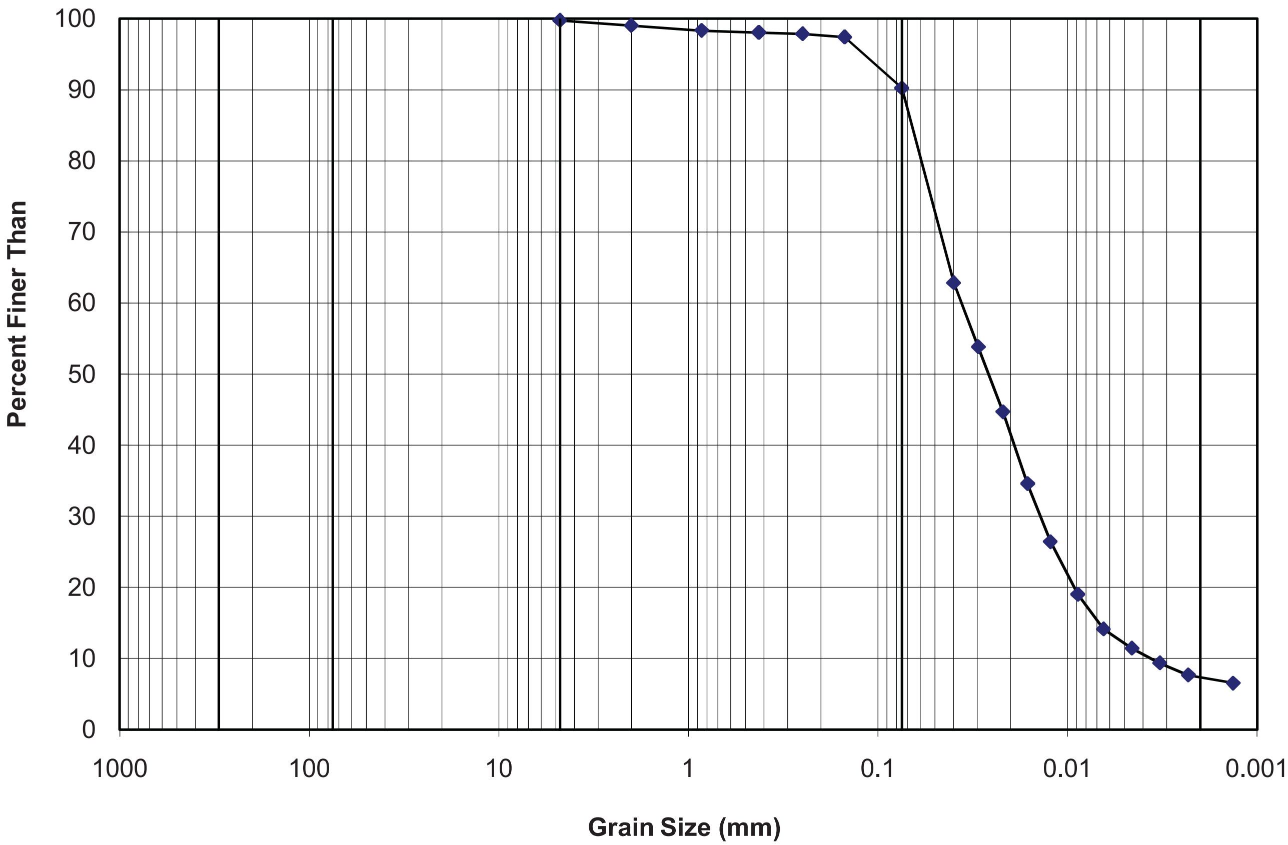
Golder Associates

GRAIN SIZE ANALYSIS - ASTM D422
(Mechanical & Hydrometer)

Project #: 09-1427-0006 | Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. | Date: April 8, 2011

Borehole #: GA11-B-14 | Sample #: SA4,5
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	99
0.850	98
0.425	98
0.250	98
0.150	97
0.075	90
0.040	63
0.030	54
0.022	45
0.016	35
0.012	26
0.009	19
0.006	14
0.005	11
0.003	9.4
0.002	7.7
0.001	6.6

Comments:
Samples GA11-B-14 SA4 and SA5 were mixed together before testing.

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Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

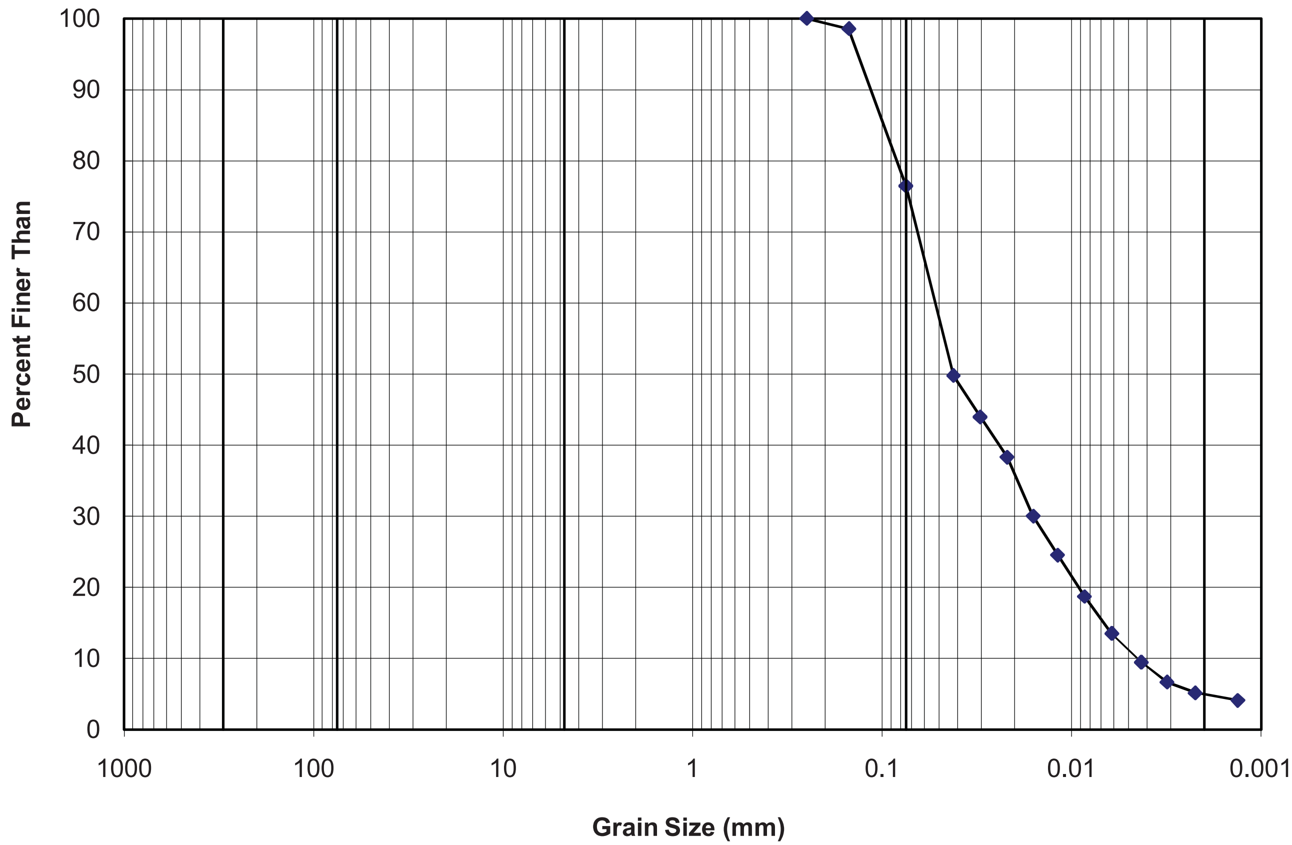
(Mechanical & Hydrometer)

Golder Associates

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 8, 2011

Borehole #: GA11-T-06 Sample #: SA1
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	99
0.075	76
0.042	50
0.030	44
0.022	38
0.016	30
0.012	25
0.009	19
0.006	14
0.004	10
0.003	6.7
0.002	5.2
0.001	4.2

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

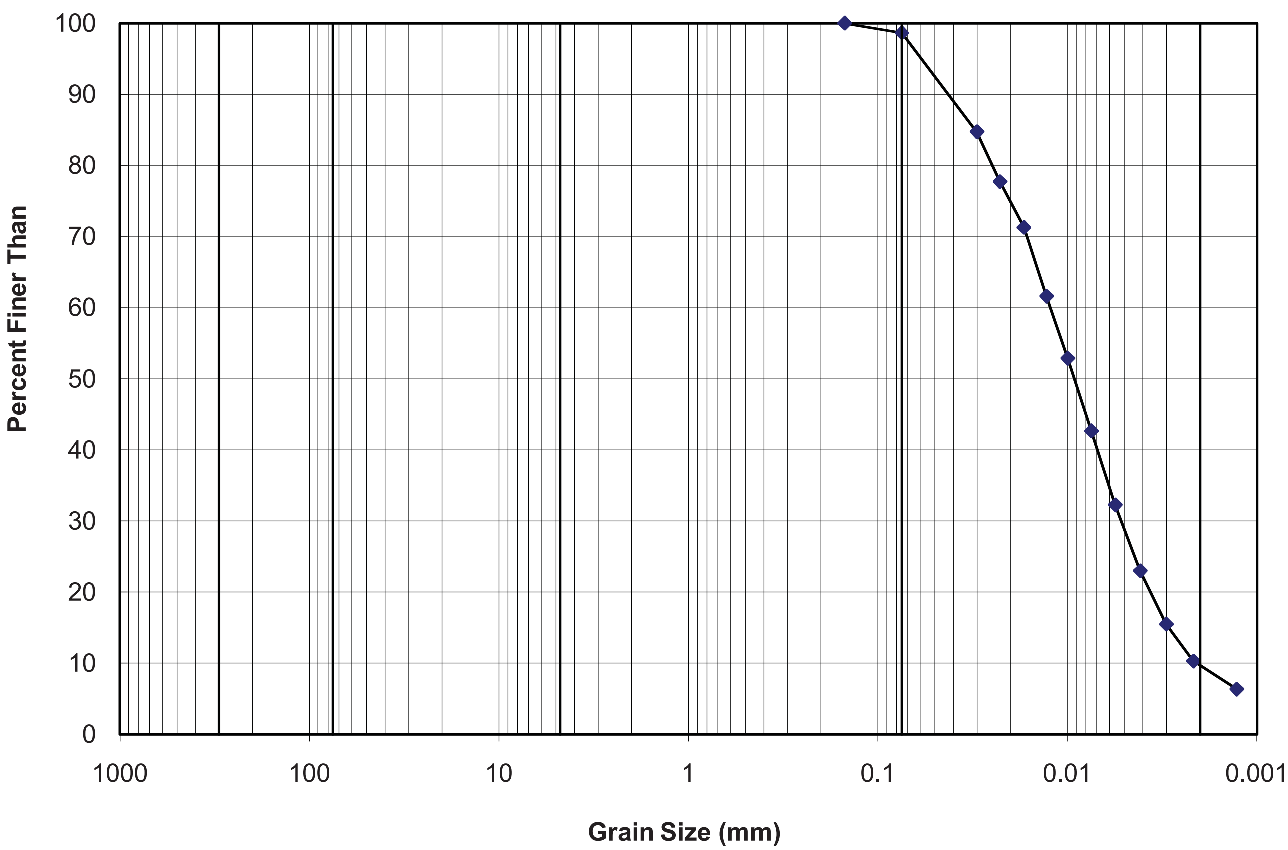
GRAIN SIZE ANALYSIS - ASTM D422

(Mechanical & Hydrometer)

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 8, 2011

Borehole #: GA11-T-06 Sample #: SA2
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	100
0.075	99
0.030	85
0.023	78
0.017	71
0.013	62
0.010	53
0.007	43
0.006	32
0.004	23
0.003	16
0.002	10
0.001	6.4

Comments:

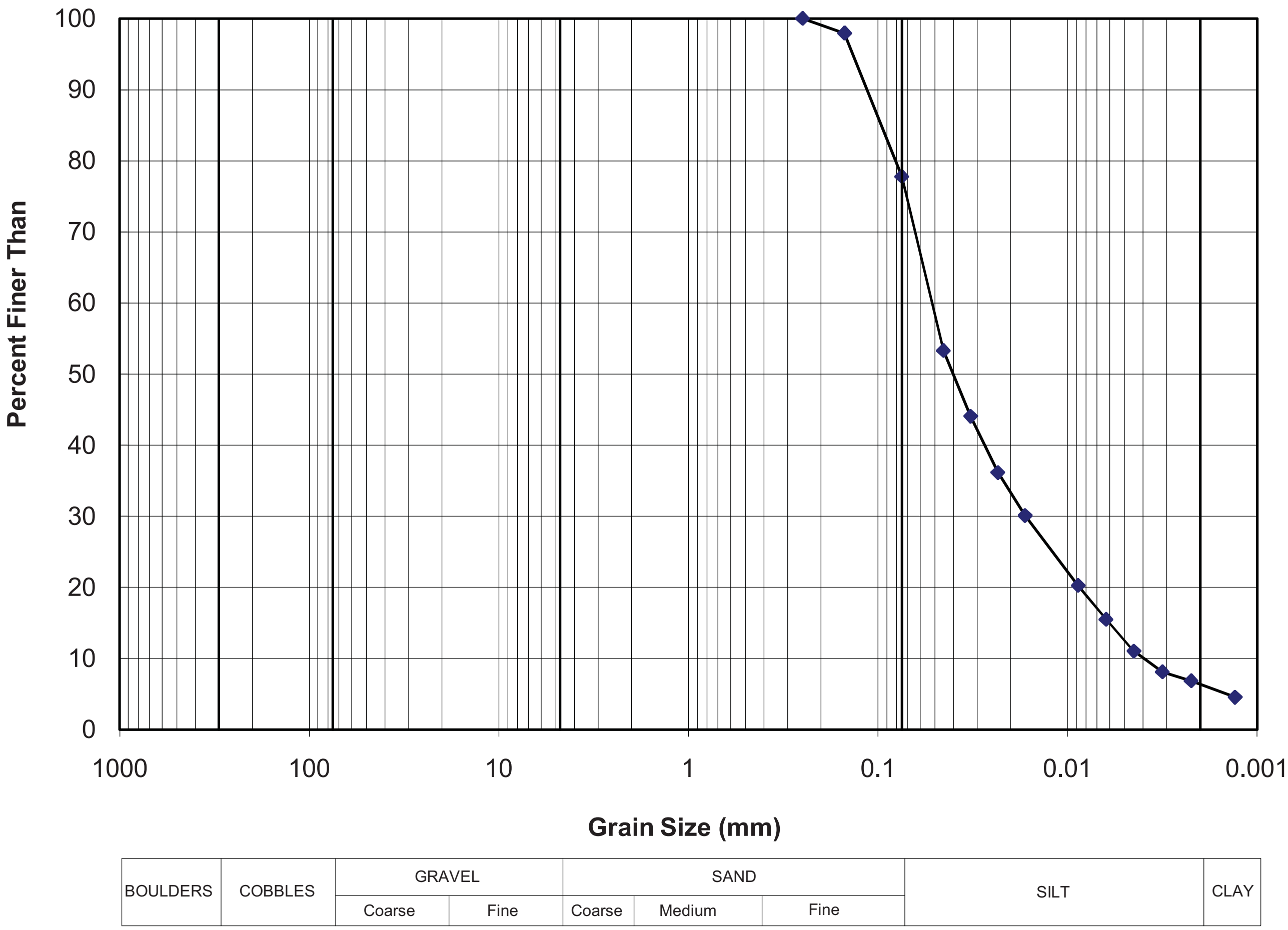
1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: ____________

GRAIN SIZE ANALYSIS - ASTM D422
(Mechanical & Hydrometer)

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 8, 2011
Borehole #: GA11-T-06 Sample #: SA3 (Bag)
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	98
0.075	78
0.045	53
0.033	44
0.023	36
0.017	30
0.009	20
0.006	16
0.004	11
0.003	8.1
0.002	6.9
0.001	4.6

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

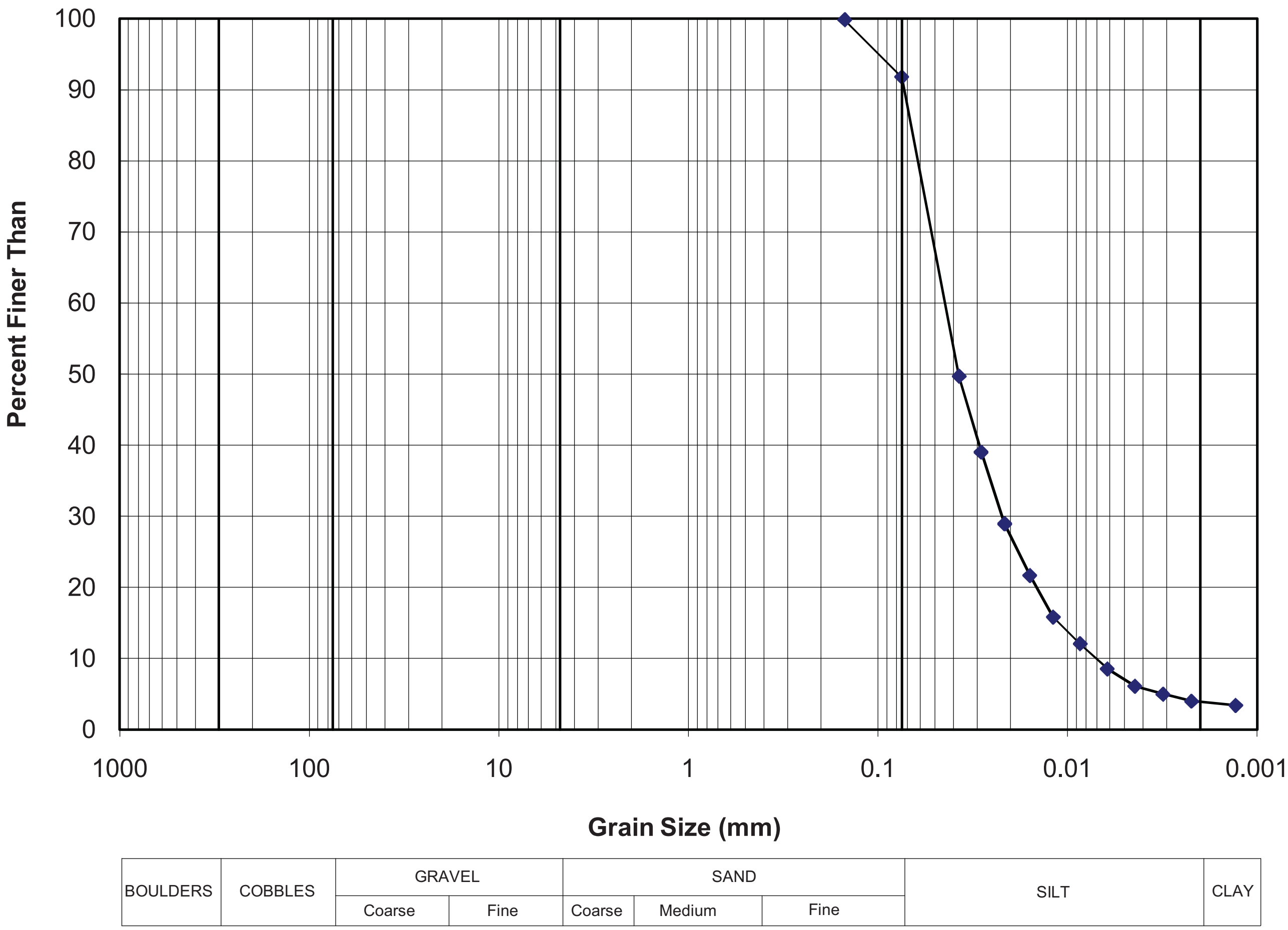
Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422
(Mechanical & Hydrometer)

Project #: 09-1427-0006 | Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. | Date: April 14, 2011

Borehole #: GA11-T-06 Sample #: SA3 (Shelby tube)
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	100
0.075	92
0.037	50
0.029	39
0.021	29
0.016	22
0.012	16
0.009	12
0.006	8.6
0.004	6.1
0.003	5.0
0.002	4.0
0.001	3.4

Comments:
Sample was taken from shelby tube.

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

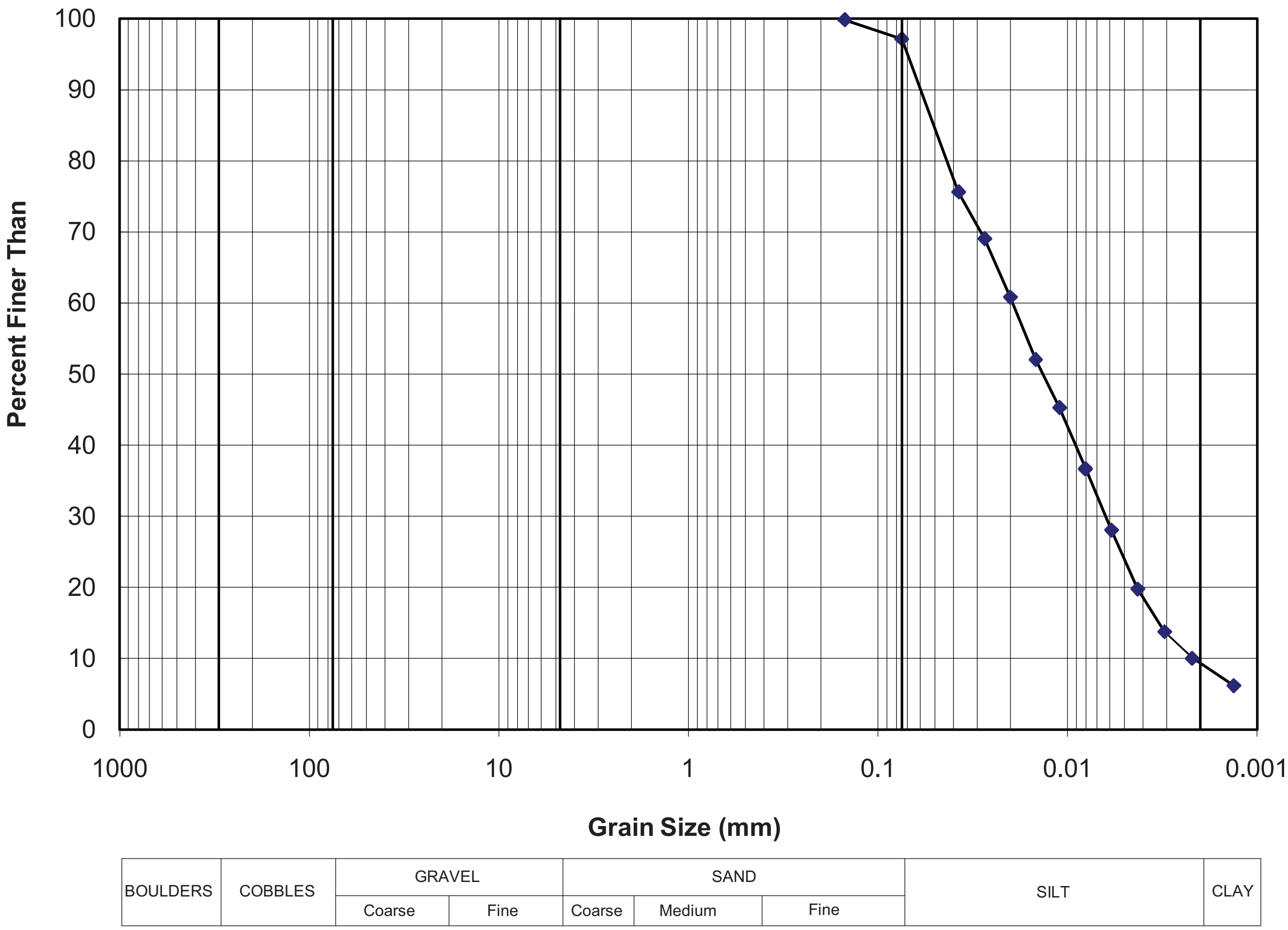
(Mechanical & Hydrometer)

Golder Associates

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 8, 2011

Borehole #: GA11-T-06 Sample #: SA4
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	100
0.075	97
0.038	76
0.027	69
0.020	61
0.015	52
0.011	45
0.008	37
0.006	28
0.004	20
0.003	14
0.002	10
0.001	6.2

Comments:

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Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

Golder Associates

GRAIN SIZE ANALYSIS - ASTM D422

(Mechanical & Hydrometer)

Project #: 09-1427-0006 Phase: 2000

Short Title: AECOM / Engineering Services / Giant Mine, NWT

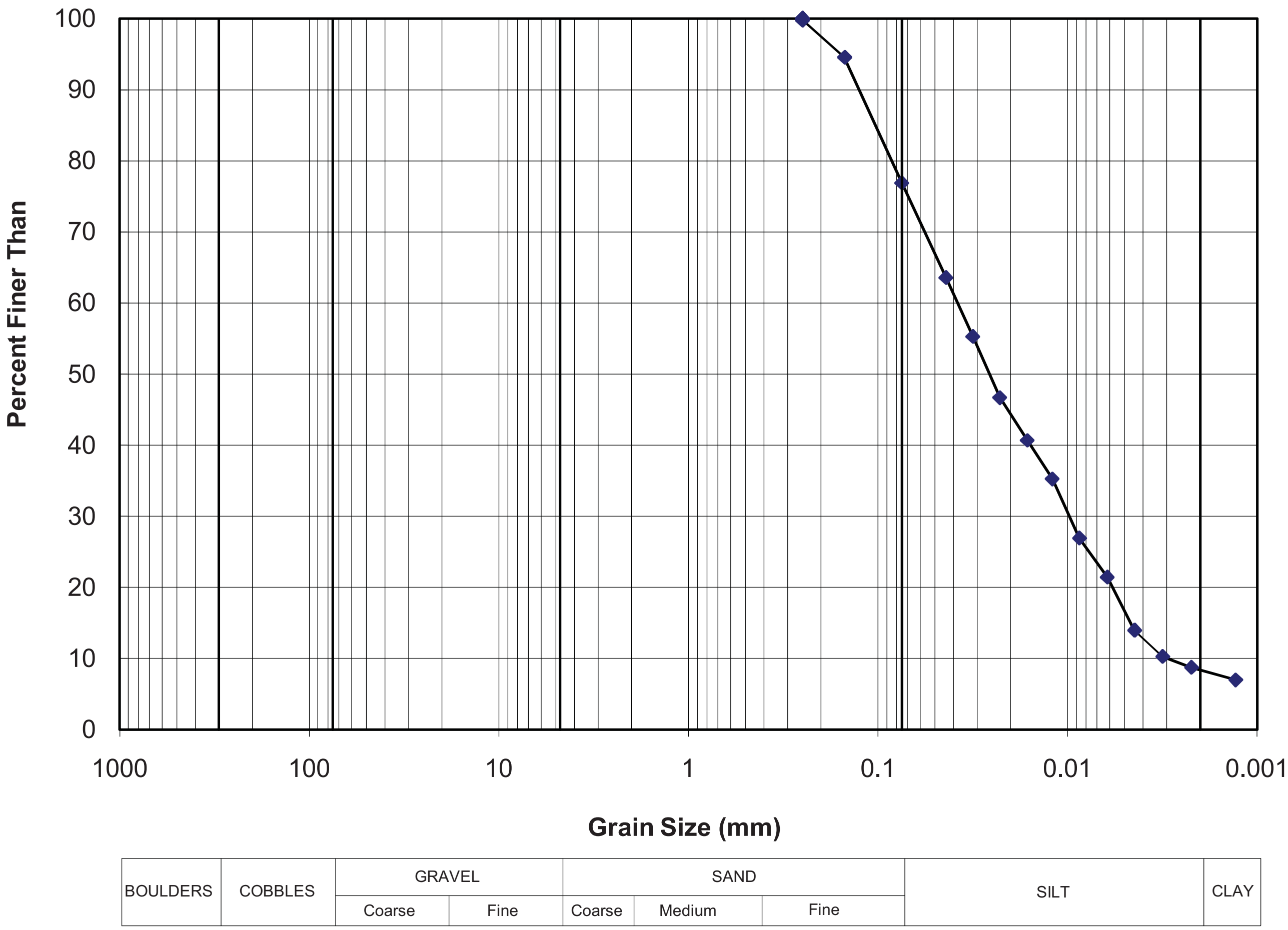
Tested by: K.N. / R.G. Date: April 8, 2011

Borehole #: GA11-T-12 Sample #: SA1

Source:

Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	95
0.075	77
0.044	64
0.032	55
0.023	47
0.016	41
0.012	35
0.009	27
0.006	21
0.004	14
0.003	10
0.002	8.8
0.001	7.0

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

(Mechanical & Hydrometer)

Project #: 09-1427-0006 — Phase: 2000

Short Title: AECOM / Engineering Services / Giant Mine, NWT

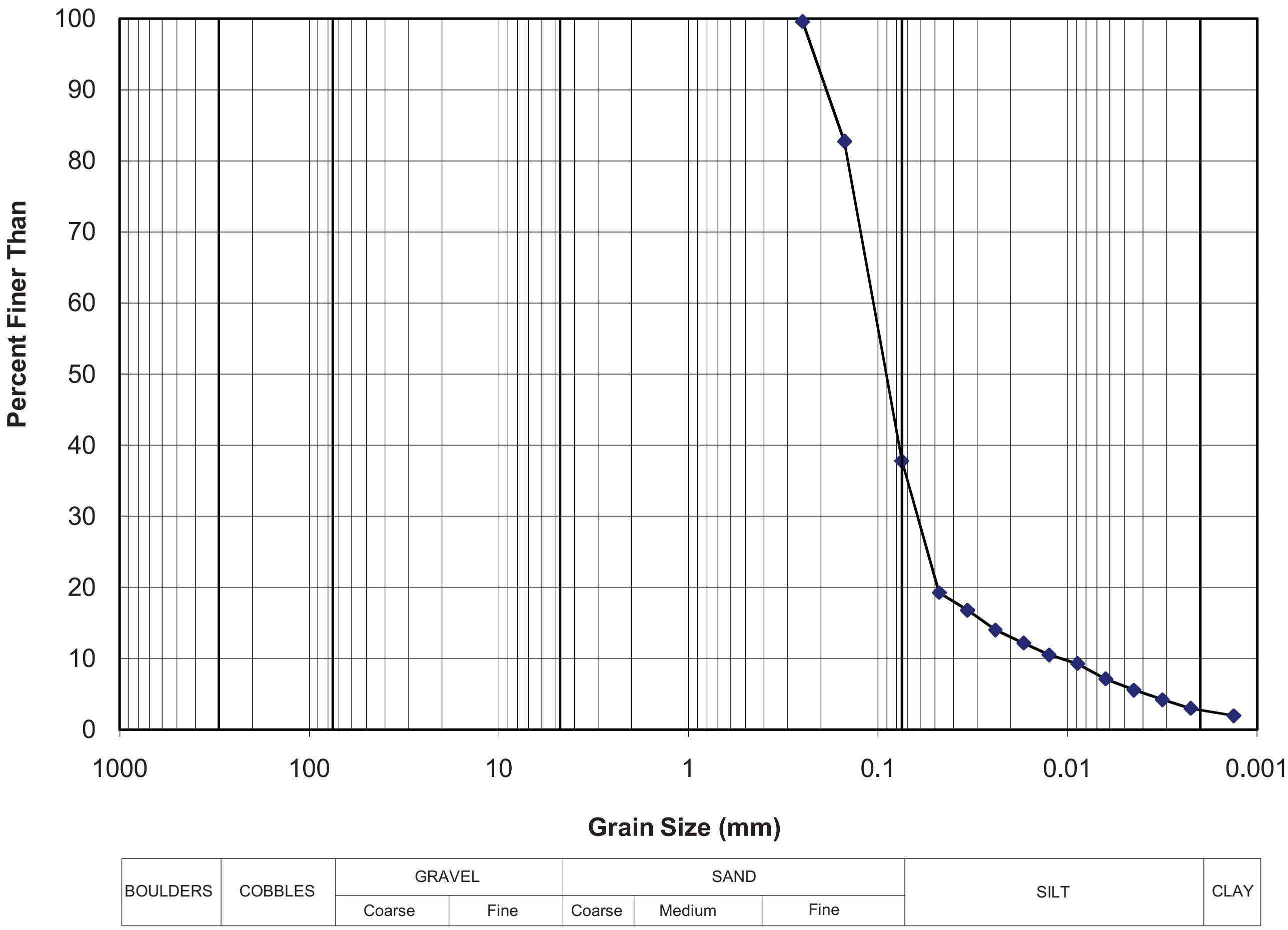
Tested by: J.K. / R.G. — Date: April 25, 2011

Borehole #: GA11-T-12 — Sample #: SA2

Source:

Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	83
0.075	38
0.048	19
0.034	17
0.024	14
0.017	12
0.012	11
0.009	9.3
0.006	7.1
0.004	5.6
0.003	4.2
0.002	3.0
0.001	2.0

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

(Mechanical & Hydrometer)

Golder Associates

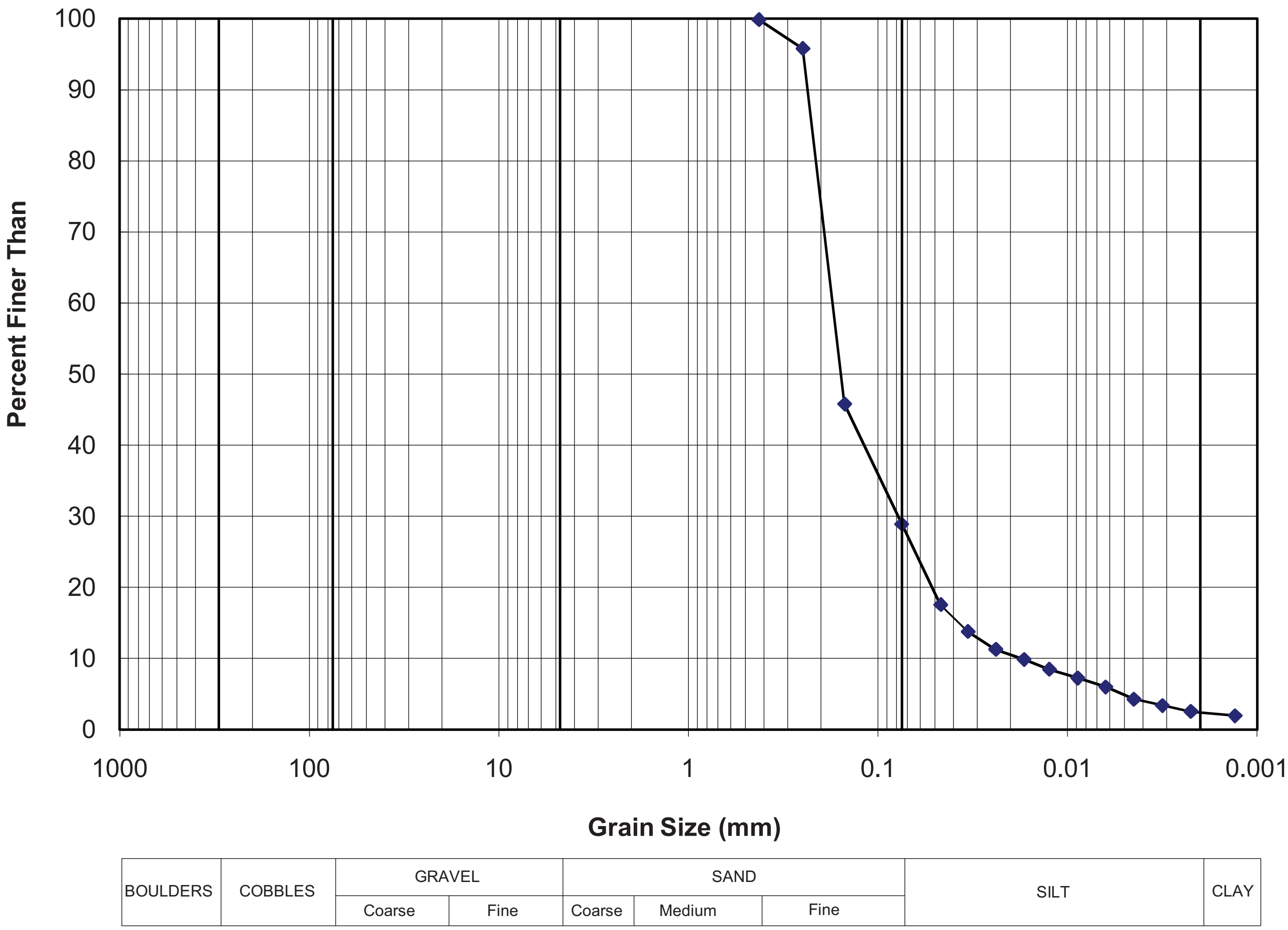
Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested by:	K.N. / R.G.	Date:	April 8, 2011

Borehole #: GA11-T-12 Sample #: SA3

Source:

Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	96
0.150	46
0.075	29
0.047	18
0.034	14
0.024	11
0.017	10
0.012	8.5
0.009	7.3
0.006	6.0
0.004	4.3
0.003	3.4
0.002	2.6
0.001	2.0

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

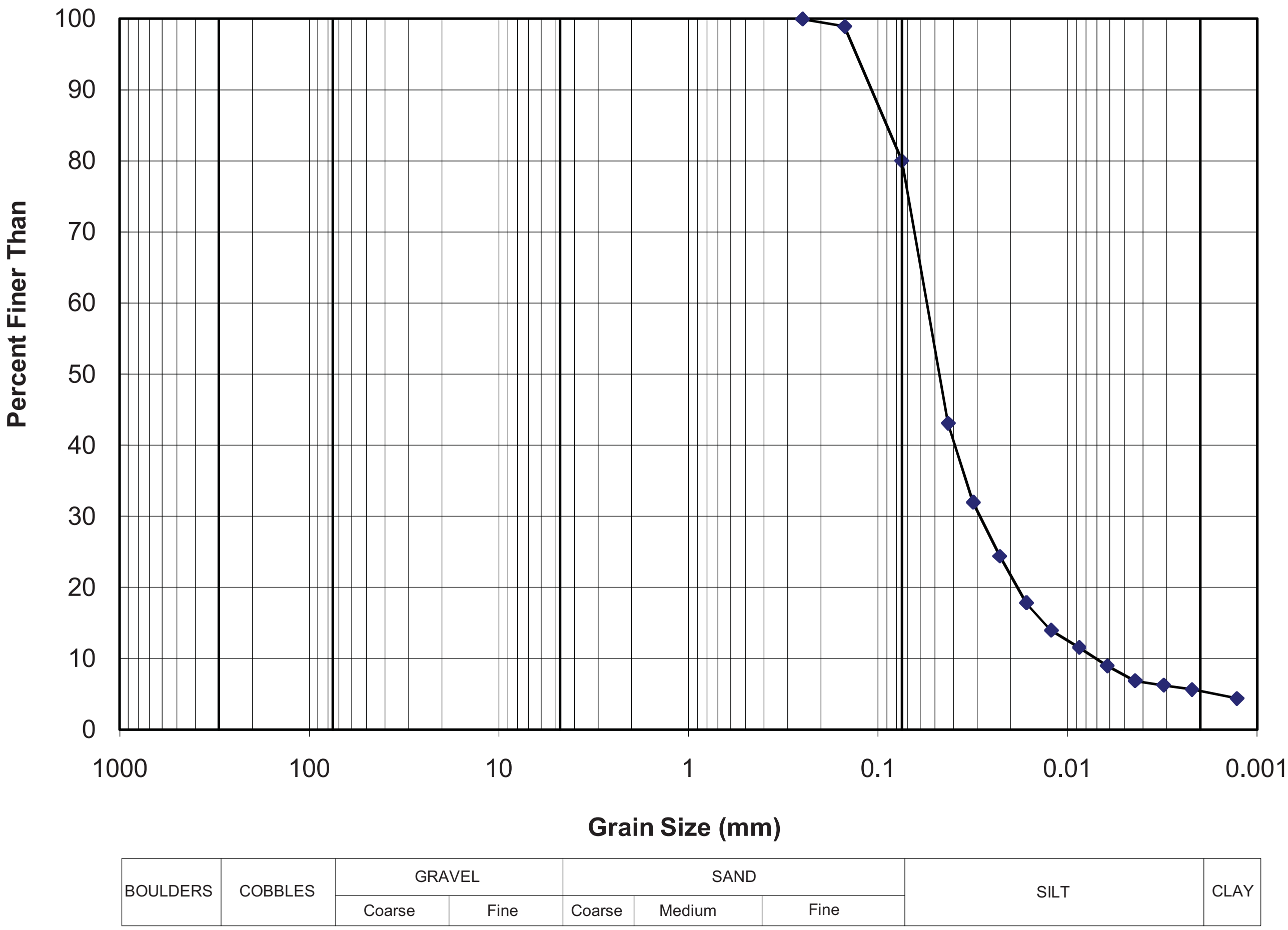
(Mechanical & Hydrometer)

Golder Associates

Project #: 09-1427-0006 Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. Date: April 25, 2011

Borehole #: GA11-T-12 Sample #: SA4
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	99
0.075	80
0.043	43
0.031	32
0.023	24
0.016	18
0.012	14
0.009	12
0.006	9.0
0.004	6.9
0.003	6.2
0.002	5.6
0.001	4.4

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422

(Mechanical & Hydrometer)

Golder Associates

Project #: 09-1427-0006 | Phase: 2000

Short Title: AECOM / Engineering Services / Giant Mine, NWT

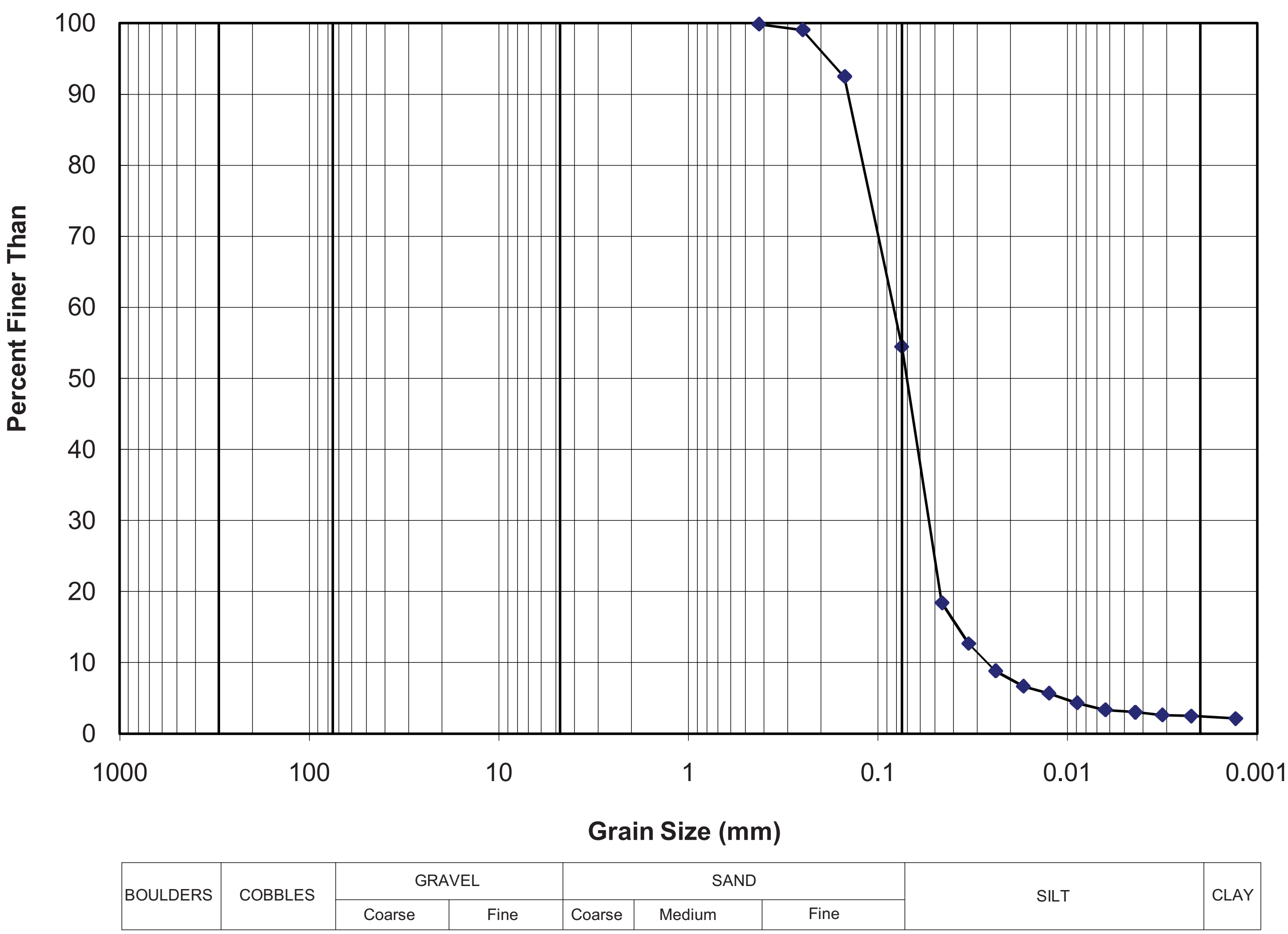
Tested by: K.N. / R.G. | Date: April 14, 2011

Borehole #: GA11-T-12 | Sample #: SA5

Source:

Date Sample Received: April 5, 2011

Graphical Analysis



Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	99
0.150	92
0.075	54
0.046	18
0.033	13
0.024	8.8
0.017	6.7
0.013	5.7
0.009	4.3
0.006	3.4
0.004	3.0
0.003	2.6
0.002	2.5
0.001	2.1

Comments:

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

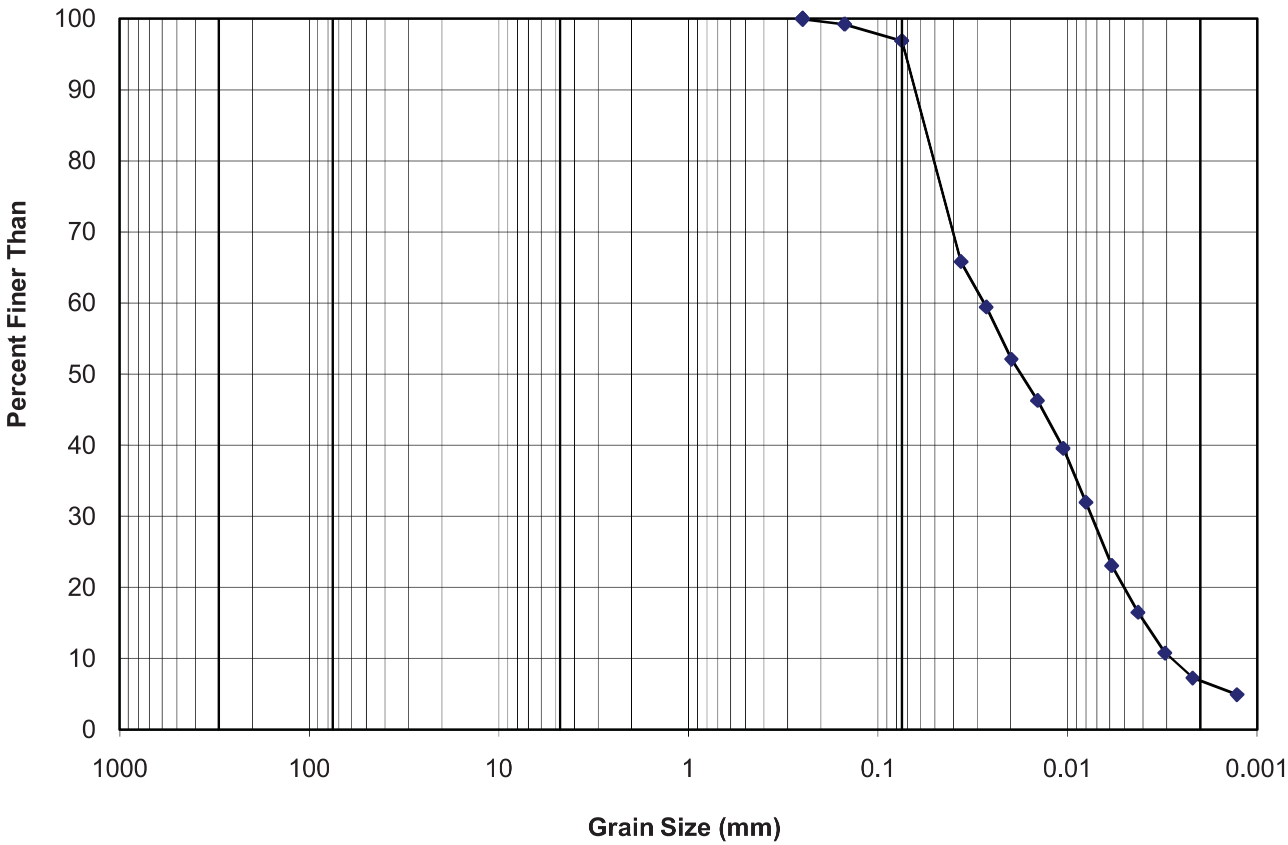
Reviewed by: [signature]

GRAIN SIZE ANALYSIS - ASTM D422
(Mechanical & Hydrometer)

Project #: 09-1427-0006 | Phase: 2000
Short Title: AECOM / Engineering Services / Giant Mine, NWT
Tested by: K.N. / R.G. | Date: April 8, 2011

Borehole #: GA11-T-14 Sample#: SA2,3
Source:
Date Sample Received: April 5, 2011

Graphical Analysis



BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		

Grain Size Analysis Results:

Opening (mm)	Percent Passing (%)
152	100
76	100
38	100
19	100
9.5	100
4.75	100
2.00	100
0.850	100
0.425	100
0.250	100
0.150	99
0.075	97
0.036	66
0.027	59
0.020	52
0.014	46
0.011	40
0.008	32
0.006	23
0.004	17
0.003	11
0.002	7.3
0.001	5.0

Comments:
Samples GA11-T-14 SA2 and SA3 were mixed together before testing.

1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by: [signature]

Soil-water Characteristic Curve

SOIL-WATER CHARACTERISTIC CURVE

Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested By:	D.B.	Date:	May 30, 2011
Sample:	GA11-T-06 SA3		

Test Results:

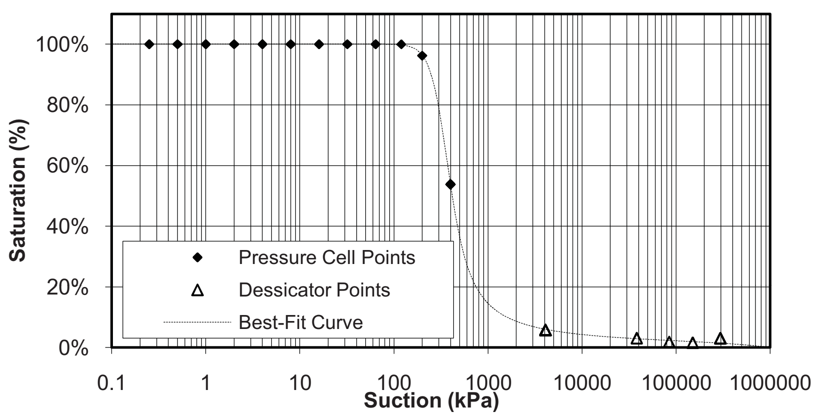
Suction (kPa)	Water Content: Gravimetric	Water Content: Volumetric
0.25	0.307	0.466
0.5	0.307	0.466
1	0.308	0.467
2	0.302	0.462
4	0.306	0.466
8	0.306	0.466
16	0.304	0.464
32	0.300	0.461
64	0.293	0.455
120	0.285	0.448
200	0.265	0.423
400	0.148	0.236
4100	0.016	0.025
38200	0.008	0.013
84350	0.005	0.008
150300	0.004	0.007
295000	0.008	0.013

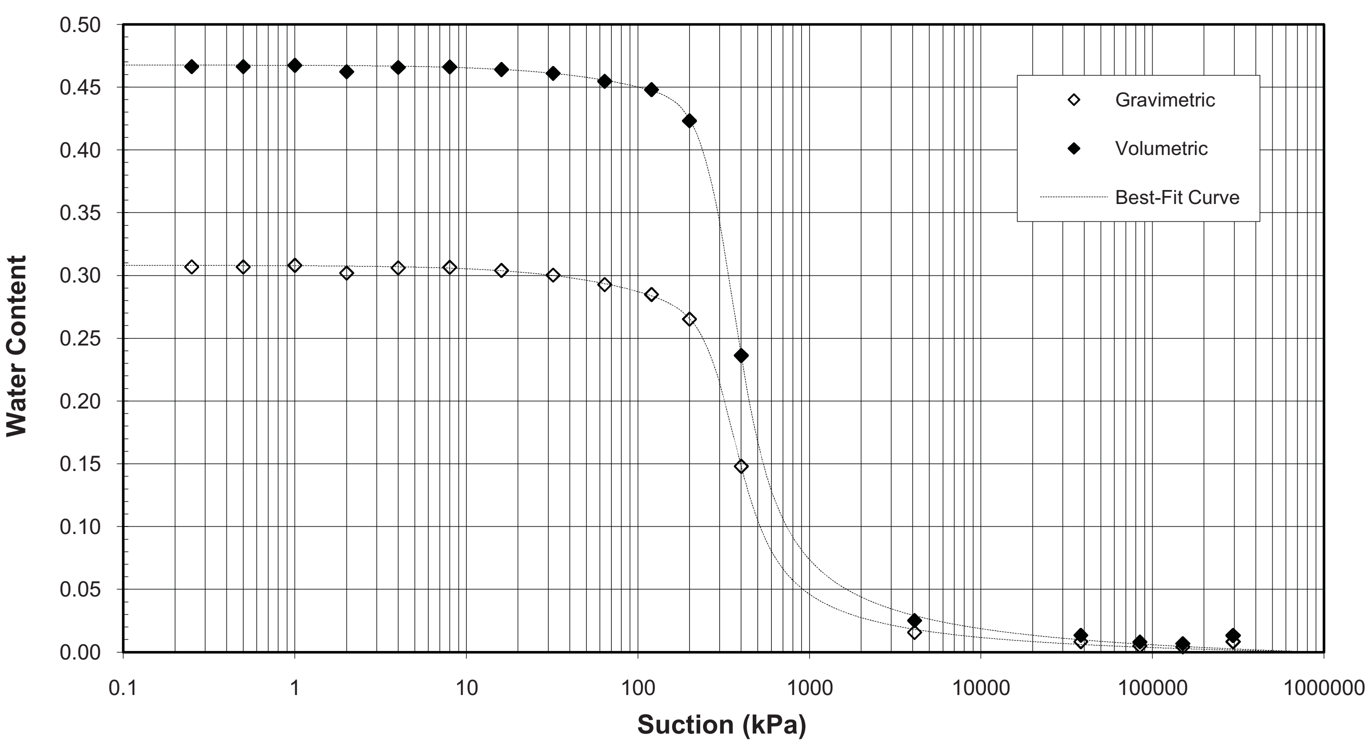
Sample Data:

Diameter:	63.88	mm (initial)
Height:	31.55	mm (initial)
Initial Water Content:	29.0	% (gravimetric)
Dry Density:	1556	kg/m^3 (initial)
Material used passing:	4.75	mm sieve

Comments:

Specimen trimmed from Shelby tube sample.





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

SOIL-WATER CHARACTERISTIC CURVE

Golder Associates

Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested By:	D.B.	Date:	May 31, 2011
Sample:	GA11-T-06 SA3		

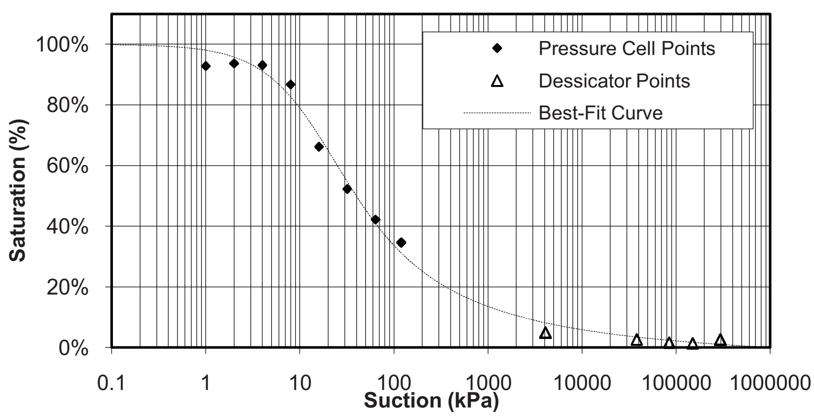
Test Results:

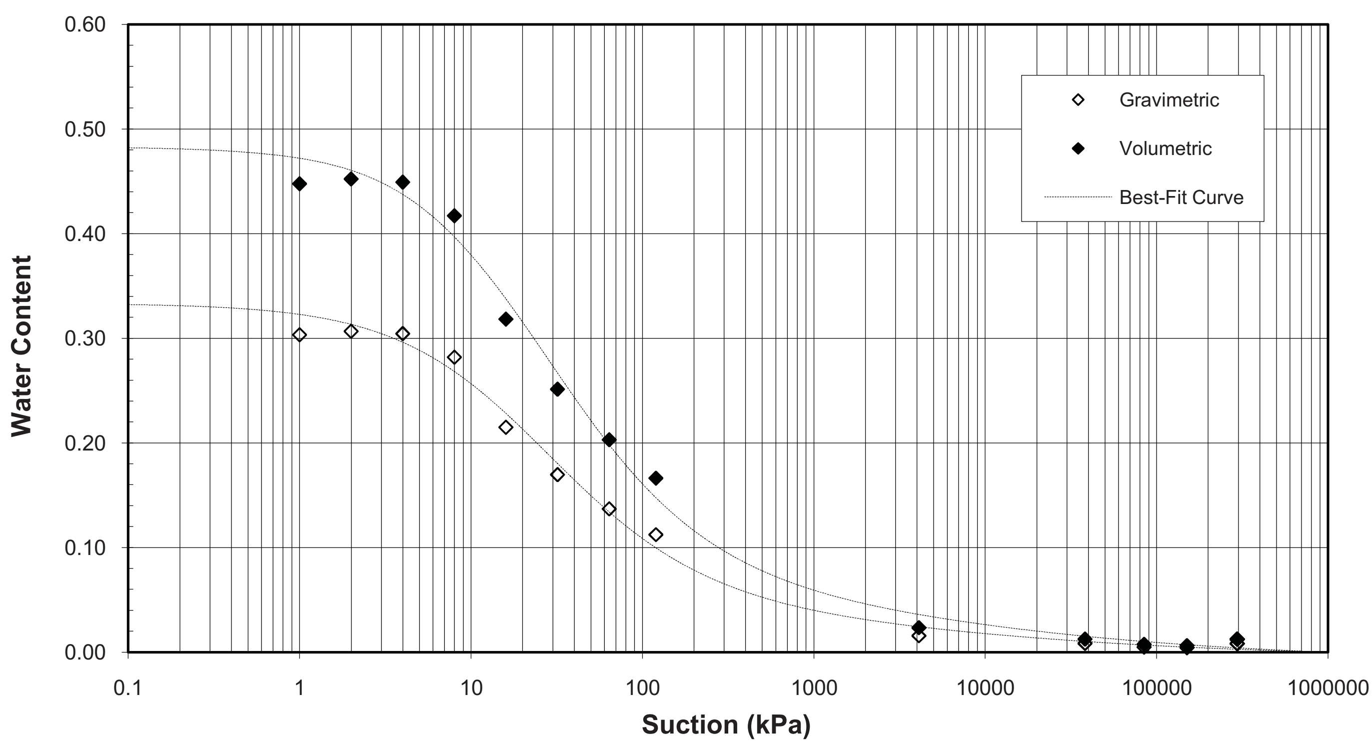
Suction	Water Content	
(kPa)	Gravimetric	Volumetric
1	0.303	0.447
2	0.307	0.452
4	0.305	0.449
8	0.282	0.417
16	0.215	0.318
32	0.170	0.251
64	0.137	0.203
120	0.112	0.166
4100	0.016	0.023
38200	0.008	0.012
84350	0.005	0.007
150300	0.004	0.006
295000	0.008	0.012

Sample Data:

Diameter:	63.87	mm (initial)
Height:	32.21	mm (initial)
Initial Water Content:	16.5	% (gravimetric)
Dry Density:	1462	kg/m^3 (initial)
Material used passing:	4.75	mm sieve

Comments:





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

SOIL-WATER CHARACTERISTIC CURVE

Golder Associates

Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested By:	D.B.	Date:	June 2, 2011
Sample:	GA11-T-12 SA2		

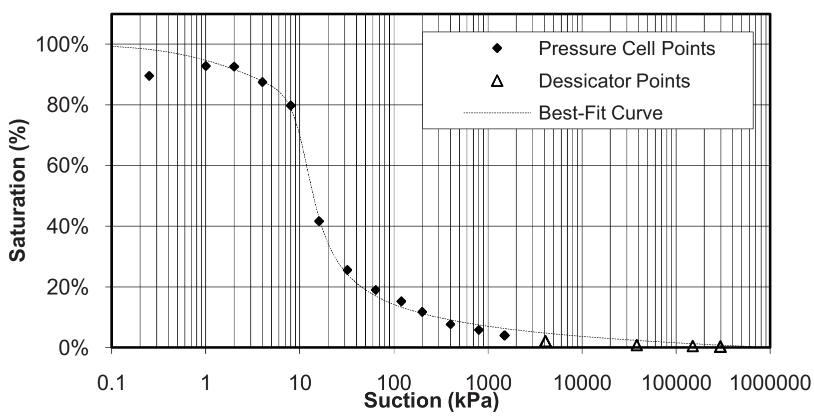
Test Results:

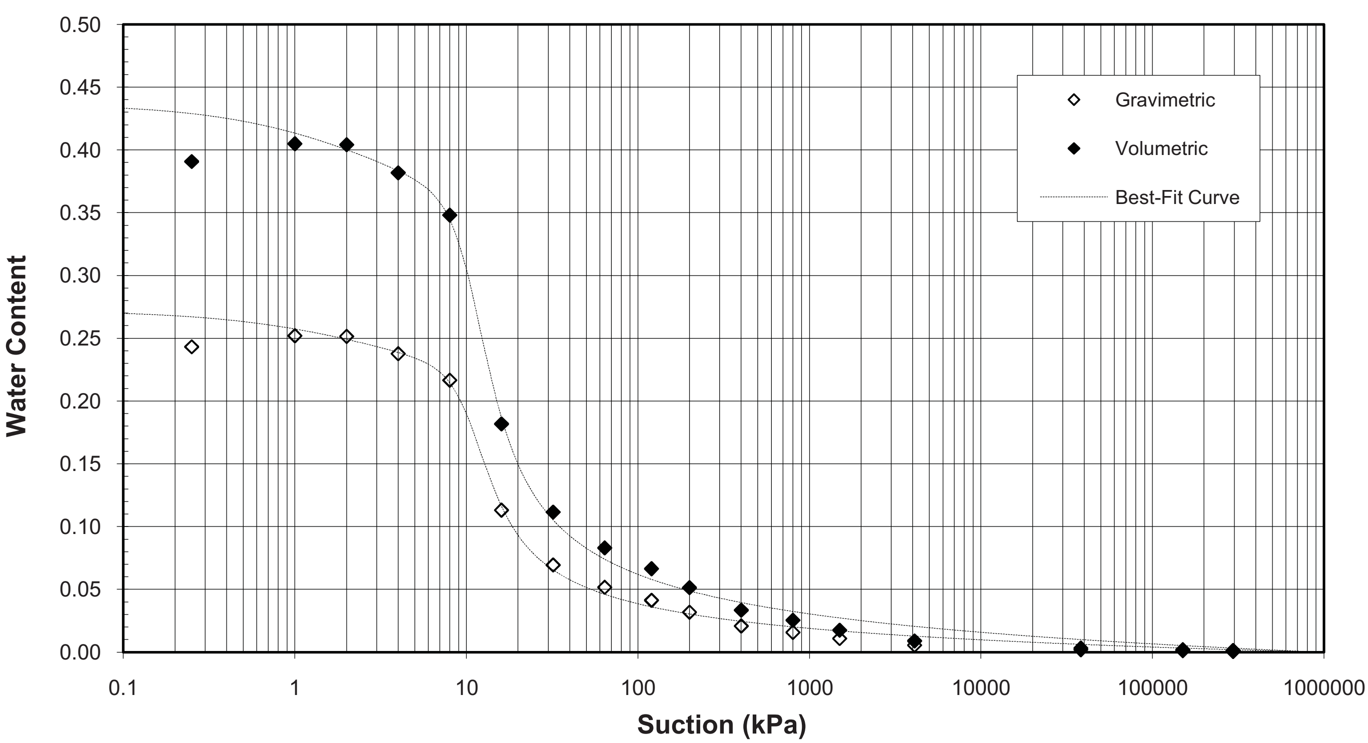
Suction (kPa)	Water Content Gravimetric	Water Content Volumetric
0.25	0.243	0.391
1	0.252	0.405
2	0.252	0.404
4	0.238	0.382
8	0.217	0.348
16	0.113	0.182
32	0.069	0.112
64	0.052	0.083
120	0.041	0.067
200	0.032	0.051
400	0.021	0.033
800	0.016	0.025
1500	0.011	0.017
4100	0.006	0.009
38200	0.002	0.003
150300	0.001	0.002
295000	0.001	0.001

Sample Data:

Diameter:	63.98	mm (initial)
Height:	31.33	mm (initial)
Initial Water Content:	4.2	% (gravimetric)
Dry Density:	1606	kg/m^3 (initial)
Material used passing:	4.75	mm sieve

Comments:





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

SOIL-WATER CHARACTERISTIC CURVE

Golder Associates

Project #:	09-1427-0006	Phase:	2000
Short Title:	AECOM / Engineering Services / Giant Mine, NWT		
Tested By:	D.B.	Date:	May 31, 2011
Sample:	GA11-T-14 SA2, SA3 (Mix Together)		

Test Results:

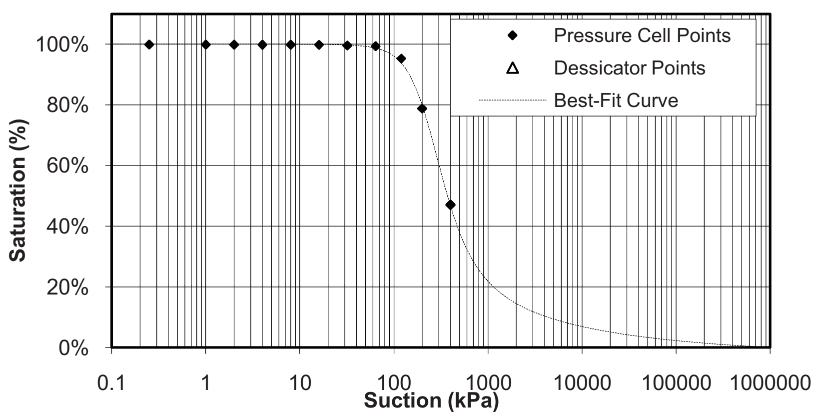
Suction (kPa)	Water Content Gravimetric	Water Content Volumetric
0.25	0.266	0.431
1	0.265	0.430
2	0.263	0.428
4	0.262	0.427
8	0.262	0.427
16	0.260	0.426
32	0.252	0.417
64	0.247	0.412
120	0.219	0.377
200	0.177	0.307
400	0.106	0.184

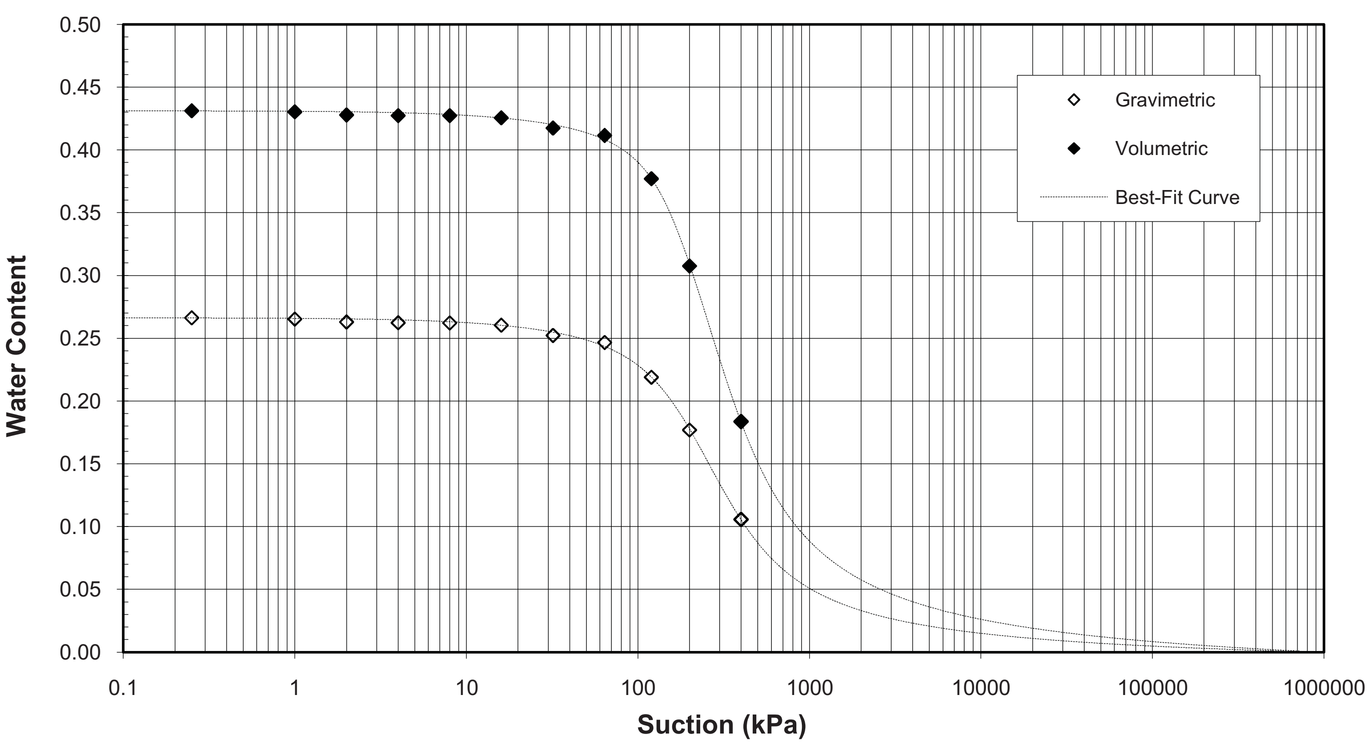
Sample Data:

Diameter:	63.94	mm (initial)
Height:	29.02	mm (initial)
Initial Water Content:	29.6	% (gravimetric, prior to consolidation)
Dry Density:	1651	kg/m^3 (after consolidation)
Material used passing:	4.75	mm sieve

Comments:

Specimen consolidated at 25 kPa prior to testing.





1721 8th Street E.,
Saskatoon, Saskatchewan, S7H 0T4

Reviewed by:

Unit Weight Determination

Dry Density Determination

Golder Associates

Project #: 09-1427-0006 Phase: 2100

Short Title: Giant Mine

Tested By: AC/DS Date: 18-Apr-11

Sample Identification:						
Borehole #	GA11-T13	GA11-T11	GA11-T04	GA11-T01	GA11-T02	GA11-T09
Sample #	3	3	6	4	2	2
Sample depth (ft)	5.0-7.5	7.5-10.0	12.5-15.0	7.5-10.0	2.5-5.0	2.5-5.0
Water Content Determination:						
Tare #	P02	24D	PG-51	2E	25B	2C
Mass of wet soil + tare (g)	349.00	419.40	456.70	402.10	410.80	452.30
Mass of dry soil + tare (g)	304.20	390.70	409.10	337.40	364.80	397.90
Mass of water (g)	44.80	28.70	47.60	64.70	46.00	54.40
Mass of tare (g)	199.60	194.50	196.60	195.30	199.50	198.70
Mass of dry soil (g)	104.60	196.20	212.50	142.10	165.30	199.20
Water content (%)	42.8	14.6	22.4	45.5	27.8	27.3
Unit Weight Determination:						
Mass of sample in air = M_s (g)	340.60	289.40	286.60	360.00	221.30	270.80
Mass of sample + wax in air (g)	358.00	303.90	300.80	375.10	241.30	286.80
Mass of sample + wax in water (g)	152.20	123.50	143.40	160.80	103.90	131.80
Mass of wax (g)	17.40	14.50	14.20	15.10	20.00	16.00
Volume of sample + wax (cc)	205.80	180.40	157.40	214.30	137.40	155.00
Volume of wax (cc) = $\frac{\text{Mass of wax}}{0.78}$	22.31	18.59	18.21	19.36	25.64	20.51
Volume of sample = V_s (cc)	183.49	161.81	139.19	194.94	111.76	134.49
Wet density = (M_s / V_s) x 1000 (kg/m^3)	1856	1789	2059	1847	1980	2014
Dry density (kg/m^3)	1300	1560	1682	1269	1549	1582

Comments:

GA11-T13-03 : Vane Shear Reading - 27.8 Kpa; Pocket Pen Reading, tons/ft^2 : Bot. - 1.25, Mid. - 0 , Top - 0.25

GA11-T11-03 : Vane Shear Reading - 18.5 Kpa; No pocket pen reading. Sample cracks.

GA11-T04-06 : Vane Shear Reading - 8 Kpa; No pocket pen reading. Sample cracks.

GA11-T01-04 : Vane Shear Reading - 18 Kpa; Pocket Pen Reading, tons/ft^2 : Bot. - 0, Mid. - 0 , Top - 0.5

GA11-T02-02 : Vane Shear Reading - 16 Kpa; No pocket pen reading. Sample cracks.

GA11-T09-02 : Vane Shear Reading - 29 Kpa; No pocket pen reading on top & bottom, sample cracks. Mid - 0.75

Reviewed by:

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

Golder Associates

TECHNICAL MEMORANDUM

DATE	January 28, 2014	**REFERENCE No.**	1314260010-092-TM-Rev0-7000
TO	Mr. Brad Thompson Giant Mine PWGSC (Public Works and Government Services Canada)		
FROM	David Caughill	**EMAIL**	dcaughill@golder.com

PHOTOGRAPHS – GIANT MINE SOUTH POND, 2013

As part of an underground paste backfill program completed in the fall of 2013 at the Giant Mine Site in the NWT, tailings were excavated from the South Pond between October and November 2013. In general, 1 to 2 m of tailings were excavated from the north-west section of the pond. Tailings were also excavated to a similar depth along western portions of the South Pond. Several photographs are provided below of the tailings surface before and after the tailings were excavated.

Photograph 1: North end of South Pond, Looking South – July 9, 2013

Photograph 2: North end of South Pond, Looking West – July 9, 2013

Photograph 3: Northwest Corner of the South Pond, Looking East, November 16, 2013

Most of the stockpiled tailings shown on the photograph have been removed since the photograph was taken.

Photograph 4: Northwest Portion of the South Pond, south of Photo 3, Looking East, November 16, 2013

Most of the stockpiled tailings shown on the photograph have been removed since the photograph was taken.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Dave Caughill, M.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

DC/JAH/ja

\\golder.gds\gal\burnaby\final\2013\1426\13-1426-0010\1314260010-092-tm-rev0-7000\1314260010-092-tm-rev0-7000-giant south pond photographs 2013 28jan_14.docx

APPENDIX 7

Land Use Plan

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue • P.O. Box 2130
YELLOWKNIFE, NT X1A 2P6
Phone (867) 669-0506 • FAX (867) 873-6610

September 13, 2012 File: MV2012S0019

Mr. Adrian Paradis
Acting Manager, Giant Mine Remediation Project
Aboriginal Affairs and Northern Development Canada
Contaminants and Remediation Directorate
YELLOWKNIFE NT X1A 2R3 Email: Adrian.Paradis@aandc-aadnc.gc.ca

Dear Mr. Paradis:

Issuance of Type A Land Use Permit
Drilling & Soils Testing, Giant Mine Site, NT

Attached is Land Use Permit MV2012S0019 granted by the Mackenzie Valley Land and Water Board (MVLWB) in accordance with the *Mackenzie Valley Resource Management Act*. This Permit has been approved for a period of five years commencing September 13, 2012 and expiring September 12, 2017.

A copy of all related correspondence and documents has been filed on the Public Registry at the office of the MVLWB. Please be advised that this letter, with its attached procedures, inspection reports, and related correspondence is part of the Public Registry and is intended to keep all interested parties informed of the manner in which the Permit's requirements are being met. All Public Registry material will be considered if an amendment to the Permit is requested.

The full cooperation of AANDC is anticipated and appreciated. If you have any questions or concerns, please contact Lynn Boettger at (867) 766-7461 or email lboettger@mvlwb.com.

Yours sincerely,

Willard Hagen
Chair

Copied to: Distribution List
Lynn Boettger, Regulatory Officer, MVLWB

Attachments:

Mackenzie Valley Land and Water Board

Land Use Permit

Permit Class	Permit No	Amendment No
A	MV2012S0019	

Subject to the Mackenzie Valley Land Use Regulations and the terms and conditions in this Permit, authority is hereby granted to:

Aboriginal Affairs and Northern Development Canada –
Contaminants and Remediation Directorate

Permittee

to proceed with the land use operation described in the application of:

Signature	Date
Mr. Adrian Paradis	July 18, 2012
Type of Land Use Operation Drilling and Soils Testing Program	
Location Giant Mine Site, Northwest Territories	

This Permit may be assigned, extended, discontinued, suspended, or cancelled pursuant to the Mackenzie Valley Land Use Regulations.

Dated at Yellowknife this 13 day of September, 2012

Signature Chair

Signature Witness

Commencement Date
September 13, 2012

Expiry Date
September 12, 2017

ATTENTION

It is a condition of this Permit that the Permittee comply with the provisions of the *Mackenzie Valley Resource Management Act* and Regulations and the terms and conditions set out herein. A failure to comply may result in suspension or cancellation of this Permit.

Conditions Annexed to and Forming Part of Land Use Permit # MV2012S0019

Part A: Scope of Permit

1. This Permit entitles Aboriginal Affairs and Northern Development Canada to conduct a drilling and soils testing investigation program on the Giant Mine property. All activities are to take place within the following area:

   62° 28' 54" N, 114° 19' 12" W and 62° 32' 38" N, 114° 22' 34" W

2. The Permit is issued subject to the conditions contained herein with respect to the use of land for the activities and area identified in Part A, Item 1 of this Permit.

3. Compliance with the terms and conditions of this Permit does not absolve the Permittee from the responsibility for compliance with the requirements of all applicable federal, territorial, and municipal legislation.

Part B: Definitions

"Act" means the *Mackenzie Valley Resource Management Act*.

"Board" means the Mackenzie Valley Land and Water Board established under Part 4 of the *Mackenzie Valley Resource Management Act*.

"Drill Waste" means all materials or chemicals, solid or liquid, associated with the drilling of boreholes and includes borehole cuttings.

"Inspector" means an Inspector designated by the Minister under the *Mackenzie Valley Resource Management Act*.

"Watercourse" means a natural body of flowing or standing water or an area occupied by water during part of the year, and includes streams, swamps and gulches but does not include groundwater.

Part C: Conditions Applying to All Activities (the headings correspond to subsection 26(1) of the Mackenzie Valley Land Use Regulations)

26(1)(*a*) Location and area

1. The Permittee shall not conduct this land use operation on any lands not designated in the accepted application. LOCATION OF ACTIVITES

2. The Permittee shall submit drill targets and soils testing locations to an Inspector and the Board on a monthly basis during any periods of active drilling or soil test pitting. DRILL LOCATIONS

3. The Permittee shall employ a recirculating drill when drilling within 100 metres of the ordinary high water mark of a Watercourse and ensure that cuttings do not enter any Watercourse. TYPE OF DRILL

26(1)(*b*) Time

4. The Permittee shall provide in writing to an Inspector, at least 48 hours prior to commencement of this land use operation, the following information: IDENTIFY AGENT

   (a) person, or persons, in charge of the field operation;
   (b) alternates; and
   (c) all methods for contacting the above person(s).

5. The Permittee shall advise an Inspector at least ten days prior to the completion of the land use operation of: (a) the plan for removal or storage of equipment and materials, and (b) when final clean-up and reclamation of the land used will be completed. REPORTS BEFORE REMOVAL

26(1)(*c*) Type and size of equipment

6. The Permittee shall not use any equipment except of a similar type, size, and number listed in the accepted application. ONLY APPROVED EQUIPMENT

26(1)(*d*) Methods and techniques

7. The Permittee shall not clear areas larger than identified in the accepted application dated. MINIMIZE AREA CLEARED

8. The Permittee shall plug all boreholes as the land use operation progresses unless otherwise authorized in writing by an Inspector. PLUG HOLES

9. The Permittee shall cap each drill casing immediately upon completion of drilling, unless delayed capping of the drill casing is authorized in writing by an Inspector. SEALING OF DRILL CASINGS

10. The Permittee shall replace all excavated material from any test pits prior to the expiry of this Permit, unless otherwise authorized in writing by an Inspector. TEST PITS

26(1)(*e*) Type, location, capacity, and operation of all facilities

11. The Permittee shall ensure that the land use area is kept clean at all times. CLEAN WORK AREA

26(1)(*f*) Control or prevention of ponding of water, flooding, erosion, slides, and subsidence of land

12. The land use operation shall not cause obstruction to any natural drainage. NATURAL DRAINAGE

13. The Permittee shall, where flowing water from bore holes is encountered, (1) plug the bore hole in such a manner as to permanently prevent any further outflow of water; and (2) report the artesian occurrence to the Inspector immediately. PLUG ARTESIAN WELLS

14. The Permittee shall not remove vegetation or soil, or operate heavy equipment within 100 meters of any Watercourse, except as described in the accepted application, unless otherwise authorized in writing by the Inspector. HABITAT DAMAGE

15. The Permittee shall prepare all drill sites on undisturbed native soils in such a manner to prevent rutting on the ground surface. PREVENTION OF RUTTING

16. The Permittee shall implement erosion control measures as the land use operation progresses. PROGRESSIVE EROSION CONTROL

26(1)(*g*) Use, storage, handling, and ultimate disposal of any chemical or toxic material

17. The Permittee shall not use any drilling fluids, muds, or additives that were not identified in the accepted application, unless the MSDS sheets are provided to the Board and usage of the chemical(s) is authorized in writing by the Board. APPROVAL OF CHEMICALS - DRILLING

18. The Permittee shall dispose of all drill waste containing TOXIC or persistent chemical additives as described in the approved Waste Management Plan. DRILL WASTE DISPOSAL

19. The Permittee shall not allow any drilling waste to spread to the surrounding lands or watercourses. DRILL WASTE CONTAINMENT

20. The Permittee shall report all spills immediately to the 24 hour Spill Report Line (867) 920-8130 in accordance with instructions contained in "NT-NU Spill Report" form. REPORT CHEMICAL AND PETROLEUM SPILLS

21. The Permittee shall dispose of all toxic or persistent substances as described in the approved Waste Management Plan. WASTE CHEMICAL DISPOSAL

22. The Permittee shall dispose of all waste petroleum products as described in the approved Waste Management Plan. WASTE PETROLEUM DISPOSAL

26(1)(*h*) Wildlife and fish habitat

23. The Permittee shall take all reasonable measures to prevent damage to wildlife and fish habitat during this land use operation. HABITAT DAMAGE

24. The Permittee shall use food handling and garbage disposal procedures that do not attract wildlife. WILDLIFE/ HUMAN CONFLICT

25. The Permittee shall not obstruct the movement of fish while conducting this land use operation. FREE FISH MOVEMENT

26(1)(*i*) Storage, handling, and disposal of refuse or Sewage

26. The Permittee shall dispose of all garbage, waste, and debris as described in the approved Waste Management Plan, unless otherwise authorized in writing by an Inspector. REMOVE GARBAGE

27. The Permittee shall adhere to the approved Waste Management Plan and shall annually review the Plan and make any necessary revisions to reflect changes in operations, technology, chemicals or fuels. Revisions to the Plan shall be submitted to the Board for approval. WASTE MANAGEMENT

26(1)(*j*) Protection of historical, archaeological, and burial sites

28. The Permittee shall not knowingly remove, disturb, or displace any archaeological specimen or site. SITE DISTURBANCE

29. The Permittee shall, where a suspected archaeological or historical site, or burial ground is discovered: (1) immediately suspend operations on the site; and (2) notify the Board at (867) 669-0506 or an Inspector at (867) 669-2768, and the Prince of Wales Northern Heritage Centre at (867) 920-6182 or 873-7688. SITE DISCOVERY AND NOTIFICATION

26(1)(*k*) Objects and places of recreational, scenic, and ecological value.

Intentionally left blank

26(1)(*l*) Security deposit

30. All costs to remediate the area under this permit are the responsibility of the Permittee. RESPONSIBILITY FOR REMEDIATION COSTS

26(1)(*m*) Fuel storage

31. The Permittee shall not allow petroleum products to spread to surrounding lands or Watercourses. FUEL CONTAINMENT

32. The Permittee shall adhere to the approved Spill Contingency Plan and shall annually review the Plan and make any necessary revisions to reflect changes in operations, technology, chemicals or fuels. Revisions to the Plan shall be submitted to the Board for approval. SPILL CONTINGENCY PLAN

33. The Permittee shall ensure that spill-response equipment is in place, prior to commencement of operations, to respond to any potential spills. SPILL RESPONSE

26(1)(*n*) Methods and techniques for debris and brush removal

34. The Permittee shall progressively dispose of all brush and trees, and shall complete all disposals prior to the expiry date of this permit. BRUSH DISPOSAL/ TIME

26(1)(*o*) Restoration of the lands

35. The Permittee shall carry out progressive reclamation of disturbed areas as soon as practical. PROGRESSIVE RECLAMATION

36. The Permittee shall complete all clean-up and restoration of the lands used prior to the expiry date of this Permit. FINAL CLEAN UP AND RESTORATION

26(1)(*p*) Display of permits and permit numbers

37. The Permittee shall keep on hand, at all times during this land use operation, a copy of the Land Use Permit. COPY OF PERMIT

26(1)(*q*) Matters not inconsistent with the regulations

38. The Permittee shall ensure that all persons working under the authority of this Permit are aware of and will adhere to the conditions as stated in this Permit. NOTIFICATION TO ALL EMPLOYEES/ CONTRACTORS

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

Reasons for Decision

Issued pursuant to paragraph 40(2)(*c*) of the *Mackenzie Valley Land Use Regulations* (MVLUR) and section 121 of the *Mackenzie Valley Resource Management Act* (MVRMA)

Land Use Permit Application	
Preliminary Screener	MVLWB
Reference/File Number	MV2012S0019
Applicant	Aboriginal Affairs and Northern Development Canada – Contaminants and Remediation Directorate (AANDC-CARD)
Project	Drilling and Soils Testing Program, Giant Mine, NT

Decision from Mackenzie Valley Land and Water Board
Meeting of

September 13, 2012

With respect to this application, notice was given in accordance with sections 63 and 64 of the MVRMA. There was no public hearing held in association with this application.

Background

This application is for a land-based drilling program at the Giant Mine site in Yellowknife, NT. The proposed work consists of drilling up to 135 holes using mud rotary, diamond drilling and down-the-hole drilling methodologies, boring up to 45 holes using an auger, excavating 100 soil test pits, and associated activities for four programs (Freeze optimization study, design support drilling and soils testing, A1, B1 and C1 pit stability, and underground stability).

The application was submitted on July 25, 2012 and then sent for review and comment. No significant issues were raised with the proposed activities.

Decision

The Board is satisfied that:

- The development has been screened pursuant to the MVRMA
- Any potential adverse environmental effects are insignificant or mitigable with known technology; and

- There is no likelihood that the proposed development might be a cause of public concern.

After reviewing the submission of the Applicant, the written comments received by the Board and the Staff Report prepared for the Board, the Board, having due regard to the facts and circumstances, the merits of the submissions made to it, and to the purpose, scope, and intent of the MVRMA and Regulations made thereunder, has determined that:

Land Use Permit MV2012S0019 be issued subject to the terms and conditions contained therein.

The Board's reasons for this decision are as follows:

- The Board is satisfied that adequate consultation has been conducted, and that advice has been sought and considered, in accordance with sections 63 and 64 of the MVRMA.
- It is the opinion of the Board that the terms and conditions attached to MV2012S0019, pursuant to the MVRMA, will reduce the potential environmental impacts resulting from the project.
- The use of land proposed by the Applicant is of a nature contemplated by the MVRMA.
- The Board has notified the Applicant, through a statement included in the scope of this Permit, that compliance with the terms and conditions of this Permit does not absolve the Permittee from responsibility for compliance with the requirements of any other legislation.
- The operation will likely contribute to the socio-economic well-being and economic development of the region.
- The Board has reviewed the information contained in the Staff Report dated September 13, 2012 regarding environmental impacts and/or public concerns.

Land Use Permit MV2012S0019 contains provisions that the Board feels necessary to ensure and monitor compliance with the MVRMA and the Regulations made thereunder and to provide appropriate safeguards in respect of the Applicant's use of the land affected by the Permit. The Board will provide additional referenced material or documents if requested in writing to do so.

SIGNATURE

Mackenzie Valley Land and Water Board

Chair

Sept. 13-12
Date

Witness

Sept. 13-12
Date

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

FILE NUMBER MV2012S0019

Date:	September 13, 2012
To:	Mr. Adrian Paradis
Organization:	AANDC – CARD – Giant Mine Remediation Project
Email	adrian.paradis@aandc.gc.ca
Copied To:	Distribution List
From:	Amanda for Willard Hagen, Chair
Number of pages including cover	14

Remarks:

Please see attached

- ☐ Enclosures
- ☐ For your information
- ☐ For your comment
- ☐ For your action
- ☐ For your approval

Delivered by		Date
☐	Mail	
☒	Email/Fax	Sept 13, 2012
☐	Hand Delivered	
	Sent by:	AG

AKAITCHO REGION DISTRIBUTION LIST

Organization	Contact Name	Contact Position/Title	Email/Fax
Akaitcho Screening Board	Stephanie Poole	Screening Officer	screeningofficer@eastarm.com;
Akaitcho Screening Board	Stephen Ellis	IMA Implementation Officer	scellis@eastarm.com;
City of Yellowknife	Gordon Van Tighem, c/o Judy Brennan	Mayor, c/o Executive Secretary	jbrennan@yellowknife.ca;
City of Yellowknife	Robert Long	City Administrator	rlong@yellowknife.ca;
Dene Nation	Lee Mandeville	Lands Program Coordinator	lmandeville@denenation.com;
Deninoo Community Council	Carol Collins	Lands Officer	Carolc.lands@gmail.com;
Deninu K'ue First Nation	Emile Bjornson	IMA Coordinator	ima_dkfn@northwestel.net;
Deninu K'ue First Nation	Chief Balsillie	Chief	admin_dkfn@northwestel.net;
DFO	Rick Walbourne	Habitat Biologist	Rick.Walbourne@dfo-mpo.gc.ca;
DFO	Lorraine Sawdon	Senior Habitat Biologist	Lorraine.Sawdon@dfo-mpo.gc.ca;
Enterprise Settlement Corporation	Mike St. Amour	Mayor	Sao_enterprise@northwestel.net;
Environment Canada	Not applicable	Central email	ec.ea.nwt@ec.gc.ca;
Fort Resolution Métis Council	Gary Bailey	President	Frmc53@yahoo.ca;
Hamlet of Fort Resolution	Carol Collins	Lands Officer	Carolc.lands@gmail.com;
Fort Smith Métis Council	Ken Hudson	President	fortsmithmetiscouncil@northwestel.net;
Fort Smith Métis Council			rcc.nwtmn@northwestel.net;
Fort Resolution Métis Council	Trudy King		(867)394-3322;
GNWT	Not applicable	Central email	Gnwt_ea@gov.nt.ca ;
GNWT – DOT	Rhonda Batchelor	Environmental Affairs Analyst	Rhonda_Batchelor@gov.nt.ca;
GNWT – ENR	Patrick Clancy	Environmental Regulatory Analyst	Patrick_Clancy@gov.nt.ca;
GNWT – HEALTH	Duane Fleming	Chief Environmental Health Officer	Duane_Fleming@gov.nt.ca;
GNWT – ITI	Amy Lizotte	Senior Analyst	Amy_Lizotte@gov.nt.ca;
GNWT – ITI	Russell Teed	Mineral and Petroleum Development Impact Analyst	Russell_Teed@gov.nt.ca;
GNWT – MACA	Mark Davy	Senior Environmental Planner	Mark_Davy@gov.nt.ca;
GNWT – PWNHC	Glen Mackay	Assessment Archaeologist	Glen_Mackay@gov.nt.ca;
Hay River Métis Government Council	George Lafferty		hrmc@northwestel.net
Hay River Metis Council	Paul Harrington	President	(867)874-4472; hrmc@northwestel.net;
AANDC – Intergovernmental Affairs	Not applicable	Central email	intergov@aandc.gc.ca;
AANDC – Mineral & Petroleum Resources			MDD@aandc.gc.ca; PDD@aandc.gc.ca;

Organization	Contact Name	Contact Position/Title	Email/Fax
Directorate			
AANDC – Aboriginal and Territorial Relations	Not applicable	Central email	consultationsupportunit@aandc.gc.ca;
AANDC – Aboriginal and Territorial Relations			
INAC – CARD – Giant Mine	Mark Palmer	Executive Director	Mark.Palmer@aandc.gc.ca;
INAC – CARD – Giant Mine	Adrian Paradis	Head, Tech. and Env. Services	Adrian.Paradis@aandc.gc.ca;
AANDC – Environment and Conservation	Julian Kanigan Krystal Thompson	A/Head, Environmental Assessment and Agreement	Julian.Kanigan@aandc.gc.ca; Krystal.Thompson@aandc.gc.ca;
AANDC – Environment and Conservation	Charlotte Henry	Renewable Resources and Environment Division	Charlotte.Henry@aandc.gc.ca;
AANDC – South Mackenzie District Office	Scott Stewart – Email only	District Manager	Scott.Stewart@aandc.gc.ca;
AANDC – South Mackenzie District Office	Charlene Coe – Email only	Land Use Administrator	Charlene.Coe@aandc.gc.ca;
AANDC- RSA Section	Nathen Richea	A/Head	Nathen.Richea@aandc.gc.ca;
AANDC	Not applicable		CAU-UCA@aandc.gc.ca;
Katlodeeche First Nation	Roy Fabian c/o Victoria St. Jean	Chief c/o Lands and Resources Manager	landsnresources@katlodeeche.com;
Kevin O'Reilly	Kevin O'Reilly		kor@theedge.ca;
Lutselk'e Dene First Nation	Antoine Michel	Chief	lkdfn.executiveChiefandCouncil@gmail.com; saolkdfn@gmail.com;
Lutselk'e Dene First Nation	Mike Tollis	Lands Manager	lkdfnlands@gmail.com;
MVEIRB	Vern Christensen	Executive Director	vchristensen@reviewboard.ca;
MVLWB Public Registry	Not applicable	Registry Clerk	permits@mvlwb.com;
North Slave Métis Alliance	Bill Enge c/o Sheryl Grieve	President c/o Environment Manager	enviromgr@nsma.net;
Northern Projects Management Office	Matthew Spence	Senior Project Coordinator	Matthew.Spence@cannor.gc.ca;
Northern Projects Management Office	Kate Witherly	Project Officer	Kate.Witherly@cannor.gc.ca;
Northwest Territory Métis Nation	Tim Heron	NWTMN IMA Coordinator	(867)872-2772; rcc.nwtmn@northwestel.net;
Senes Consultants	Sarah Baines	Consultant	sbaines@senes.ca;
INAC – CARD – Giant Mine	Adrian Paradis	Head, Tech. and Env. Services	Adrian.Paradis@aandc.gc.ca;
Salt River First Nations	David poitras	Chief	ceo@srfn195.com;
Smith Landing First Nation	Cheyeanne Paulette	Chief	(867)872-5154;
Smith Landing First Nation	Cec Heron	Lands & Resources Manager	c_heron@smithlanding.com;
Tlicho Government - Lands Protection Department	Karri Garner	Lands Manager	kerrigarner@tlicho.com;
Town of Fort Smith	Dwayne Woodward	A/Senior Administrative Officer	dwoodward@fortsmith.ca;

Organization	Contact Name	Contact Position/Title	Email/Fax
Town of Hay River	Michael Richardson	Senior Administrative Officer	mrichardson@hayriver.com;
WSCC – Employer Services	Susan Abernethy	Manager	Susan.Abernethy@wscc.nt.ca;
West Point First Nation	Gwen Cayen	Chief	(867)874-2486; wpfn@northwestel.net;
Yellowknives Dene First Nation	Not applicable	Central email	environment@ykdene.com;
Yellowknives Dene First Nation	Todd Slack	Lands and Environment Office	tslack@ykdene.com;
Yellowknives Dene First Nation (Dettah)	Eddie Sangris	Chief	(867)873-5969; esangris@ykdene.com;
Yellowknives Dene First Nation (Ndilo)	Ted Tsetta	Chief	(867)873-8545; ttsetta@ykdene.com;

Fax Broadcast Report

Date/Time : SEP-13-2012 03:29PM THU
Fax Number : 8678736610
Fax Name : MVLWB YK
Model Name : Phaser 3635MFP

Total Pages Scanned: 13

No.	Remote Station	Start Time	Duration	Page	Mode	Job Type	Result
001	8738545	09-13 03:07PM	03'42	012/013	EC	HS	FA
002	8735969	09-13 03:11PM	02'11	013/013	EC	HS	CP
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004	18678725154	09-13 03:16PM	02'06	013/013	EC	HS	CP
005	18678722772	09-13 03:19PM	00'00	000/013	EC	HS	FA
006	18678744472	09-13 03:20PM	01'57	013/013	EC	HS	CP
007	18673943322	09-13 03:22PM	02'42	013/013	EC	HS	CP
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009	18678722772	09-13 03:27PM	00'00	000/013	EC	HS	FA
010	18678722772	09-13 03:28PM	00'00	000/013	EC	HS	FA

Abbreviations:

HS:Host Send	PL:Polled Local	CP:Completed	TS:Terminated by System
HR:Host Receive	PR:Polled Remote	FA:Fail	TU:Terminated by User
MS:Mailbox Save	WS:Waiting To Send	RP:Report	G3:Group3
MP:Mailbox Print	EC:Error Correct		

Amanda Gauthier - MVLWB

From: Amanda Gauthier - MVLWB [agauthier@mvlwb.com]
Sent: Friday, September 14, 2012 2:27 PM
To: 'screeningofficer@eastarm.com'; 'scellis@eastarm.com'; 'jbrennan@yellowknife.ca'; 'rlong@yellowknife.ca'; 'lmandeville@denenation.com'; 'Carolc.lands@gmail.com'; 'ima_dkfn@northwestel.net'; 'admin_dkfn@northwestel.net'; 'Rick.Walbourne@dfo-mpo.gc.ca'; 'Lorraine.Sawdon@dfo-mpo.gc.ca'; 'Sao_enterprise@northwestel.net'; 'ec.ea.nwt@ec.gc.ca'; 'Frmc53@yahoo.ca'; 'Carolc.lands@gmail.com'; 'fortsmithmetiscouncil@northwestel.net'; 'rcc.nwtmn@northwestel.net'; 'Gnwt_ea@gov.nt.ca'; 'Rhonda_Batchelor@gov.nt.ca'; 'Patrick_Clancy@gov.nt.ca'; 'Duane_Fleming@gov.nt.ca'; 'Amy_Lizotte@gov.nt.ca'; 'Russell_Teed@gov.nt.ca'; 'Mark_Davy@gov.nt.ca'; 'Glen_Mackay@gov.nt.ca'; 'hrmc@northwestel.net'; 'hrmc@northwestel.net'; 'intergov@aandc.gc.ca'; 'MDD@aandc.gc.ca'; 'PDD@aandc.gc.ca'; 'consultationsupportunit@aandc.gc.ca'; 'Mark.Palmer@aandc.gc.ca'; 'Adrian.Paradis@aandc.gc.ca'; 'Julian.Kanigan@aandc.gc.ca'; 'Krystal.Thompson@aandc.gc.ca'; 'Charlotte.Henry@aandc.gc.ca'; 'Scott.Stewart@aandc.gc.ca'; 'Charlene.Coe@aandc.gc.ca'; 'Nathen.Richea@aandc.gc.ca'; 'CAU-UCA@aandc.gc.ca'; 'landsnresources@katlodeeche.com'; 'kor@theedge.ca'; 'lkdfn.executiveChiefandCouncil@gmail.com'; 'saolkdfn@gmail.com'; 'lkdfnlands@gmail.com'; 'vchristensen@reviewboard.ca'; 'permits@mvlwb.com'; 'enviromgr@nsma.net'; 'Matthew.Spence@cannor.gc.ca'; 'Kate.Witherly@cannor.gc.ca'; 'rcc.nwtmn@northwestel.net'; 'sbaines@senes.ca'; 'Adrian.Paradis@aandc.gc.ca'; 'ceo@srfn195.com'; 'c_heron@smithlanding.com'; 'kerrigarner@tlicho.com'; 'dwoodward@fortsmith.ca'; 'mrichardson@hayriver.com'; 'Susan.Abernethy@wscc.nt.ca'; 'wpfn@northwestel.net'; 'environment@ykdene.com'; 'tslack@ykdene.com'; 'esangris@ykdene.com'; 'ttsetta@ykdene.com'
Cc: Lynn
Subject: MV2012S0019 - AANDC - CARD - Giant Mine Remediation Project - issuance - Type A Land Use Permit
Attachments: MV2012S0019 - AANDC - CARD - Giant Mine Remediation Project - Issuance - Type A Land Use Permit.pdf

Good day,

Please see the attached documents. If you have any questions, please contact Lynn Boettger at (867) 766-7461 or email lboettger@mvlwb.com.

Regards,

Amanda Gauthier
Executive Coordinator
Mackenzie Valley Land and Water Board
7th Floor, 4922 48th St. |PO Box 2130 | Yellowknife NT | X1A 2P6
ph 867.766.7460 |mobile 867.444.9822| fax 867.873.6610
agauthier@mvlwb.com | www.mvlwb.com

Fax Confirmation Report

Date/Time : SEP-14-2012 01:36PM FRI
Fax Number : 8678736610
Fax Name : MVLWB YK
Model Name : Phaser 3635MFP

Total Pages Scanned: 13

No.	Remote Station	Start Time	Duration	Page	Mode	Job Type	Result
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Abbreviations:

HS:Host Send	PL:Polled Local	CP:Completed	TS:Terminated by System
HR:Host Receive	PR:Polled Remote	FA:Fail	TU:Terminated by User
MS:Mailbox Save	WS:Waiting To Send	RP:Report	G3:Group3
MP:Mailbox Print	EC:Error Correct		

Mackenzie Valley Land and Water Board

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

FILE NUMBER MV2012S0019

Date: September 13, 2012

To: Mr. Adrian Paradis

Organization: AANDC – CARD – Giant Mine Remediation Project

Email adrian.paradis@aandc.gc.ca

Copied To: Distribution List

From: Amanda for Willard Hagen, Chair

Number of pages including cover 14

Remarks:

Please see attached

- ☐ Enclosures
- ☐ For your information
- ☐ For your comment
- ☐ For your action
- ☐ For your approval

Delivered by	Date
☐ Mail	
☒ Email/Fax	Sept 13, 2012
☐ Hand Delivered	
Sent by:	AG

APPENDIX 8

Water License

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue • P.O. Box 2130
YELLOWKNIFE, NT X1A 2P6
Phone (867) 669-0506 • FAX (867) 873-6610

March 28, 2013 File: MV2012L8-0010

Ms. Katherine Silcock
for Mr. Adrian Paradis
Acting Manager, Giant Mine Remediation Project
Aboriginal Affairs and Northern Development Canada
Contaminants and Remediation Directorate (AANDC-CARD)
YELLOWKNIFE NT X1A 2R3 Email: Katherine.Silcock@aadnc-aandc.gc.ca
Adrian.Paradis@aandc-aadnc.gc.ca

Dear Ms. Silcock:

Issuance of Type B Water Licence
Roaster Deconstruction and Underground Stabilization Work
Giant Mine, NT

Attached is Water Licence MV2012L8-0010 granted by the Mackenzie Valley Land and Water Board (MVLWB or the Board) in accordance with the *Northwest Territories Waters Act*. A copy of this Licence has been filed on the Public Registry at the MVLWB office. Water Licence MV2012L8-0010 has been approved for a period of three years commencing March 28, 2013 and expiring March 27, 2016. Also attached is a copy of the "General Procedures for the Administration of Licences in the Northwest Territories". Please review these carefully and address any questions to the Board's office.

AANDC-CARD shall adhere to the commitments made in their response to reviewer comments dated March 8, 2013.

This letter, with attached procedures, all inspection reports, and correspondence related thereto, is part of the Public Registry and is intended to keep all interested parties informed of the manner in which the Licence's requirements are being met. All Public Registry material will be considered if an amendment to the Licence is requested.

Your full cooperation is anticipated and appreciated. If you have any questions or concerns, please contact Lynn Boettger at (867) 766-7461 or email lboettger@mvlwb.com.

Yours sincerely,

Willard Hagen
Chair

Copied to: Distribution List
Lynn Boettger, Regulatory Officer, MVLWB

Attachment

Mackenzie Valley Land and Water Board
Water Licence

Pursuant to the *Mackenzie Valley Resource Management Act* and Regulations, the Mackenzie Valley Land and Water Board, hereinafter referred to as the Board, hereby grants to:

Aboriginal Affairs and Northern Development Canada – Contaminants and Remediation Directorate
(Licensee)

of 5103-48th Street, PO Box 1500, Yellowknife, NT X1A 2R3
(mailing address)

hereinafter called the Licensee, the right to alter, divert, or otherwise use water subject to the restrictions and conditions contained in the *Northwest Territories Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence number:	MV2012L8-0010
Licence type:	B
Water Management Area:	Northwest Territories 01
Location:	62°28'54" N, 114°19'12" W 62°32'38" N, 114°22'34" W
Purpose:	To use water and dispose of waste and associated uses
Description:	Roaster Complex Deconstruction and Underground Stabilization Activities
Quantity of water **not to be exceeded**:	300 cubic metres per day
Effective date of Licence:	March 28, 2013
Expiry date of Licence:	March 27, 2016

This Licence, issued and recorded at Yellowknife, includes and is subject to the annexed conditions.

Mackenzie Valley Land and Water Board

Chair

Witness

Part A: Scope and Definitions

Scope

1. This Licence entitles Aboriginal Affairs and Northern Development Canada to use Water and dispose of Waste for miscellaneous undertakings limited to the deconstruction of the Roaster Complex and stabilization of the Underground Stabilization Work Area and associated activities as described in the Accepted Application located at the Giant Mine Site (62°28'54" N, 114°19'12" W and 62°32'38" N, 114°22'34" W), Northwest Territories.

2. This Licence is issued subject to the conditions contained herein with respect to the taking of Water and the depositing of Waste of any type in any Waters or in any place under any conditions where such Waste or any other Waste that results from the deposits of such Waste may enter any Waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Northwest Territories* Waters *Act*, or other statutes imposing more stringent conditions relating to the quantity or type of Waste that may be so deposited or under which any such Waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be automatically amended to conform to such Regulations.

3. Compliance with the terms and conditions of this Licence does not absolve the Licensee from the responsibility for compliance with the requirements of all applicable federal, territorial, and municipal legislation.

Definitions

In this Licence: **MV2012L8-0010**

"Accepted Application" means the type B Water Licence application as submitted to the Board on December 19, 2012 and the "Site Stabilization Plan for the Giant Mine Remediation Project" dated October 14, 2011 (redactions reduced version) submitted on January 22, 2013.

"Act" means the *Northwest Territories* Waters *Act*.

"Analyst" means an Analyst designated by the Minister under subsection 35(1) of the Act.

"Board" means the Mackenzie Valley Land and Water Board established under Part 4 of the *Mackenzie Valley Resource Management Act*.

"Inspector" means an Inspector designated by the Minister under subsection 35(1) of the Act.

"Licensee" means the holder of this Licence.

"Minister" means the Minister of Indian Affairs and Northern Development.

"**Polishing Pond**" means the retention structure downstream of the effluent treatment plant that is designed to receive treated minewater. Located at 62° 30' 43.146" N, 114° 20' 54.961" W.

"**Roaster Complex**" means a group of industrial process buildings at the Giant Mine Site located south of the B 1 Pit on the south side of Highway 4 (Figures 13 and 14 in the Roaster Complex Deconstruction Detailed Project Description provided in the Accepted Application). Located at 62° 30' 7.099" N, 114° 21' 27.534" W.

"Regulations" means Regulations proclaimed pursuant to section 33 of the *Northwest Territories* Waters *Act*.

"Temporary Waste Storage Area" means an area located in the northeast corner of the Central Tailings Pond (UTM Zone 11V, 636969.04 mE and 6933427.92 mN) designated for the temporary storage of hazardous and non-hazardous Waste. Refer to Figure 6 – Temporary Waste Storage Location in the document Giant Mine Roaster Complex Deconstruction – Water Management Plan submitted with the Accepted Application.

"**Underground Stabilization Work Area**" includes the underground stopes, chambers and bulkheads that are clustered near the B1 and B2 open pits; on the west side of the Mill near Highway 4; and at the north end of the roaster complex (as shown on Figures 3, 4a and 4b in the Underground Stabilization Detailed Project Description provided the Accepted Application package).

"Waste(s)" means Waste as defined by section 2 of the Act.

"Water(s)" means any Waters as defined by section 2 of the Act.

Part B: General Conditions

1. The Licensee shall file semi-annual reports with the Board as follows which shall contain the information as listed in Schedule 1, item 1:

Reporting Period	Semi-Annual Report Submission Date
May 1 – October 31 each year	January 31 each year
November 1 – April 30 each year	July 31 each year

2. The Licensee shall comply with the terms of any plans approved pursuant to the conditions of this Licence and with any amendments to the plans as may be made from time to time pursuant to the conditions of this Licence and as approved by the Board.

3. Compliance dates specified in the Licence may be modified at the discretion of the Board.

4. The Licensee shall comply with the Schedules annexed to this Licence, and with any amendments to the Schedules as may be made from time to time pursuant to the conditions of this Licence and as approved by the Board.

5. Meters, devices, or other methods used for measuring the volumes of Water used and Waste discharged shall be installed, operated, and maintained by the Licensee to the satisfaction of an Inspector.

6. The Licensee shall ensure a copy of this Licence and all approved plans under this Licence are maintained at site operation at all times.

7. The Licensee shall adhere to the "Communication Plan for Duration of Site Stabilization Activities" as detailed in the Accepted Application.

Part C: Conditions Applying to Water Use

1. The Licensee shall obtain all recycled Water from the Polishing Pond.

2. The Licensee shall obtain all fresh Water from on site storage tanks.

3. The quantity of treated minewater used for all purposes shall not exceed 300 cubic metres per day.

Part D: Conditions Applying to Waste Disposal

1. The Licensee shall ensure that any unauthorized Wastes associated with this Licence undertaking do not enter any Waters.

2. The Licensee shall, 45 days prior to starting deconstruction of the Roaster Complex, submit to the Board for approval a Giant Mine Roaster Complex Deconstruction Waste Management Plan.

3. The Licensee shall, 45 days prior to starting backfilling of stopes or chambers, construction of new bulkheads or repair of existing bulkheads, in the Underground Work Stabilization Area, submit to the Board for approval an Underground Stabilization Waste Management Plan.

4. The Licensee shall implement the plans referred to in Part D items 2 and 3 as and when approved by the Board.

5. If not approved by the Board, the plans referred to in Part D items 2 and 3 shall be revised and resubmitted for approval as directed by the Board.

6. The Licensee shall modify the Waste Management Plans referred to in Part D, items 2 and 3 as necessary to reflect any proposed changes in operations. Any proposed changes shall be submitted to the Board for approval.

7. The Licensee shall not remove or pump any ponded water encountered in the South and Central tailings ponds to areas other than within the South and Central tailings ponds unless otherwise approved by the Board.

8. The Licensee shall provide written correspondence to the Board and Inspector ten days prior to the initial deposit of Waste demonstrating that the facility has agreed to accept the Waste and has the ability to receive the volumes of Waste requested.

Part E: Conditions Applying to Modifications

Intentionally left blank

Part F: Conditions Applying to Contingency Planning

1. If, during the period of this Licence, an unauthorized discharge of Waste occurs, or if such a discharge is foreseeable, the Licensee shall:
    a. Employ the appropriate contingency plan;
    b. Report the incident immediately via the 24-hour NWT Spill Report Line. Currently the number is (867) 920-8130; and
    c. Submit to an Inspector a detailed report on each occurrence not later than 30 days after initially reporting the event that includes a summary of clean-up actions and preventative measures to avoid any further unauthorized discharges as applicable.

2. The Licensee shall adhere to the approved General Contingency and Emergency Spill Response Plan as submitted with the Accepted Application.

3. The Licensee shall modify the General Contingency and Emergency Spill Response Plan referred to in Part F, item 2 as necessary to reflect any proposed changes in operations. Any proposed changes shall be submitted to the Board for approval.

Part G: Conditions Applying to Abandonment and Restoration

Intentionally left blank

Part H: Conditions Applying to Construction

1. The Licensee shall, 45 days prior to starting deconstruction of the Roaster Complex, submit to the Board for approval a Roaster Complex Detailed Deconstruction Plan. This plan shall contain the items as listed under Schedule 2, item 1.

2. The Licensee shall, 30 days prior to the use of any wetting agents during decontamination for Roaster Complex deconstruction, submit to the Board for approval the Material Safety Data Sheet(s) for the wetting agents.

3. The Licensee shall, 45 days prior to starting backfilling of stopes or chambers, construction of new bulkheads or repair of existing bulkheads in the Underground Work Stabilization Area, submit to the Board for approval a detailed Underground Work Stabilization Plan. This plan shall contain the items as listed under Schedule 2, item 2.

4. The Licensee shall implement the plans referred to in Part H items 1 and 3 as and when approved by the Board.

5. If not approved by the Board, the plans referred to in Part H items 1 and 3 shall be revised and resubmitted for approval as directed by the Board.

6. The Licensee shall modify the plans referred to in Part H items 1 and 3 as necessary to reflect any proposed changes in operations. Any proposed changes shall be submitted to the Board for approval.

7. The Licencee shall only use tailings paste, waste rock from mine development, or existing inert rock material stockpiled on the surface to backfill the chambers and stopes unless otherwise approved by the Board.

8. The Licensee shall repair or reinforce bulkheads as described in the Giant Mine Underground Stabilization Detailed Project Description, submitted with the Accepted Application, unless otherwise approved by the Board.

Part I: Conditions Applying to Operation and Maintenance

Intentionally left blank

Mackenzie Valley Land and Water Board

Chair	**Witness**

Schedule 1 – General Conditions

1. The Semi-Annual Report(s) referred to in Part B, item 1 shall include, but not be limited to, the following information:

a. The monthly and semi-annual quantities in cubic metres of fresh Water obtained from all sources;

b. The monthly and semi-annual quantities in cubic metres of recycled Water obtained from all sources;

c. The monthly and semi-annual quantities in cubic metres of each and all Waste discharged including but not limited to any "bleed" water collected from the tailings paste;

d. A list of unauthorized discharges, including any clean-up actions taken and preventative measures implemented to prevent future discharges;

e. An outline of any spill training and communications exercises carried out;

f. A summary of any engagement and consultation activities completed during the reporting period and an outline of any activities anticipated for the upcoming reporting period;

g. A summary of any revisions to the approved General Contingency and Emergency Spill Response Plans;

h. A summary of any revisions to the approved Waste Management Plans for Roaster Complex Deconstruction and Underground Stabilization;

i. Details of all work completed for the Roaster Complex, including but not limited to the actual deconstruction sequence of the associated structures;

j. Details of all work completed for the Underground Stabilization Work Area;

k. Details of any anticipated activities for the upcoming reporting period for the Roaster Complex deconstruction and the Underground Stabilization Work Area, including the proposed sequence in which the structures of the Roaster Complex will be deconstructed;

l. Details on the types and quantities of hazardous materials removed from the Roaster Complex deconstruction;

m. Details on the types and quantities of packaging used for storing waste at the Temporary Waste Storage Area, including non-hazardous and arsenic-containing hazardous waste;

n. Details on the volume of each type of backfill material used in each stope or chamber during the reporting period;

o. Completed "As-Built Statement of Risk Mitigation" letters stamped by a professional engineer that confirm the mitigation of risks associated with the Underground Stabilization Work Area; and

p. Any other details on Water Use or Waste disposal requested by the Board three months prior to the semi-annual report submission date.

Schedule 2 – Conditions Applying to Construction

1. The Roaster Complex Detailed Deconstruction Plan referred to in Part H, item 1 shall include, but not be limited to, the following:

   a. An assessment of the potential risks to the environment from the chosen deconstruction methods and mitigating measures to address these risks;

   b. A summary of the equipment and methodology to be used for deconstruction of the Roaster Complex;

   c. The proposed sequence of deconstruction work within each structure of the Roaster Complex to be taken down, including where decontamination work is required as part of the structure deconstruction;

   d. The size reduction, stacking, packaging, and storage procedures for non-hazardous waste and arsenic-containing hazardous waste, and packaging type as applicable;

   e. Spill contingency plans specific to Roaster Complex deconstruction if the plans deviate from or add to the November 2012 General Contingency and Emergency Spill Response Plan prepared by Nuna/Deton Cho Joint Venture as submitted in the Accepted Application;

   f. A plan for the management and monitoring of dust, including but not limited to thresholds, action levels, and management responses; and

   g. Design of the recycled water collection and transport system, and related spill prevention measures.

2. The detailed Underground Work Stabilization Plan referred to in Part H, item 3 shall include, but not be limited to, the following:

   a. A summary of the types of backfill material required which may be one or a combination of tailings paste, waste rock from mine development, or existing inert rock material on the surface (e.g., quarried rock);

   b. An estimate of the volume of each backfill material required;

   c. Details of the proposed methodologies for carrying out backfilling of the chambers and repairing/reinforcing bulkheads;

   d. Detailed plans to mitigate potential effects to the environment and issues related to tailings excavation including:

      - Management of wet or frozen tailings if encountered;
      - Ensuring acceptable grain size range of tailings as there can be no slimes used in making paste;
      - Operational dust control (wetting of tailings during excavation and paste production using treated minewater);
      - Operational water management (treated minewater usage associated with dust control and wash down of equipment);
      - Cross-highway transport of tailings to temporary stockpiles (trucked or piped);

   e. Details on the process to collect, store, and treat "bleed" water from tailings pastes; and

   f. Spill contingency plans specific to the Underground Stabilization Work Area if the plans deviate from or add to the November 2012 General Contingency and Emergency Spill Response Plan prepared by Nuna/Deton Cho Joint Venture as submitted in the Accepted Application.

General Procedures for the Administration of Licences Issued Under the *Northwest Territories Waters Act* in the Northwest Territories

1. At the time of issuance, a copy of the Licence is placed on the Public Registry in the office of the Mackenzie Valley Land and Water Board (MVLWB or the Board) in Yellowknife and is then available to the public.

2. To enforce the terms and conditions of the Licence, the Minister of Aboriginal Affairs and Northern Development Canada has appointed Inspectors in accordance with subsection 35(1) of the *Northwest Territories Waters Act*. The Inspectors coordinate their activities with staff of the MVLWB. The Inspector responsible for Licence MV2012L8-0010 is located in the Yellowknife office.

3. To keep the MVLWB and members of the public informed of the Licensee's conformity to the Licence's conditions, the inspectors prepare reports which detail observations on how each item in the Licence has been met. These reports are forwarded to the Licensee with a covering letter indicating which action, if any, should be taken. The inspection reports and cover letters are placed on the Public Registry, as are any responses received from the Licensee pertaining to the inspection reports. It is therefore of prime importance that you react in all areas of concern regarding all inspection reports so that these concerns may be clarified.

4. It is the responsibility of the Licensee to apply to the MVLWB for a new licence. The past performance of the Licensee, new documentation and information, and points raised during a public hearing, if required, will be used to determine the terms and conditions of any new licence. Please note that if the Licence expires and another has not been issued, then water and waste disposal must cease, or you, the Licensee, would be in contravention of the *Northwest Territories Waters Act.* It is suggested that an application for a new licence be made at least eight months in advance of the Licence's expiry date.

5. If, for some reason, Licence # MV2012L8-0010 requires amendment, a public hearing may be required. You are reminded that applications for amendments should be submitted as soon as possible to provide the MVLWB ample time to complete the amendment process. The process may take up to six months or more depending on the scope of the amendment requested.

.../2

6. Specific clauses of your Licence make reference to the Board, Analyst, or Inspector. The contact person, address, phone, and fax number of each is:

Mackenzie Valley Land and Water Board:

Public Registry Clerk
Mackenzie Valley Land and Water Board
7th Floor - 4922 48 Street,
P.O. Box 2130
YELLOWKNIFE NT XIA 2P6
Phone (867) 669-0506
Fax (867) 873-6610

Analyst:

Analyst
Water Laboratory
Aboriginal Affairs and Northern Development Canada
P.O. Box 1500
4601- 52nd Avenue
YELLOWKNIFE NT XIA 2R3
Phone (867) 669-2780
Fax (867) 669-2718

Inspector:

Water Resource Officer
Aboriginal Affairs and Northern Development Canada
South Mackenzie District
16 Yellowknife Airport
YELLOWKNIFE NT X1A 3T2
Phone (867) 669-2764
Fax (867) 669-2720

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

Reasons for Decision

Issued pursuant to Section 26 of the *Northwest Territories Waters Act (*NWTWA*)*

Type B Water Licence Application	
Preliminary Screener	Mackenzie Valley Land and Water Board
Reference/File Number	MV2012L8-0010
Applicant	Aboriginal Affairs and Northern Development Canada – Contaminants and Remediation Directorate
Project	Roaster Complex Deconstruction and Underground Stabilization, Giant Mine, NT

Decision from Mackenzie Valley Land and Water Board
Meeting of

March 28, 2013

With respect to this application, notice was given in accordance with sections 63 and 64 of the Mackenzie Valley Resource Management Act (MVRMA) and section 23 of the NWTWA. There was no public hearing held in association with this application.

Background

This Water Licence (WL) application package is for a Type B WL for the deconstruction of the roaster complex and underground stabilization activities at the Giant Mine site. Aboriginal Affairs and Northern Development Canada (AANDC), the Applicant, requested that the Mackenzie Valley Land and Water Board (MVLWB or the Board) "...via section 119(b) of the Mackenzie Valley Resource Management Act proceed to the licensing phase for these two activities".

Section 119 (b) of the Mackenzie Valley Resource Management Act (MVRMA) states that:

> **119.** No preliminary screening, environmental assessment or environmental impact review is required to be conducted in relation to a proposal for a development
>
> (*a*) that is carried out in response to a national emergency for which special temporary measures are being taken under the *Emergencies Act*; or

(*b*) that is carried out in response to an emergency in circumstances such that it is in the interest of protecting property or the environment or in the interest of public welfare, health or safety to carry out the proposal forthwith.

The WL application was received on December 19, 2012 and circulated for review and comment on January 2, 2013. Comments were provided to the Mackenzie Valley Land and Water Board (MVLWB or the Board) by Environment Canada (EC), Fisheries and Oceans Canada (DFO), Yellowknives Dene First Nation (YKDFN), and Alternatives North (AN) on February 15, 2013. The Proponent responded to comments on March 8, 2013.

The work(s) proposed by this WL application is currently subject to an ongoing Environmental Assessment (EA0809-001) by the Mackenzie Valley Review Board (Review Board). The Review Board indicated to the MVLWB in correspondence dated March 13, 2013 that

> ...this work is necessary to protect human health and the environment, and [*the Review Board*] is willing to exclude these specific activities from the scope of the development undergoing assessment, based on the considerations described in its March 13th 2013 letter to the developer.

Based on the evidence provided, the Board confirmed that section 119 of the MVRMA was applicable. The proposed Roaster Complex deconstruction and the underground stabilization work activities are eligible for licensing.

Summary of Issues

Many of the concerns raised during the review period were agreed to by AANDC-CARD, and amendments were made to the draft licence to address the concerns raised. Detailed rationale for decisions made are provided in the attached table - Appendix A to these Reasons for Decision.

Two issues where there was not agreement between the Applicant and Reviewers related to air quality/dust management and the requirement for an affected parties engagement or communications plan.

The Board notes that a communications plan (Tab 7 – Communications Plan for Duration of Site Stabilization Activities) was submitted with the WL application. Following review of this plan the Board included a condition in the licence requiring the Licensee to adhere to this plan. Adherence to this plan by the Licencee will ensure interested parties are kept informed of the activities on site for the duration of this work.

Dust management and monitoring was also raised as a concern by reviewers. The Board has included conditions within WLs relating to dust monitoring and management in the past. This work can generate dust that has the potential to be contaminated with both arsenic trioxide and asbestos. This could have a negative impact on the land and waters of the surrounding the area(s). In order to address this concern, the Board has required, as part of the Roaster Complex detailed deconstruction plan (Part H, item 1 and Schedule 2, Item 1 f) and the detailed Underground Work Stabilization Plan (Part H, Item 3 and Schedule 2, Item 2 d), detailed plans to mitigate the generation of dust, including operational dust control measures to prevent potential effects to the environment, and plans to monitor ambient air quality. Both of these plans require Board approval.

There were some issues brought forward that are not within the Board's jurisdiction (e.g. traffic control and worker health and safety) to address.

Decision

After reviewing the submission of the Applicant, the written comments received by the Board and the Staff Report prepared for the Board, the Board, having due regard to the facts and circumstances, the merits of the submissions made to it, and to the purpose, scope, and intent of the MVRMA and the NWTWA and Regulations made thereunder, has determined that:

Water Licence MV2012L8-0010 be issued subject to the terms and conditions contained therein.

The Board's reasons for this decision are as follows:

- The Board is satisfied that adequate consultation has been conducted and that advice has been sought and considered in accordance with sections 63 and 64 of the MVRMA.
- It is the opinion of the Board that the conditions attached to MV2012L8-0010, pursuant to the NWTWA, reduce the potential environmental impacts resulting from water use and/or deposit of waste.
- The Board has notified the Applicant, through a statement included in the scope of this Licence, that compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of any other legislation.

Water Licence MV2012L8-0010 contains provisions that the Board feels necessary to ensure and monitor compliance with the MVRMA and the NWTWA and the Regulations made thereunder and to provide appropriate safeguards in respect of the Applicant's use of the waters and/or deposit of waste affected by the Licence. The Board will provide additional referenced material or documents if requested in writing to do so.

SIGNATURE

Mackenzie Valley Land and Water Board

Chair

April 03, 2013

Date

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

FILE NUMBER MV2012L8-0010

Date: April 3, 2013

To: Ms. Katherine Silcock

Organization: AANDC – CARD – Giant Mine Remediation

Email: katherine.silcock@aandc.gc.ca
Adrian.paradis@aandc.gc.ca

Copied To: Distribution List

From: Amanda for Willard Hagen, Chair

Number of pages including cover 22

Remarks:

- ☐ Enclosures
- ☐ For your information
- ☐ For your comment
- ☐ For your action
- ☐ For your approval

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☒	Email/Fax	Apr. 3/13
☐	Hand Delivered	
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April 2, 2013 **File Number: MV2012L8-0010**

AKAITCHO REGION DISTRIBUTION LIST

Organization	Contact Name	Contact Position/Title	Email/Fax
Akaitcho Screening Board	Stephanie Poole	Screening Officer	screeningofficer@eastarm.com;
Akaitcho Screening Board	Stephen Ellis	IMA Implementation Officer	scellis@eastarm.com;
City of Yellowknife	Gordon Van Tighem, c/o Judy Brennan	Mayor, c/o Executive Secretary	jbrennan@yellowknife.ca;
City of Yellowknife	Robert Long	City Administrator	rlong@yellowknife.ca;
Dene Nation	Lee Mandeville	Lands Program Coordinator	lmandeville@denenation.com;
Deninoo Community Council	Carol Collins	Lands Officer	Carolc.lands@gmail.com;
Deninu K'ue First Nation	Emile Bjornson	IMA Coordinator	ima_dkfn@northwestel.net;
Deninu K'ue First Nation	Chief Louis Balsillie	Chief	admin_dkfn@northwestel.net;
DFO	Rick Walbourne	Habitat Biologist	Rick.Walbourne@dfo-mpo.gc.ca;
Enterprise Settlement Corporation	Mike St. Amour	Mayor	Sao_enterprise@northwestel.net;
Environment Canada	Not applicable	Central email	ec.ea.nwt@ec.gc.ca;
Fort Resolution Métis Council	Gary Bailey	President	Frmc53@yahoo.ca;
Hamlet of Fort Resolution	Carol Collins	Lands Officer	Carolc.lands@gmail.com;
Fort Resolution Metis Council	Trudy King	Member	fieldworker.frmc53@northwestel.net;
Fort Smith Métis Council	Ken Hudson	President	fortsmithmetiscouncil@northwestel.net;
Fort Smith Métis Council			rcc.nwtmn@northwestel.net;
Fort Resolution Métis Council	Trudy King		(867)394-3322;
GNWT	Not applicable	Central email	Gnwt_ea@gov.nt.ca ;
GNWT – DOT	Rhonda Batchelor	Environmental Affairs Analyst	Rhonda_Batchelor@gov.nt.ca;
GNWT – ENR	Patrick Clancy	Environmental Regulatory Analyst	Patrick_Clancy@gov.nt.ca;
GNWT – HEALTH	Duane Fleming	Chief Environmental Health Officer	Duane_Fleming@gov.nt.ca;
GNWT – HEALTH	Doug Carr	Environmental Health officer	doug_carr@gov.nt.ca;
GNWT – HEALTH	Jeremy Roberts	Environmental Health officer	Jeremy_roberts@gov.nt.ca;
GNWT – HEALTH	Steven Shen	Environmental Health officer	Steven_shen@gov.nt.ca;
GNWT – HEALTH	Tim Hibbs	Environmental Health officer	Tim_hibbs@gov.nt.ca;
GNWT – ITI	Amy Lizotte	Senior Analyst	Amy_Lizotte@gov.nt.ca;
GNWT – ITI	Russell Teed	Mineral and Petroleum Development Impact Analyst	Russell_Teed@gov.nt.ca;

Organization	Contact Name	Contact Position/Title	Email/Fax
GNWT – MACA	Mark Davy	Senior Environmental Planner	Mark_Davy@gov.nt.ca;
GNWT – PWNHC	Glen Mackay	Assessment Archaeologist	Glen_Mackay@gov.nt.ca;
Hay River Métis Government Council	George Lafferty		hrmc@northwestel.net
Hay River Metis Council	Paul Harrington	President	(867)874-4472; hrmc@northwestel.net;
AANDC – Intergovernmental Affairs	Not applicable	Central email	intergov@aandc.gc.ca;
AANDC – Mineral & Petroleum Resources Directorate			MDD@aandc.gc.ca; PDD@aandc.gc.ca;
AANDC – Aboriginal and Territorial Relations	Not applicable	Central email	consultationsupportunit@aandc.gc.ca;
	Alison Heslep	Project Officer	Alison.Heslep@aandc.gc.ca;
INAC – CARD – Giant Mine	Vacant	Executive Director	
INAC – CARD – Giant Mine	Adrian Paradis	Head, Tech. and Env. Services	Adrian.Paradis@aandc.gc.ca;
AANDC – Environment and Conservation	Julian Kanigan Krystal Thompson	A/Head, Environmental Assessment and Agreement	Julian.Kanigan@aandc.gc.ca; Krystal.Thompson@aandc.gc.ca;
AANDC – Environment and Conservation	Charlotte Henry	Renewable Resources and Environment Division	Charlotte.Henry@aandc.gc.ca;
AANDC – South Mackenzie District Office	Scott Stewart – Email only	District Manager	Scott.Stewart@aandc.gc.ca;
AANDC – South Mackenzie District Office	Charlene Coe – Email only	Land Use Administrator	Charlene.Coe@aandc.gc.ca;
AANDC – Water Resources	Robert Jenkins	Manager	Robert.Jenkins@aandc.gc.ca;
AANDC - Water Resources	Patrick Kramers	Resource Management Officer	Patrick.Kramers@aandc.gc.ca;
AANDC- RSA Section	Nathen Richea	A/Head	Nathen.Richea@aandc.gc.ca;
AANDC	Not applicable		CAU-UCA@aandc.gc.ca;
Katlodeeche First Nation	Roy Fabian c/o Victoria St. Jean	Chief c/o Lands and Resources Manager	landsnresources@katlodeeche.com;
Kevin O'Reilly	Kevin O'Reilly		kor@theedge.ca;
Lutselk'e Dene First Nation	Dora Enzoe	Chief	lkdfn.executiveChiefandCouncil@gmail.com;
MVEIRB	Vern Christensen	Executive Director	vchristensen@reviewboard.ca;
MVEIRB		Environmental Assessment Officer	preliminaryscreening@reviewboard.ca;
MVLWB Public Registry	Not applicable	Registry Clerk	permits@mvlwb.com;
North Slave Métis Alliance		Office Manager	researcher@nsma.net;
	Eric Binion	Regulatory Analyst	reganalyst@nsma.net;
	Arnold Enge	Director	arnoldenge@gmail.com;
Northern Projects Management Office	Matthew Spence	Senior Project Coordinator	Matthew.Spence@cannor.gc.ca;

Organization	Contact Name	Contact Position/Title	Email/Fax
NWT Metis Nation	Tim Heron	NWTMN IMA Coordinator	(867)872-2772; rcc.nwtmn@northwestel.net;
AANDC-CARD	Katherine Silcock	Project Manager	Katherine.Silcock@aadnc-aandc.gc.ca;
Salt River First Nations	David Poitras	Chief	chief@srfn195.com;
Smith Landing First Nation	Cheyeanne Paulette	Chief	(867)872-5154;
Smith Landing First Nation	Jeff Dixon	Lands & Resources Coordinator	lands@slfn196.com;
Tlicho Government - Lands Protection Department	Karri Garner	Lands Manager	kerrigarner@tlicho.com;
Town of Fort Smith	Jim Hood	Senior Administrative Officer	jhood@fortsmith.ca;
Town of Hay River	Michael Richardson	Senior Administrative Officer	mrichardson@hayriver.com;
True North Safaris	Gary Jaeb	Owner/Operator	gary@truenorthsafaris.com;
WSCC – Employer Services	Susan Abernethy	Manager	Susan.Abernethy@wscc.nt.ca;
West Point First Nation	Gwen Cayen	Chief	wpfn@northwestel.net;
Yellowknives Dene First Nation	Not applicable	Central email	environment@ykdene.com;
Yellowknives Dene First Nation	Todd Slack	Lands and Environment Office	tslack@ykdene.com;
Yellowknives Dene First Nation (Dettah)	Eddie Sangris	Chief	(867)873-5969; esangris@ykdene.com;
Yellowknives Dene First Nation (Ndilo)	Ted Tsetta	Chief	(867)873-8545; ttsetta@ykdene.com;

Fax Broadcast Report

Date/Time : APR-03-2013 04:19PM WED
Fax Number : 8678736610
Fax Name : MVLWB YK
Model Name : Phaser 3635MFP

Total Pages Scanned: 22

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004	18678722772	04-03 04:06PM	03'11	022/022	EC	HS	CP
005	18678744472	04-03 04:10PM	02'49	022/022	EC	HS	CP
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Abbreviations:

HS:Host Send	PL:Polled Local	CP:Completed	TS:Terminated by System
HR:Host Receive	PR:Polled Remote	FA:Fail	TU:Terminated by User
MS:Mailbox Save	WS:Waiting To Send	RP:Report	G3:Group3
MP:Mailbox Print	EC:Error Correct		

Amanda Gauthier - MVLWB

From: Amanda Gauthier - MVLWB [agauthier@mvlwb.com]
Sent: Wednesday, April 03, 2013 4:50 PM
To: 'screeningofficer@eastarm.com'; 'scellis@eastarm.com'; 'jbrennan@yellowknife.ca'; 'rlong@yellowknife.ca'; 'lmandeville@denenation.com'; 'Carolc.lands@gmail.com'; 'ima_dkfn@northwestel.net'; 'admin_dkfn@northwestel.net'; 'Rick.Walbourne@dfo-mpo.gc.ca'; 'Sao_enterprise@northwestel.net'; 'ec.ea.nwt@ec.gc.ca'; 'Frmc53@yahoo.ca'; 'Carolc.lands@gmail.com'; 'fieldworker.frmc53@northwestel.net'; 'fortsmithmetiscouncil@northwestel.net'; 'rcc.nwtmn@northwestel.net'; 'Gnwt_ea@gov.nt.ca'; 'Rhonda_Batchelor@gov.nt.ca'; 'Patrick_Clancy@gov.nt.ca'; 'Duane_Fleming@gov.nt.ca'; 'doug_carr@gov.nt.ca'; 'Jeremy_roberts@gov.nt.ca'; 'Steven_shen@gov.nt.ca'; 'Tim_hibbs@gov.nt.ca'; 'Amy_Lizotte@gov.nt.ca'; 'Russell_Teed@gov.nt.ca'; 'Mark_Davy@gov.nt.ca'; 'Glen_Mackay@gov.nt.ca'; 'hrmc@northwestel.net'; 'hrmc@northwestel.net'; 'intergov@aandc.gc.ca'; 'MDD@aandc.gc.ca'; 'PDD@aandc.gc.ca'; 'consultationsupportunit@aandc.gc.ca'; 'Alison.Heslep@aandc.gc.ca'; 'Adrian.Paradis@aandc.gc.ca'; 'Julian.Kanigan@aandc.gc.ca'; 'Krystal.Thompson@aandc.gc.ca'; 'Charlotte.Henry@aandc.gc.ca'; 'Scott.Stewart@aandc.gc.ca'; 'Charlene.Coe@aandc.gc.ca'; 'Robert.Jenkins@aandc.gc.ca'; 'Patrick.Kramers@aandc.gc.ca'; 'Nathen.Richea@aandc.gc.ca'; 'CAU-UCA@aandc.gc.ca'; 'landsnresources@katlodeeche.com'; 'kor@theedge.ca'; 'lkdfn.executiveChiefandCouncil@gmail.com'; 'vchristensen@reviewboard.ca'; 'preliminaryscreening@reviewboard.ca'; 'researcher@nsma.net'; 'reganalyst@nsma.net'; 'arnoldenge@gmail.com'; 'Matthew.Spence@cannor.gc.ca'; 'rcc.nwtmn@northwestel.net'; 'Katherine.Silcock@aadnc-aandc.gc.ca'; 'chief@srfn195.com'; 'lands@slfn196.com'; 'kerrigarner@tlicho.com'; 'jhood@fortsmith.ca'; 'mrichardson@hayriver.com'; 'gary@truenorthsafaris.com'; 'Susan.Abernethy@wscc.nt.ca'; 'wpfn@northwestel.net'; 'environment@ykdene.com'; 'tslack@ykdene.com'; 'esangris@ykdene.com'; 'ttsetta@ykdene.com'
Cc: 'Lynn Boettger - MVLWB'
Subject: MV2012L8-0010 - AANDC - CARD - Giant Mine Remediation - Sec. 119(b) Determination & Issuance - Type B Water Licence
Attachments: MV2012L8-0010 - AANDC - CARD - Giant Mine Remediation - Section 119(b) Determination.PDF; MV2012L8-0010 - AANDC - CARD - Giant Mine Remediation - Issuance - Type B Water Licence.PDF

Good day,

Please see the attached documents. If you have any questions, please contact Lynn Boettger at (867) 766-7461 or email lboettger@mvlwb.com.

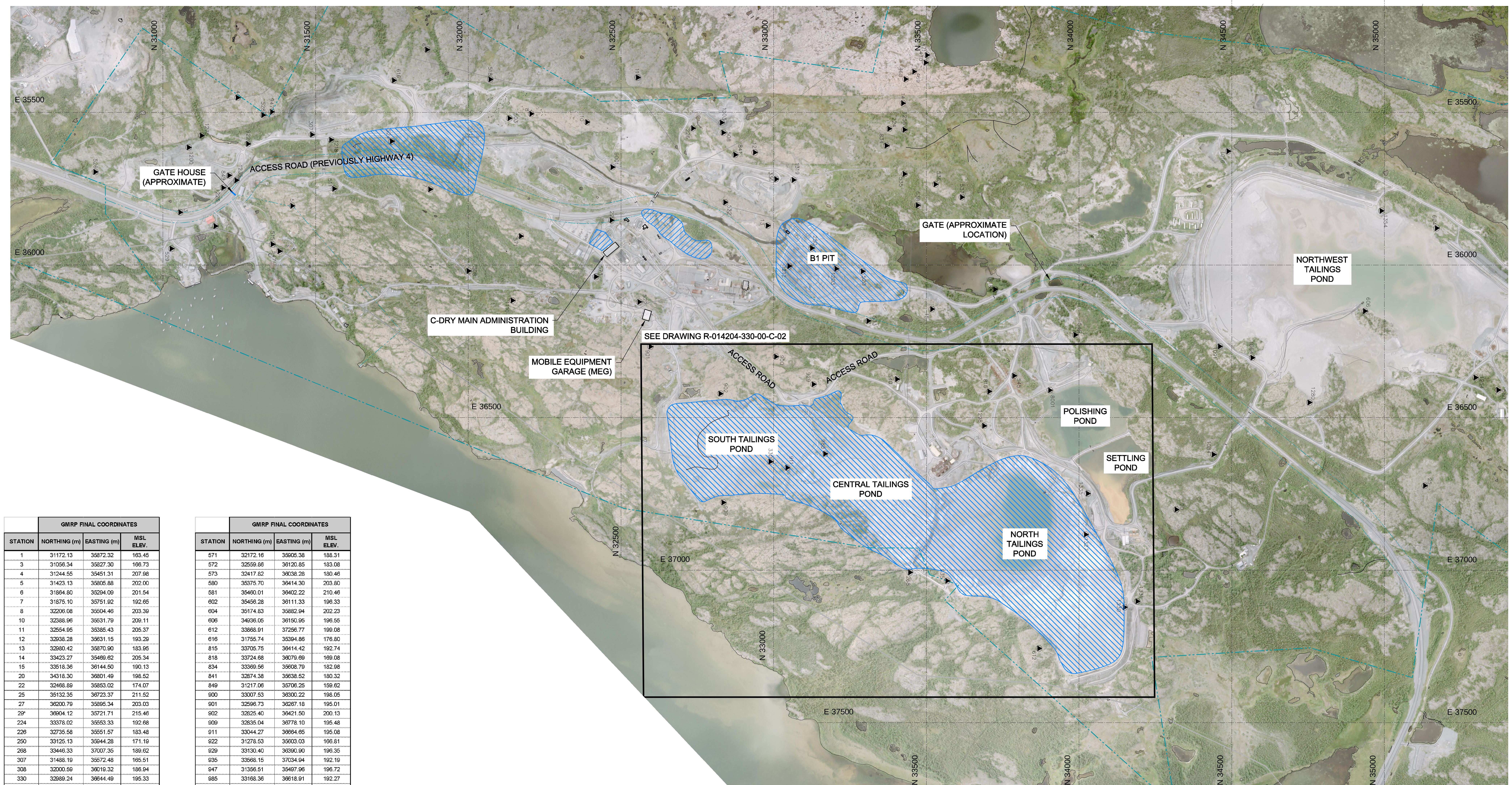
Regards,

Amanda Gauthier
Executive Coordinator
Mackenzie Valley Land and Water Board
7th Floor, 4922 48th St. |PO Box 2130 | Yellowknife NT | X1A 2P6
ph 867.766.7460 |mobile 867.444.9822| fax 867.873.6610
agauthier@mvlwb.com | www.mvlwb.com

APPENDIX 9

Map of Accessible Roads

Sheet Size: A1 (841mm x 594mm)
Saved by: Motiuk, Mark
Plotted on: January 31, 2014
CADD FILE LOCN: P:\60309942\900-WORK\910-CAD\20-SHEETS\C\R-014204-330_00-C-01_RX.DWG



	GMRP FINAL COORDINATES		
STATION	NORTHING (m)	EASTING (m)	MSL ELEV.
1	31172.13	35872.32	163.45
3	31056.34	35827.30	166.73
4	31244.55	35451.31	207.98
5	31423.13	35805.88	202.00
6	31864.80	35294.09	201.54
7	31875.10	35751.92	192.65
8	32206.08	35504.46	203.39
10	32388.96	35531.79	209.11
11	32554.95	35385.43	205.37
12	32938.28	35631.15	193.29
13	32980.42	35870.90	183.95
14	33423.27	35469.62	205.34
15	33518.36	36144.50	190.13
20	34318.30	36801.49	198.52
22	32468.89	35853.02	174.07
25	35132.35	36723.37	211.52
27	36200.79	35895.34	203.03
29*	36904.12	35721.71	215.46
224	33378.02	35553.33	192.68
226	32735.58	35551.57	183.48
250	33125.13	35944.28	171.19
268	33446.33	37007.35	189.62
307	31488.19	35572.48	165.51
308	32000.59	36019.32	186.94
330	32989.24	36644.49	195.33
336	33008.01	35718.46	169.41
468	33432.17	35390.81	213.37
469	33459.28	35365.91	214.11
470	33497.92	35336.75	210.80
471	33502.19	35311.89	207.85
503	32134.29	35518.97	180.04
508	32835.00	35566.27	191.99
511	31560.56	35750.01	173.81
515	31358.75	35932.17	173.37
518	32071.93	35391.50	198.02
520	33291.12	36020.66	176.22
522	32841.01	35794.59	189.30
524*	31749.26	35594.37	166.56
526	30778.46	35694.86	178.37
528	31328.37	35508.45	194.69
529*	31027.91	35946.26	166.81
533*	33309.82	36183.25	177.71
535	33428.43	35701.50	180.66
536	33530.09	35735.43	188.77
537	33616.31	35777.70	184.46
538	33471.69	35804.13	179.92
540	33403.90	36373.86	188.90
545*	33787.29	36362.89	183.38
546	33987.93	36228.82	180.84
547	31381.75	35955.00	174.36

* indicates monument was found bent and measured at base

	GMRP FINAL COORDINATES		
STATION	NORTHING (m)	EASTING (m)	MSL ELEV.
571	32172.16	35905.38	188.31
572	32559.86	36120.85	183.08
573	32417.82	36038.28	180.46
580	35375.70	36414.30	203.80
581	35460.01	36402.22	210.46
602	35456.28	36111.33	196.33
604	35174.83	35882.94	202.23
606	34936.05	36150.95	196.55
612	33868.91	37256.77	199.08
616	31755.74	35394.86	176.80
815	33705.75	36414.42	192.74
818	33724.68	36079.69	169.08
834	33369.56	35608.79	182.98
841	32874.38	35638.52	180.32
849	31217.06	35706.25	159.62
900	33007.53	36300.22	198.05
901	32596.73	36267.18	195.01
902	32825.40	36421.50	200.13
909	32835.04	36778.10	195.48
911	33044.27	36664.65	195.08
922	31278.53	35603.03	166.81
929	33130.40	36390.90	196.35
935	33568.15	37034.94	192.19
947	31356.51	35497.96	196.72
985	33168.36	36618.91	192.27
1016	34488.60	35627.02	195.67
1064	34567.45	36303.92	197.30
1084	34440.70	36621.02	190.33
1091	34460.89	36266.55	194.84
1110	32144.78	36116.22	190.64
1200	31084.42	35614.42	156.95
1203	33204.97	36012.00	165.83
1212	33050.74	36003.35	163.02
1218	31550.55	35589.36	163.00
1226	31197.37	35746.73	160.32
1235*	31240.78	35722.08	164.29
1254	35298.51	36368.85	203.09
1258	33428.17	35556.68	188.33
1275	31126.75	35575.86	167.38
1280	34754.44	36450.50	211.27
1298	33689.05	36526.99	196.46
1303	32830.02	35533.15	191.10
1319	33065.15	35721.32	170.87
1327	34021.80	36883.13	182.24
1330	34149.65	37121.84	187.99
1331	34190.67	37102.38	183.22
1335	34028.59	36748.74	182.61
1354	34990.31	35822.38	197.89
3002	30022.42	35534.01	192.13
3053	30378.96	35541.45	198.70
8001	33904.65	36410.18	177.40
9001	32471.84	35679.17	186.70

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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

AECOM

LEGEND:

MAIN CONTRACTOR WORK AREAS

GMRP BENCHMARKS

NOTES:

1. COORDINATES ARE IN GMRP LOCAL COORDINATE SYSTEM.
2. CONDITION OF ACCESS ROADS TO BE DETERMINED BY CONTRACTOR.
3. PUBLIC ACCESS HIGHWAY 4 HAS BEEN RELOCATED OFF-SITE.

Professional Seals / Sceaux

DO NOT SCALE DRAWINGS

Revision/Revision	Description/Description	Date/Date
C		
B		
A	ISSUED FOR TENDER	14/01/31

Client/client

PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet

GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T INTERIM UNDERGROUND STABILIZATION ACTIVITIES

Approved by/Approuvé par
Rudy Schmidtke

Designed by/Concept par
J. Singbeil

Drawn by/Dessiné par
W. Kruger / N. Kais

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
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Drawing title/Titre du dessin

GIANT MINE SITE OVERVIEW

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
R.014204.330	C01 OF 2	A

APPENDIX 10

Tailings Pond Drainage Map

TECHNICAL MEMORANDUM

DATE January 27, 2014 **REFERENCE No.** 1314260010-090-TM-Rev0-1000

TO Brad Thompson
Giant Mine

FROM Dave Caughill and John Hull **EMAIL** dcaughill@golder.com; jhull@golder.com

SURFACE DRAINAGE PATTERNS – SOUTH, CENTRAL, NORTH PONDS

This memorandum provides an overview of the surface drainage patterns on the South, Central and North Ponds at the Giant Mine, NWT, as they existed in August 2013. Overall, surface water on the three ponds drains to the water pond in the central portion of the North Pond, as shown on Figure 1. The general direction of the drainage is shown by arrows on the figure. Surface water on the South Pond drains to the small pond in the north-east corner of the pond. Water that collects in this pond is then drained to the Central Pond through a buried pipe, as indicated on Figure 1. The pipe outlet is in the channel on the western side of the Central Pond. The flow pattern on the east side of the Central Pond has been modified by the MSA Pad, but generally surface water would flow to the west side of the pond and then north. Water in this channel then flows to the North Pond through a culvert / decant structure in the embankment (Dyke 6) separating the ponds.

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED AND SEALED

Dave Caughill, M.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

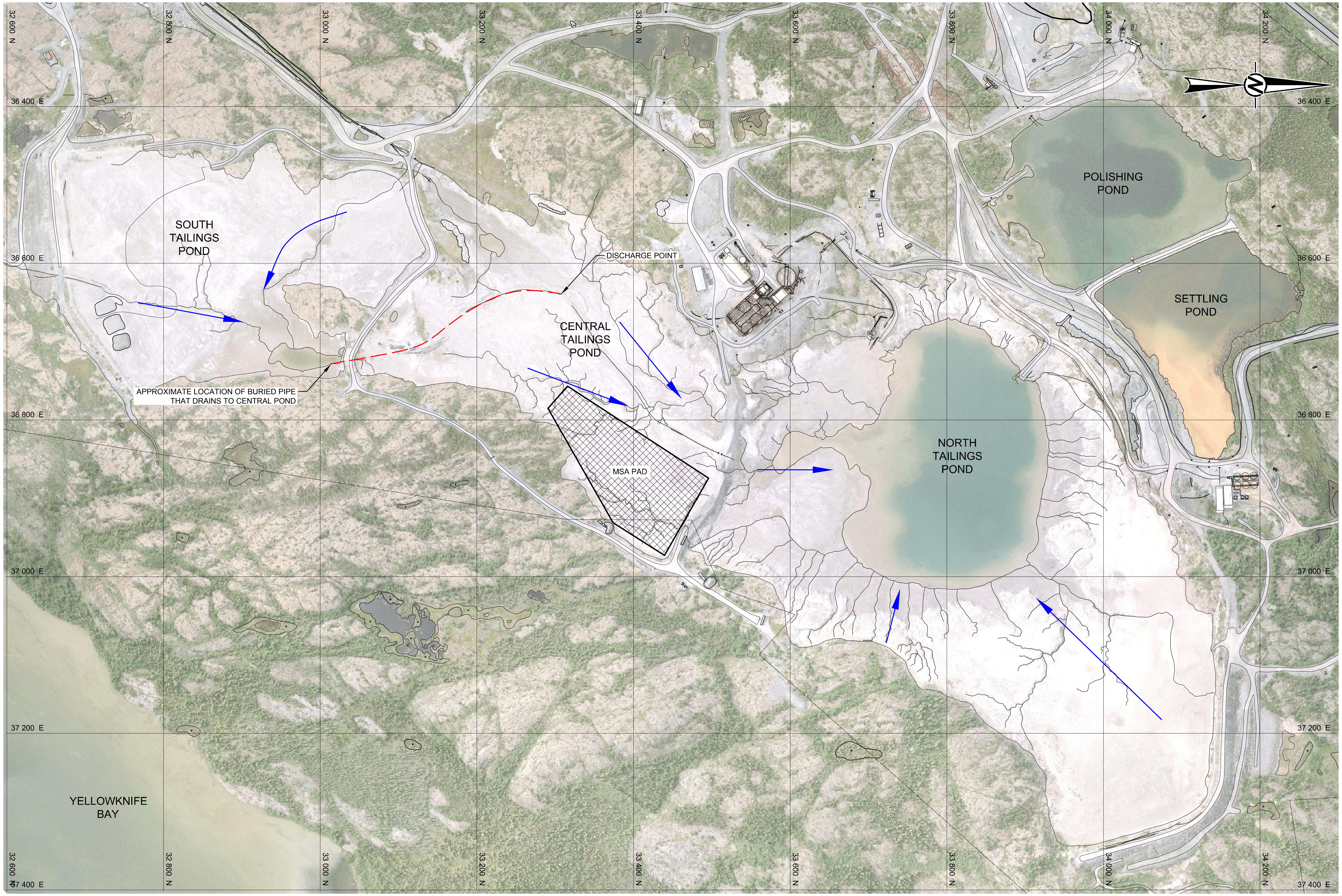
ORIGINAL SIGNED

John Hull, M.Sc., P.Eng.
Principal, Mining Division

DC/JAH/kp

Attachment: Figure 1: Existing Surface Drainage Patterns on North, South, and Central Ponds

o:\final\2013\1426\13-1426-0010\1314260010-090-tm-rev0-1000\1314260010-090-tm-rev0-1000-tcf drainage patterns 27jan_14.docx



LEGEND

GENERAL DIRECTION OF EXISTING SURFACE DRAINAGE

PLAN VIEW

SCALE A

NOTES

ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED. COORDINATE SYSTEM IS THE GMRP COORDINATE SYSTEM.

REFERENCES

AERIAL PHOTO DATED 2009, PROVIDED BY PUBLIC WORKS GOVERNMENT SERVICES CANADA

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SCALE A METRES

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Revision/Révision	Description/Description	Date/Date
A	ISSUED WITH DOC. #090 REV A	2014-01-24

Client/client
PUBLIC WORKS GOVERNMENT SERVICES CANADA

Project title/Titre du projet
GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuvé par: JH
Designed by/Concept par: DC
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
EXISTING SURFACE DRAINAGE PATTERNS ON NORTH, SOUTH AND CENTRAL POND

Project No./No. du projet: 13-1426-0010 DOC. #090
Sheet/Feuille: FIGURE 1 OF 1
Revision no./La Révision no.: A

CADD FILE LOC'N: N:\Bur-Graphics\Projects\2013\1426\13-1426-0010\1000\1608\PRODUCTION\13-1426-0010-1000-1608_09.dwg Layout:Figure 1 Friday, January 24, 2014 3:09:52 PM By: jkowneski

PWGSC – A1 – 841X594

13-1426-0010-1000-1608_09

APPENDIX 11

B1-18 On-site Paste Testing

January 31, 2014

LABORATORY REPORT FOR

Giant Mine
On-Site Backfill Testing

Submitted to:

Public Works and Government Services Canada
(PWGSC)
Telus Tower North
5th Floor, 10025 Jasper Avenue
Edmonton, Alberta T5J 1S6

Attention: Brad Thompson

REPORT

Reference Number: 1314260010-106-R-Rev0-5000

Distribution:

1 Electronic Copy: PWGSC

1 Hard Copy: Golder Associates Ltd., Sudbury, Ontario

Golder Associates

Study Limitations

This report was prepared for the exclusive use of Public Works and Government Services Canada (PWGSC) on the Giant Mine Project. The report, which specifically includes all tables, figures and appendices, is based on measurements and observations made and data and information collected during the laboratory studies conducted by Golder Associates Ltd. (Golder) for PWGSC. The test results are based solely on the ambient conditions of the laboratory at the time the measurements and tests were conducted.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The sample(s) provided for the tests are assumed to be representative of material found at the site. The test data given herein pertains to the sample(s) provided, and may not be applicable to material from other production periods or zones. Assessment of the sample environmental conditions and possible hazards associated with the material composition is based on the results of chemical analysis of samples which are possibly from a limited number of locations. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site or a production line may remain undetected. The results found from the tests may not be reproducible under the field conditions.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by PWGSC, communications between Golder and PWGSC, and to any other reports prepared by Golder for PWGSC relative to the specific site described in the report, tables, drawings, figures and appendices. ***In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.***

No other party may use or rely on this report or any portion thereof without Golder's express written consent. Any use, which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

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TABLES

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FIGURES

APPENDIX A
UCS Strength Tables

APPENDIX B
UCS Strength Tables Target vs. Actual

APPENDIX C
Observations

APPENDIX D
Photos

1.0 INTRODUCTION

Public Works and Government Services Canada (PWGSC) has retained Golder Associates Ltd. (Golder) to carry out on-site quality assurance laboratory testing on Giant Mine tailings to assess the moisture content and strength properties of the backfill being placed underground in Giant Mine's B1-18 Stope. This test work coincides with work done previously to determine the suitability of the Giant Mine tailings as backfill material preceding the paste production phase of the project.

2.0 SAMPLE RECEIPT

2.1 Sample Receipt

Daily moisture samples were taken from the tailings feed pile positioned beside the Mixer truck (#1 or #2). The samples were stored in sealed 1L standard plastic sample containers. In addition, 3"x6" cylinders for unconfined compressive strength (UCS) testing were cast during daily production at the B1 Pit area and stored temporarily in coolers before shipping them initially to Golder's off-site laboratory in the Golder Yellowknife office and after Nov 12, 2013, to the on-site Golder laboratory at the Giant Mine Mobile Equipment Garage (M.E.G.). Cylinders were cast in the morning and afternoon and whenever the recipe or borehole changed. As a result there may be several cylinders taken on the same day.

Table 1: UCS Sample Receipt Summary

Date	Amount/Container	Golder Sample Pour ID
Oct 21, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 22, 2013	12 cylinders	BH 118-05 - Trk #1 - morning
Oct 22, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 25, 2013	12 cylinders	BH 118-05 - Trk #1 - morning
Oct 25, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 25, 2013	12 cylinders	BH 118-05 - Trk #2 - morning
Oct 25, 2013	12 cylinders	BH 118-05 - Trk #2 - afternoon
Oct 26, 2013	12 cylinders	BH 118-05 - Trk #1 - morning
Oct 26, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 26, 2013	12 cylinders	BH 118-05 - Trk #2 - morning
Oct 26, 2013	12 cylinders	BH 118-05 - Trk #2 - afternoon
Oct 27, 2013	12 cylinders	BH 118-03 - Trk #1 - morning
Oct 27, 2013	12 cylinders	BH 118-03 - Trk #2 - morning
Oct 27, 2013	12 cylinders	BH 118-03 - Trk #2 - afternoon
Oct 28, 2013	12 cylinders	BH 118-03 - Trk #1 - morning
Oct 28, 2013	12 cylinders	BH 118-03 - Trk #2 - morning
Oct 28, 2013	12 cylinders	BH 118-03 - Trk #2 - afternoon
Oct 29, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 29, 2013	12 cylinders	BH 118-04 - Trk #2 - afternoon
Oct 30, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Oct 30, 2013	12 cylinders	BH 118-05 - Trk #1 - afternoon
Oct 30, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon

Date	Amount/Container	Golder Sample Pour ID
Oct 31, 2013	12 cylinders	BH 118-05 - Trk #1 - morning
Oct 31, 2013	12 cylinders	BH 118-05 - Trk #2 - morning
Oct 31, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Oct 31, 2013	12 cylinders	BH 118-04 - Trk #2 - afternoon
Nov 1, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Nov 1, 2013	12 cylinders	OB 118-02 - Trk #1 - afternoon
Nov 1, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 1, 2013	12 cylinders	OB 118-02 - Trk #2 - afternoon
Nov 1, 2013	12 cylinders	BH 118-03 - Trk #2 - afternoon
Nov 2, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 2, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Nov 2, 2013	12 cylinders	BH 118-03 - Trk #2 - afternoon
Nov 3, 2013	12 cylinders	BH 118-03 - Trk #1 - morning
Nov 3, 2013	12 cylinders	BH 118-03 - Trk #2 - morning
Nov 3, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Nov 3, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 4, 2013	12 cylinders	BH 118-03 - Trk #1 - morning
Nov 4, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Nov 4, 2013	12 cylinders	BH 118-03 - Trk #2 - afternoon
Nov 4, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 5, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 5, 2013	12 cylinders	BH 118-12 - Trk #1 - morning
Nov 5, 2013	12 cylinders	BH 118-12 - Trk #2 - morning
Nov 5, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon
Nov 6, 2013	12 cylinders	BH 118-01 - Trk #1 - afternoon
Nov 6, 2013	12 cylinders	BH 118-04 - Trk #2 - morning
Nov 6, 2013	12 cylinders	BH 118-12 - Trk #1 - morning
Nov 6, 2013	12 cylinders	BH 118-12 - Trk #2 - morning
Nov 6, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon
Nov 7, 2013	12 cylinders	BH 118-01 - Trk #1 - morning
Nov 7, 2013	12 cylinders	BH 118-01 - Trk #2 - morning
Nov 7, 2013	12 cylinders	BH 118-01 - Trk #1 - afternoon
Nov 7, 2013	12 cylinders	BH 118-01 - Trk #2 - afternoon
Nov 7, 2013	12 cylinders	BH 118-12 - Trk #1 - morning
Nov 7, 2013	12 cylinders	BH 118-12 - Trk #2 - morning
Nov 8, 2013	12 cylinders	BH 118-12 - Trk #1 - morning
Nov 8, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon
Nov 9, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Nov 10, 2013	12 cylinders	BH 118-01 - Trk #1 - morning
Nov 10, 2013	12 cylinders	BH 118-12 - Trk #1 - morning

Date	Amount/Container	Golder Sample Pour ID
Nov 11, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon
Nov 11, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon 2:30
Nov 11, 2013	12 cylinders	BH 118-06- Trk #2 - morning
Nov 11, 2013	12 cylinders	BH 118-06- Trk #2 - afternoon
Nov 12, 2013	12 cylinders	BH 118-01- Trk #1 - morning
Nov 12, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 12, 2013	12 cylinders	BH 118-12- Trk #1 - afternoon
Nov 12, 2013	12 cylinders	BH 118-06- Trk #2 - afternoon
Nov 13, 2013	12 cylinders	BH 118-01- Trk #1 - morning
Nov 13, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 13, 2013	12 cylinders	BH 118-12- Trk #1 - afternoon
Nov 14, 2013	12 cylinders	BH 118-01- Trk #1 - morning
Nov 14, 2013	12 cylinders	BH 118-01- Trk #2 - afternoon
Nov 14, 2013	12 cylinders	BH 118-12- Trk #1 - morning
Nov 15, 2013	9 cylinders	BH 118-01- Trk #1 - morning
Nov 15, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 16, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 17, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 17, 2013	12 cylinders	BH 118-01- Trk #2 - afternoon
Nov 18, 2013	12 cylinders	BH 118-01- Trk #2 - morning
Nov 19, 2013	12 cylinders	BH 118-03- Trk #1 - morning
Nov 20, 2013	12 cylinders	BH 118-03- Trk #1 - morning
Nov 20, 2013	12 cylinders	BKGT 12-15- Trk #1 - afternoon
Nov 21, 2013	12 cylinders	BKGT 12-15- Trk #1 - morning
Nov 21, 2013	12 cylinders	BKGT 12-15- Trk #1 - afternoon
Nov 22, 2013	12 cylinders	BH 118-11- Trk #2 - morning
Nov 22, 2013	12 cylinders	BKGT 12-15- Trk #1 - afternoon
Nov 23, 2013	12 cylinders	BH 118-03- Trk #1 - morning
Nov 23, 2013	12 cylinders	BH 118-03- Trk #1 - afternoon
Nov 24, 2013	12 cylinders	BH 118-03- Trk #1 - morning
Nov 24, 2013	12 cylinders	BH 118-15- Trk #1 - afternoon
Nov 25, 2013	12 cylinders	BH 118-15- Trk #1 - morning
Nov 25, 2013	12 cylinders	BH 118-15- Trk #1 - afternoon
Nov 26, 2013	12 cylinders	BH 118-03- Trk #1 - morning
Nov 26, 2013	12 cylinders	BH 118-03- Trk #1 - afternoon
Nov 27, 2013	12 cylinders	BKGT 12-15 - Trk #2 - afternoon
Nov 28, 2013	12 cylinders	BKGT 12-15 - Trk #1 - morning
Nov 28, 2013	12 cylinders	BH 118-12 - Trk #1 - afternoon
Nov 29, 2013	12 cylinders	BH 118-11 - Trk #2 - afternoon
Dec 2, 2013	12 cylinders	BH 118-11 - Trk #2 - morning

Date	Amount/Container	Golder Sample Pour ID
Dec 3, 2013	12 cylinders	BH 118-11 - Trk #2 - afternoon
Dec 5, 2013	12 cylinders	BH 118-01 - Trk #1 - morning
Dec 5, 2013	12 cylinders	BH 118-01 - Trk #1 - afternoon
Dec 6, 2013	12 cylinders	BH 118-15 - Trk #1 - afternoon
Dec 7, 2013	12 cylinders	BH 118-15 - Trk #1 - morning
Dec 7, 2013	12 cylinders	BH 118-03 - Trk #1 - afternoon
Dec 8, 2013	12 cylinders	BH 118-08 - Trk #1 - morning
Dec 9, 2013	12 cylinders	OBS-02 - Trk #1 - morning
Dec 9, 2013	12 cylinders	BH 118-08 - Trk#1 - morning
Dec 10, 2013	12 cylinders	BH 118-08 - Trk#1 - morning

Table 2: Moisture Sample Receipt Summary

Date	Amount/Container	Golder Sample ID
Oct 21, 2013	1 - 1L container	Oct 21-13 - tailings moisture
Oct 22, 2013	1 - 1L container	Oct 22-13 - tailings moisture
Oct 25, 2013	1 - 1L container	Oct 25-13 - tailings moisture
Oct 26, 2013	1 - 1L container	Oct 26-13 - tailings moisture
Oct 27, 2013	1 - 1L container	Oct 27-13 - tailings moisture
Oct 28, 2013	1 - 1L container	Oct 28-13 - tailings moisture
Oct 30, 2013	1 - 1L container	Oct 30-13 - tailings moisture
Oct 31, 2013	1 - 1L container	Oct 31-13 - tailings moisture
Nov 1, 2013	1 - 1L container	Nov 01-13 - tailings moisture
Nov 2, 2013	1 - 1L container	Nov 02-13 - tailings moisture
Nov 3, 2013	1 - 1L container	Nov 03-13 - tailings moisture
Nov 5, 2013	1 - 1L container	Nov 05-13 - tailings moisture
Nov 6, 2013	1 - 1L container	Nov 06-13 - tailings moisture
Nov 7, 2013	1 - 1L container	Nov 07-13 - tailings moisture
Nov 8, 2013	1 - 1L container	Nov 08-13 - tailings moisture
Nov 12, 2013	1 - 1L container	Nov 12-13 - tailings moisture
Nov 13, 2013	1 - 1L container	Nov 13-13 - tailings moisture
Nov 14, 2013	1 - 1L container	Nov 14-13 - tailings moisture
Nov 15, 2013	1 - 1L container	Nov 15-13 - tailings moisture
Nov 16, 2013	1 - 1L container	Nov 16-13 - tailings moisture
Nov 17, 2013	1 - 1L container	Nov 17-13 - tailings moisture
Nov 18, 2013	1 - 1L container	Nov 18-13 - tailings moisture
Nov 20, 2013	1 - 1L container	Nov 20-13 - tailings moisture
Nov 21, 2013	1 - 1L container	Nov 21-13 - tailings moisture
Nov 22, 2013	1 - 1L container	Nov 22-13 - tailings moisture
Nov 23, 2013	1 - 1L container	Nov 23-13 - tailings moisture - AM
Nov 23, 2013	1 - 1L container	Nov 23-13 - tailings moisture - PM

Date	Amount/Container	Golder Sample ID
Nov 24, 2013	1 - 1L container	Nov 24-13 - tailings moisture
Nov 24, 2013	1 - 1L container	Nov 24-13 – bulk tailings moisture for cylinder's
Nov 25, 2013	1 - 1L container	Nov 25-13 - tailings moisture
Nov 26, 2013	1 - 1L container	Nov 26-13 - tailings moisture
Nov 27, 2013	1 - 1L container	Nov 27-13 - tailings moisture
Nov 28, 2013	1 - 1L container	Nov 28-13 - tailings moisture
Nov 29, 2013	1 - 1L container	Nov 29-13 - tailings moisture
Dec 2, 2013	1 - 1L container	Dec 02-13 - tailings moisture
Dec 3, 2013	1 - 1L container	Dec 03-13 - tailings moisture
Dec 5, 2013	1 - 1L container	Dec 05-13 - tailings moisture
Dec 7, 2013	1 - 1L container	Dec 07-13 - tailings moisture
Dec 9, 2013	1 - 1L container	Dec 09-13 - tailings moisture

3.0 MOISTURE CONTENT TESTING

The tailings moisture samples were weighted and dried in an oven located in the laboratory. The oven temperature was adjusted to 60°C. The results are presented in Table 3 as well as on Figure 1.

Table 3: Tailings Moisture Content

Sample ID	Pan Tare (g)	Pan/Tails Wet (g)	Pan/Tails Dry (g)	Wt% Solids	Wt% Moisture
Oct 21 -13 - tailings moisture	2.10	136.10	110.20	80.67%	19.33%
Oct 22 -13 - tailings moisture	2.10	126.20	114.70	90.73%	9.27%
Oct 25 -13 - tailings moisture	2.20	104.00	93.70	89.88%	10.12%
Oct 26 -13 - tailings moisture	2.60	77.80	70.30	90.03%	9.97%
Oct 27 -13 - tailings moisture	2.20	79.80	74.20	92.78%	7.22%
Oct 28 -13 - tailings moisture	2.20	92.30	85.00	91.90%	8.10%
Oct 30 -13 - tailings moisture	2.20	91.10	84.30	92.35%	7.65%
Oct 31 -13 - tailings moisture	2.20	95.70	88.70	92.51%	7.49%
Nov 01 -13 - tailings moisture	2.20	90.70	83.90	92.32%	7.68%
Nov 02 -13 - tailings moisture	2.20	95.80	88.20	91.88%	8.12%
Nov 03 -13 - tailings moisture	2.30	83.50	77.00	92.00%	8.00%
Nov 05 -13 - tailings moisture	2.30	76.20	70.80	92.69%	7.31%
Nov 06 -13 - tailings moisture	2.20	85.50	79.30	92.56%	7.44%
Nov 07 -13 - tailings moisture	2.30	91.30	84.70	92.58%	7.42%
Nov 08 -13 - tailings moisture	2.30	99.50	91.90	92.18%	7.82%
Nov 12 -13 - tailings moisture	2.30	84.30	75.60	89.39%	10.61%
Nov 13 -13 - tailings moisture	2.20	75.50	66.80	88.13%	11.87%
Nov 14 -13 - tailings moisture	2.20	76.40	66.90	87.20%	12.80%
Nov 15 -13 - tailings moisture	2.30	79.20	69.00	86.74%	13.26%

Sample ID	Pan Tare (g)	Pan/Tails Wet (g)	Pan/Tails Dry (g)	Wt% Solids	Wt% Moisture
Nov 16 -13 - tailings moisture	2.20	83.40	72.70	86.82%	13.18%
Nov 17 -13 - tailings moisture	2.30	93.90	81.60	86.57%	13.43%
Nov 18 -13 - tailings moisture	2.20	91.90	77.10	83.50%	16.50%
Nov 20 -13 - tailings moisture	2.20	100.00	85.50	85.17%	14.83%
Nov 21 -13 - tailings moisture	2.20	93.00	78.90	84.47%	15.53%
Nov 22 -13 - tailings moisture	2.30	94.30	81.60	86.20%	13.80%
Nov 23 -13 - tailings moisture - AM	2.20	84.50	73.90	87.12%	12.88%
Nov 23 -13 - tailings moisture - PM	2.30	91.80	80.50	87.37%	12.63%
Nov 24 -13 - tailings moisture	2.30	92.30	82.00	88.56%	11.44%
Nov 25 -13 - tailings moisture	2.20	78.40	70.70	89.90%	10.10%
Nov 26 -13 - tailings moisture	2.10	86.10	74.90	86.67%	13.33%
Nov 27 -13 - tailings moisture	2.10	84.10	75.60	89.63%	10.37%
Nov 28 -13 - tailings moisture	2.20	94.10	84.50	89.55%	10.45%
Nov 29 -13 - tailings moisture	2.40	89.50	80.10	89.21%	10.79%
Dec 02 -13 - tailings moisture	2.10	86.10	78.10	90.48%	9.52%
Dec 03 -13 - tailings moisture	2.10	89.40	80.80	90.15%	9.85%
Dec 05 -13 - tailings moisture	2.30	100.40	90.60	90.01%	9.99%
Dec 07 -13 - tailings moisture	2.20	100.20	91.00	90.61%	9.39%
Dec 09 -13 - tailings moisture	2.20	91.60	82.80	90.16%	9.84%

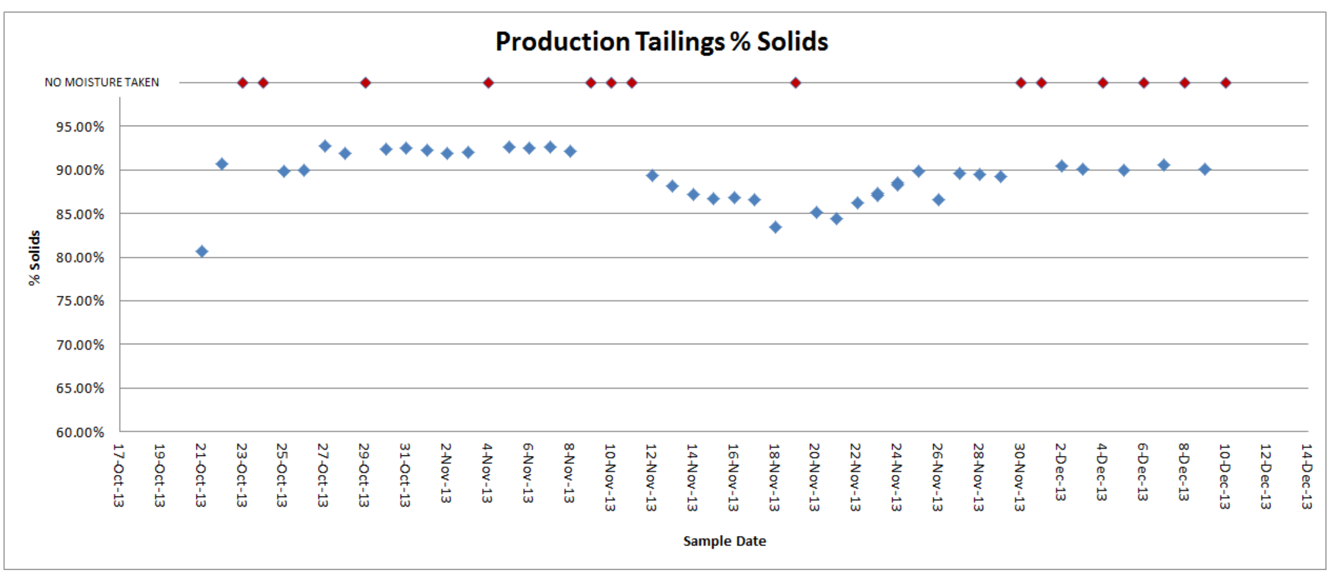


Figure 1: Tailings Feed Material % Solids Content

4.0 UNCONFINED COMPRESSIVE STRENGTH (UCS) TESTING

UCS testing was carried out using a Sigma-1 GeoTac load frame. The load was measured using a 10,000 lb (45 kN) s-type load cell for all test work.

The cured cylinders were placed one at a time between two platens and during testing, the bottom platen advanced at a rate of 2 mm (0.08 inch) per minute. The load was continuously monitored and the load data including the peak load were automatically recorded by the instrument.

4.1 Lab Test Equipment and Setup

A temporary lab was setup to perform the required testwork during the production period. Initially the lab was located in the Golder Yellowknife office however this was changed to an onsite facility mid-way through production to better accommodate the storage, transportation and disposal of UCS cylinders. The setup at both facilities made use of the same equipment.

Figure 2: UCS Lab Equipment as set up at Giant Mine M.E.G. Facility.

Major equipment used during the UCS programme included a GeoTac load frame complete with DAQ software used to break cylinders, a 10,000lb load cell, and a digital scale to weigh the samples. Cylinders were stored in on-site ‘curing chambers’ consisting of a galvanized tub with shelving installed. The tub was wrapped in wet burlap and covered in a plastic drop cloth in an attempt to maintain 100% humidity at room temperature (24-30°C). The burlap was regularly sprayed with water to maintain this target humidity.

All tests were performed in the same manner. Cylinders were removed from their mold, their tops were trimmed level, and they were weighed and positioned appropriately in the load frame. The data file was set up accordingly and the break took place while automatically recording the necessary information. The broken cylinder was observed and discarded. Test pictures were captured of all cylinders tested after November 14th.

4.2 Cylinder Preparation

At the paste production area, cylinders were cast immediately after a sample was pulled and a slump test was performed. The samples were subsequently stored and transported in coolers (see figure 3 below).

Figure 3: Cylinders Being Prepared in the Field

4.3 UCS Program and Results

The UCS program was carried out to assess the backfill strength using 76 x 152 mm (3'' x 6'') cylinders. Cylinders were transferred to the curing tubs in the laboratory immediately following the end of daily production. Three cylinders per curing period were casted and broken and the results were averaged. The results are separated by mix design and presented in Figures 4 to 15 as well as in Appendix A in tabular form. The laboratory data represented in Figure 15 was the test performed in Sudbury lab in August, 2013. The remaining laboratory data results for the on-site recipes will be added as the results become available.

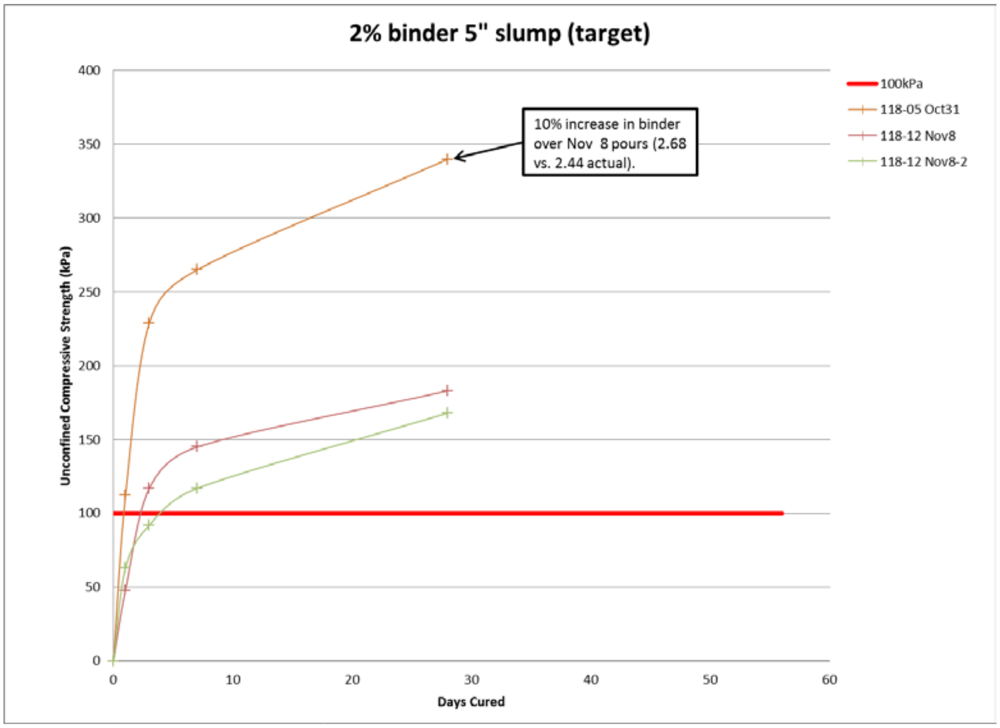


Figure 4: UCS Results- 2 % Binder 5" Slump

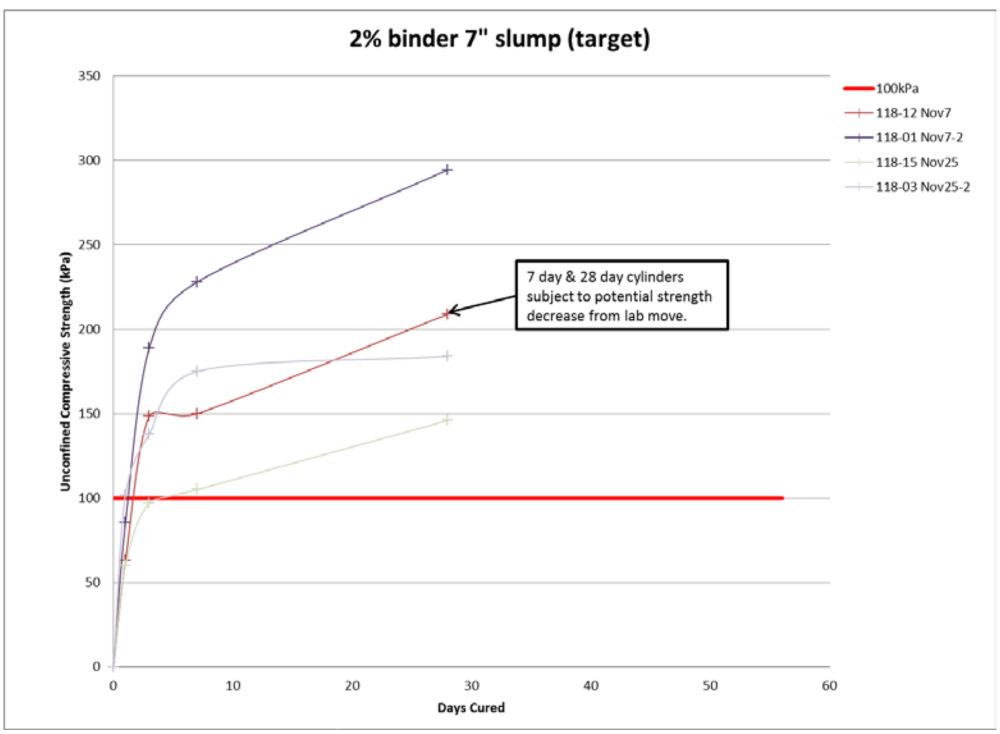


Figure 5: UCS Results- 2% Binder 7" Slump

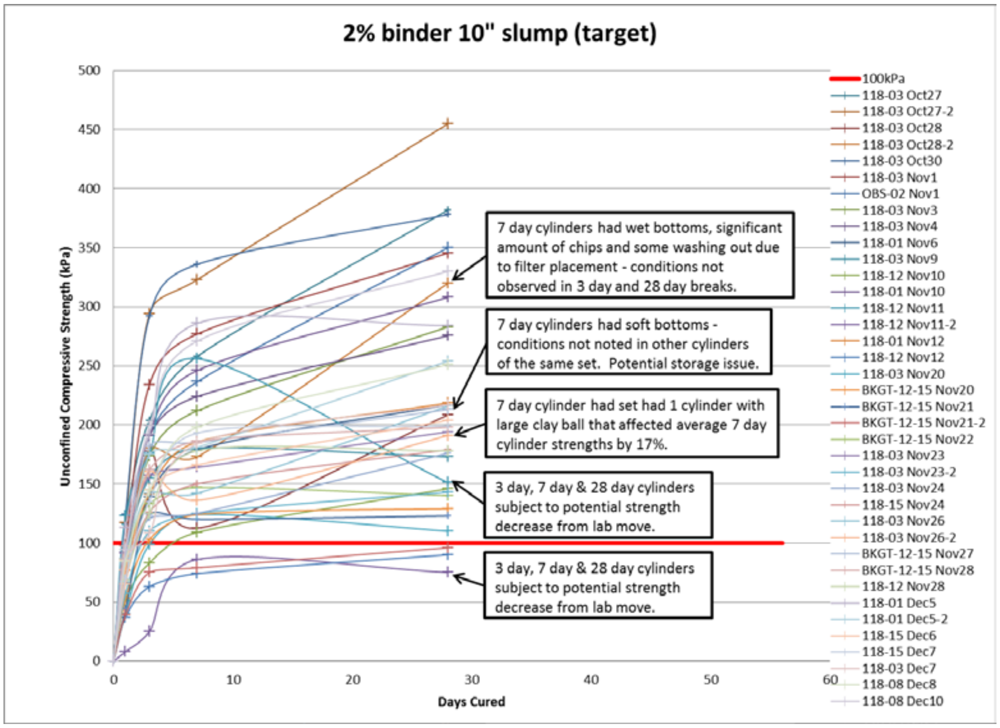


Figure 6: UCS Results- 2% Binder 10" Slump

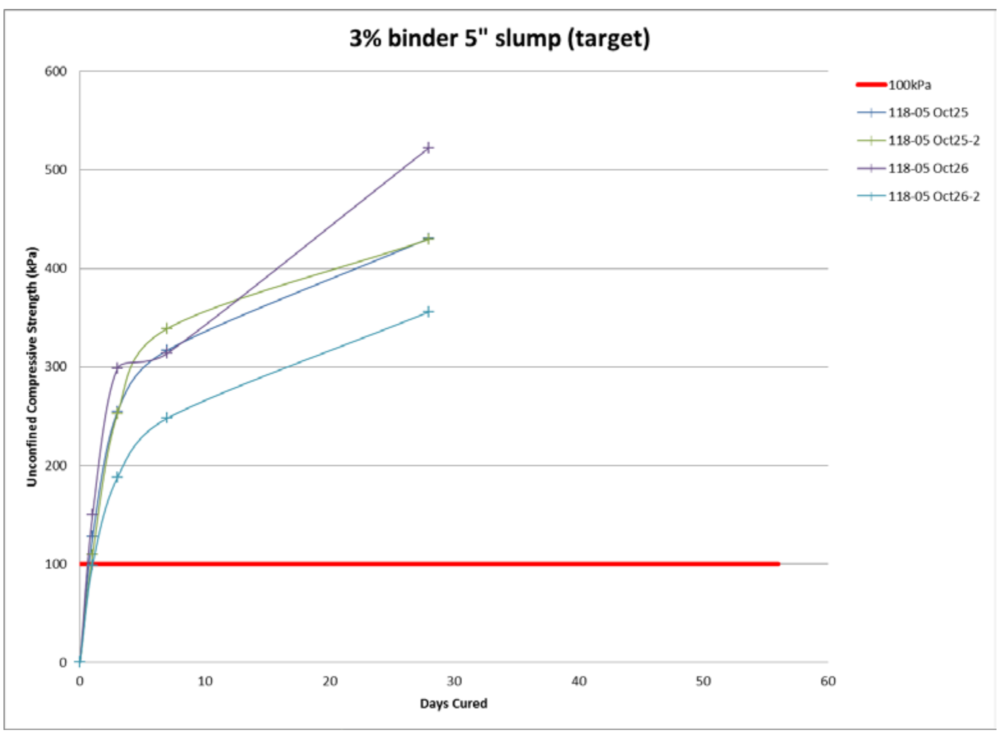


Figure 7: UCS Results- 3% Binder 5" Slump

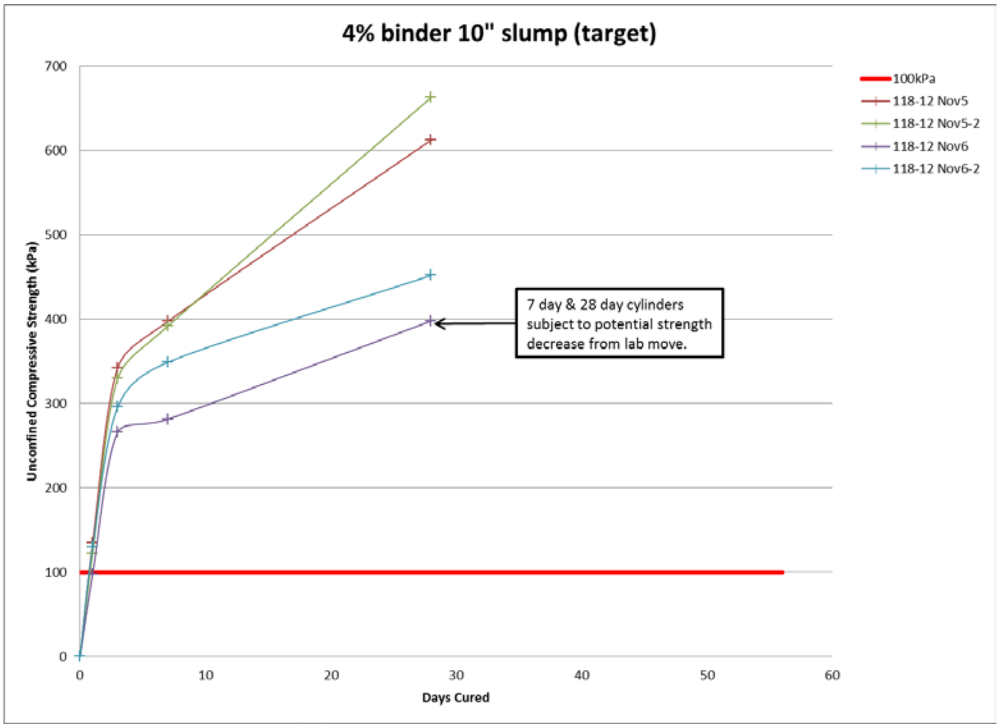


Figure 8: UCS Results- 4% Binder 10" Slump

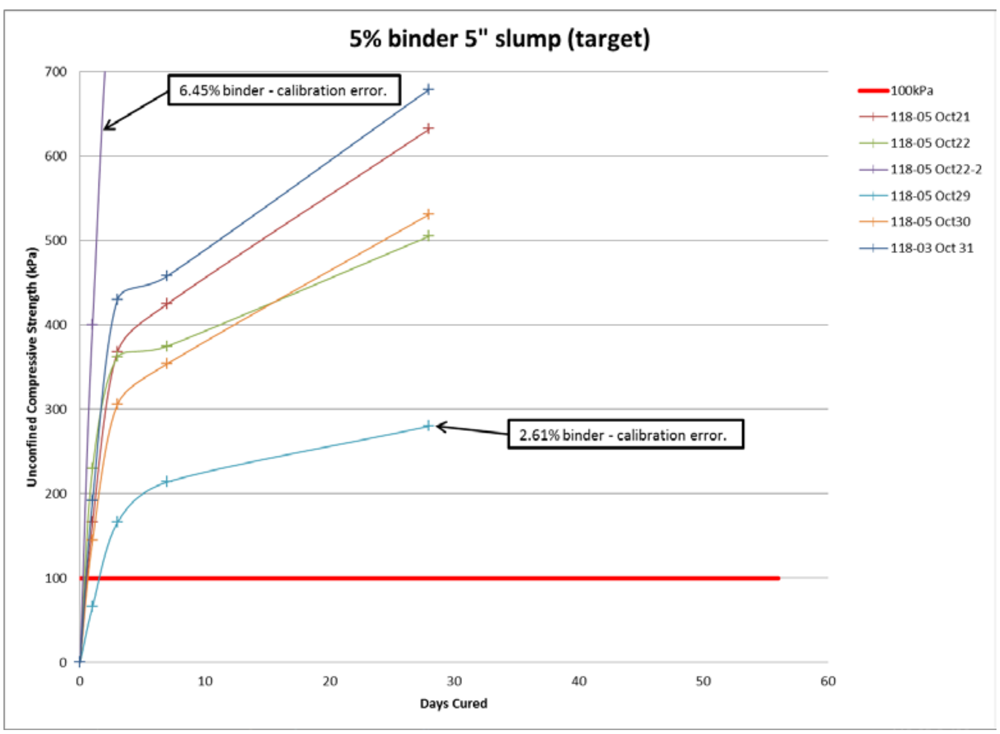


Figure 9: UCS Results- 5% Binder 5" Slump

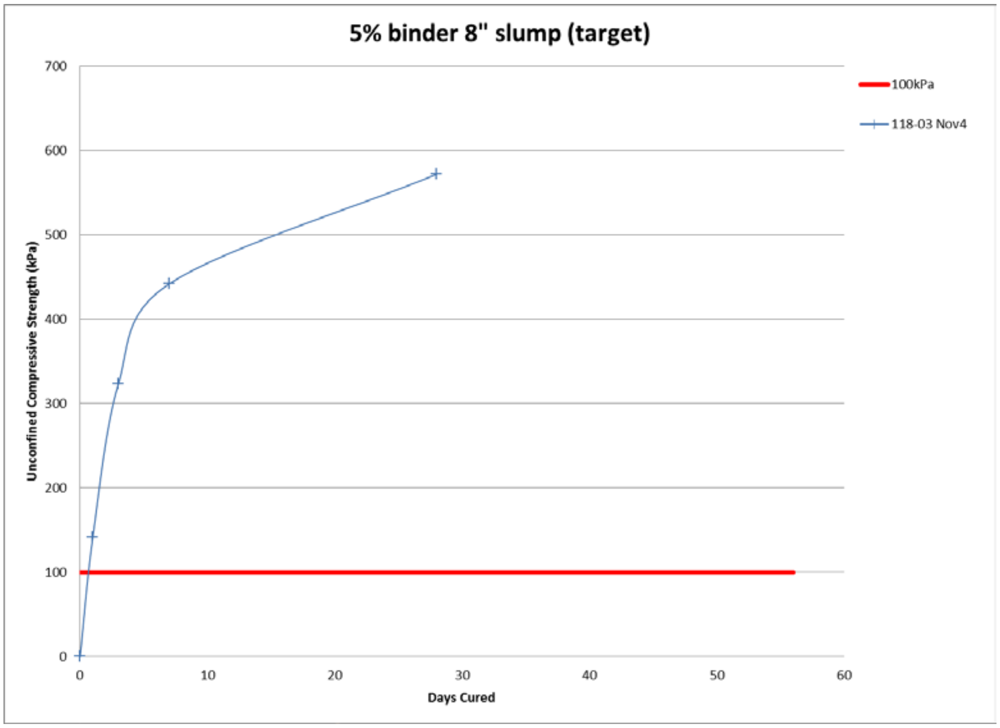


Figure 10: UCS Results- 5% Binder 8" Slump

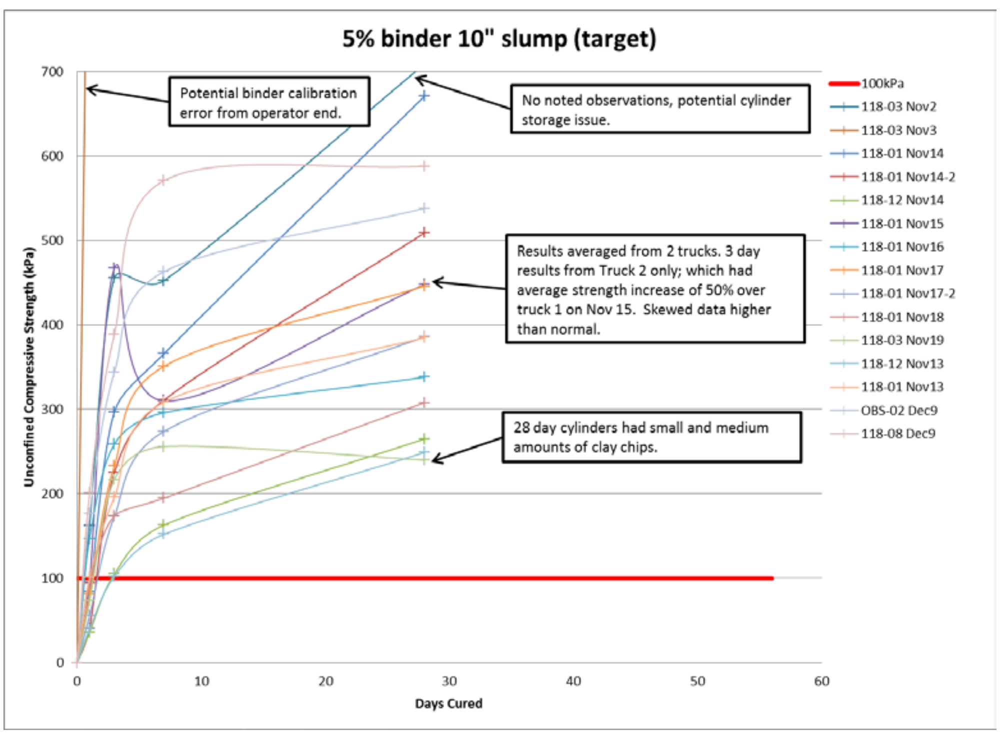


Figure 11: UCS Results- 5% Binder 10" Slump

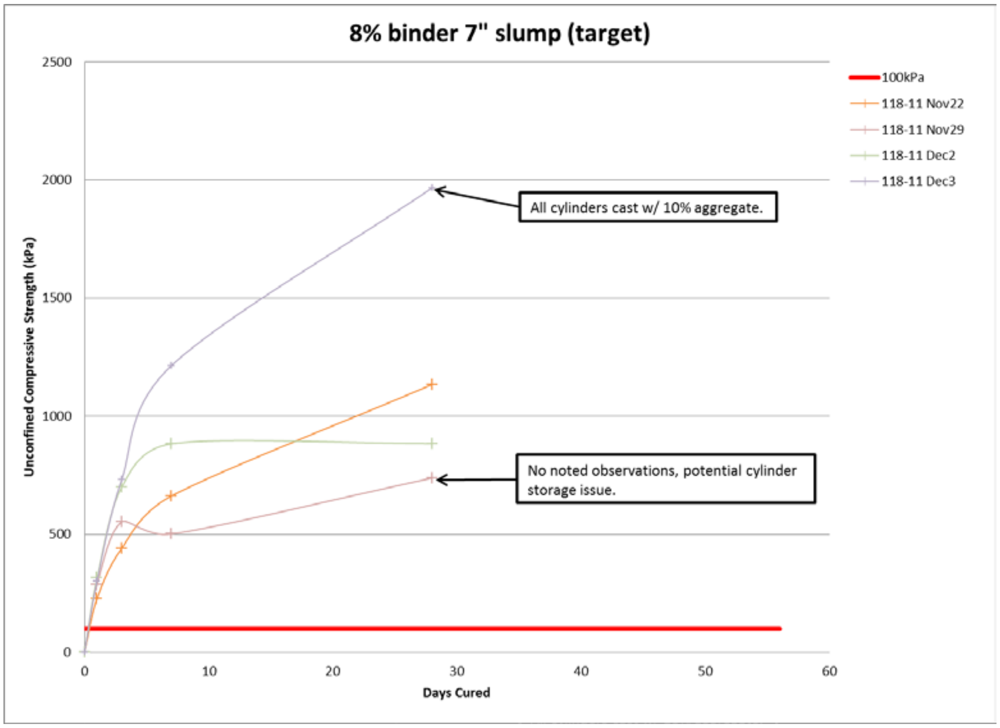


Figure 12: UCS Results- 8% Binder 7" Slump

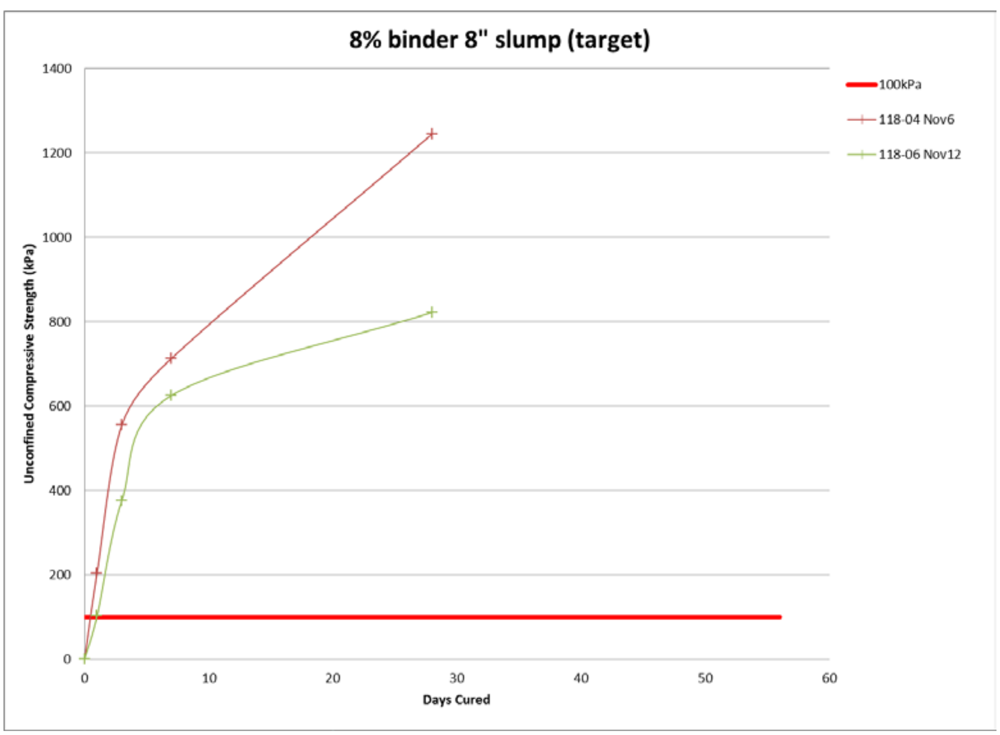


Figure 13: UCS Results- 8% Binder 8" Slump

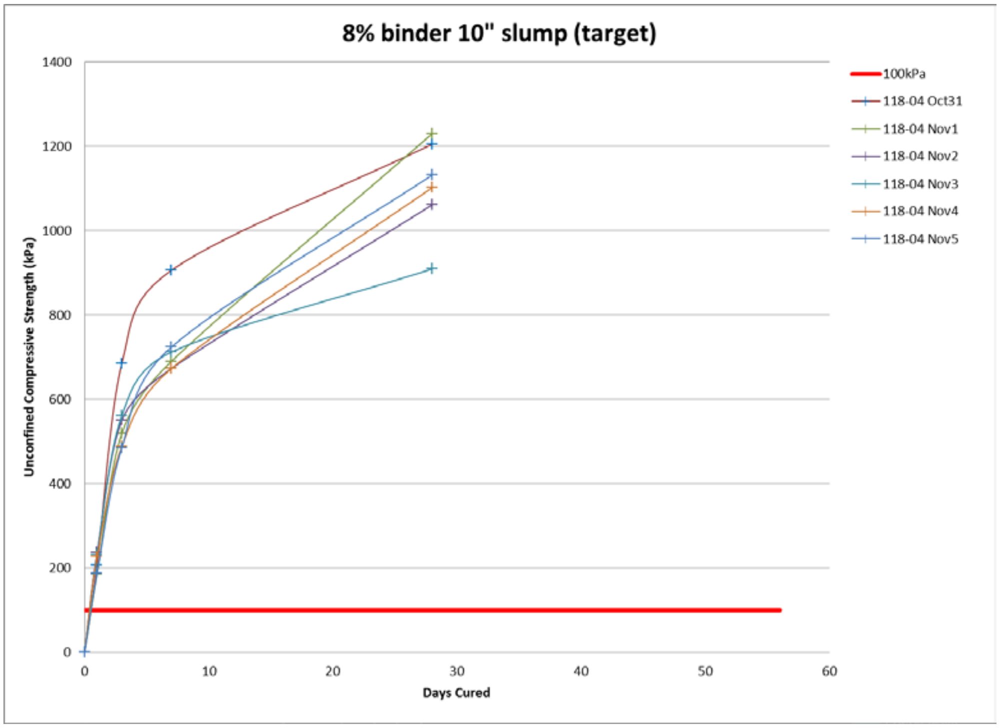


Figure 14: UCS Results- 8% Binder 10" Slump

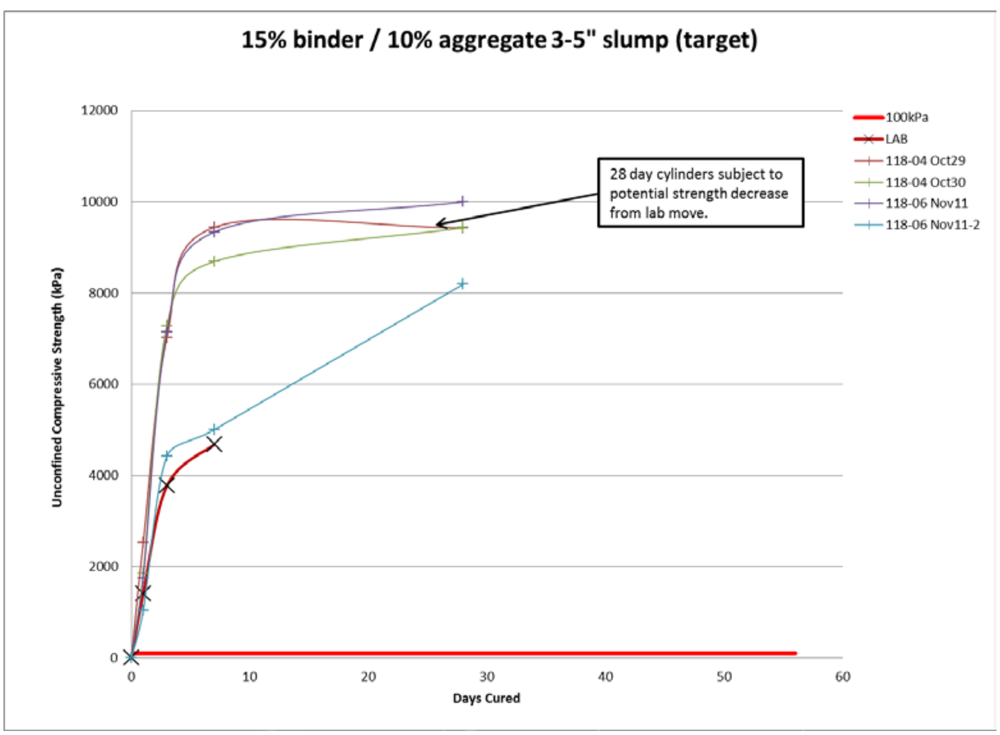


Figure 15: UCS Results- 15% Binder, 10% Aggregate 3-5" Slump

4.4 Observations

In addition to the factual evidence presented within the report, several anecdotal observations are noted in response to the results obtained. Appendix C displays anecdotal observations obtained during the cylinder breaks performed in the lab in a table format. Appendix D includes photographs of the observations discussed below along with commentary that further addresses these and other qualitative observations in a general manner. Observations of interest include; relocating lab, cylinder storage within the lab, drainage filter placement in cylinder mold, tailings content and temperature.

The largest disruption, and potentially biggest contributing factor to the results obtained, during the testing program is the relocation of the lab mid-way through production. This move had the potential to affect the strength in the 276 cylinders that were moved during their curing period (about 20% of the total amount of cylinders for the program). Cylinders subject to the move are noted in Appendix C. The potential for adverse effects on cylinder strength is increased the more they are handled. During the move, cylinders that were partially cured were re-loaded into coolers and transported to the new facility by road where they are subject to some degree of vibration. It is unknown to what extent the displacement had on the cylinder strengths however some cylinders that were part of the move were observed to have a reduction in strength from others within their set.

A large deal of effort had gone into maintaining appropriate conditions for cylinder curing in accordance with ASTM D2166. Both human and environmental conditions played a large role in what conditions the cylinders were subject to during their cure time. The cylinders were regularly moistened (one to two times daily) to keep humidity levels high relative to the dry ambient air. In addition to a physical spraying of water onto the cylinders; burlap and plastic wrap were used to both absorb moisture (slowing the dry time after a spray) and contain moisture condensate and keep it near the sample. Quality control of the process was insufficient during the first days of production resulting in a dryer, less humid curing chamber. Temperature also played a potential role concerning strengths developed over time. The lab in Golder's Yellowknife office did maintain an average temperature of 21 degrees centigrade with little deviation. In contrast, the lab and cylinder storage area at Giant's M.E.G. facility had observed temperatures varying from 15 to 30 degrees.

A control test was performed in the Golder Sudbury Laboratory to determine the effects of humidity and temperature. Cylinders were casted with 100% tailings plus 3% binder at 10" slump. The results are presented in table 4 below.

Table 4: Temperature Control Test

Sample I.D.	Curing Conditions	Strength (kPa)				
		Curing 1 day	Curing 3 day	Curing 7 days	Curing 28 days	Curing 56 days
100% 13-1426-0010 SP-TP 4+5+6	100% humid. 21°C - 25°C (Curing Chamber)	59	118	135	183	192
100% 13-1426-0010 SP-TP 4+5+6	4°C (Laboratory fridge)	Too soft	48	72	125	175
100% 13-1426-0010 SP-TP 4+5+6	30% humid. 20°C	41	97	164	228	369

Based on the control test results, the cylinders cured inside the fridge, in colder and dryer conditions than the other two sets, showed lower strengths results in the short and long term. Humidity seems to affect the strengths of the samples, as the samples placed in the curing chamber showed lower strength results in the long term. The higher strengths were obtained from the cylinders cured at laboratory ambient conditions, 30% humid and 20ºC

Outside ambient temperature could have also played a role in strength development of cylinders samples collected for the UCS testwork. Cylinders prepared in the field were often cast and stored outside in coolers. Sample material could range from 10°C to 2°C during casting and be subject to -25°C temperature for a period of 6 hours before being transported to the lab to cure in the curing chamber. This effect would be most prominent in the 1 day cylinder breaks as the cylinders had little time to thaw and cure before being subject to removal from their mold and loaded till failure; however all cylinders from a set affected by cold would have residual strength loss. This effect is strictly applicable to cylinders stored on surface and not applicable to production fill placed underground because of the temperature differences (sub-surface temperatures averaging 5°C).

Strength results may also have been affected by filter inclusion/placement within the cylinder mold. This was evident during UCS breaks as voids appeared in many of the cylinders tested with filters that were either improperly placed or missing altogether (prevalent during the first few days of production). The creation of the void is due to the displacement of tailings fines that washed out of the cylinder during initial water drainage. Filter placement did play a significant role in the few cylinders that were missing them. Strengths noted from cylinders labelled ‘BH118-05 trk1 morn’ showed a decrease in strength ranging from 25% to as much as 68% for cylinders without filters as compared to others in the same set with the filters. About 80 cylinders were affected by misplaced or missing filters.

Also affecting strength results were the contents of the cylinders. Many cylinders contained clay chunks that, depending on their size and quantity, had impacted the UCS result in an adverse manner. Some cylinders had clay chunks present so massive in diameter that the cylinder broke during removal from the mold. Another detrimental content was water in the form of ice which had the potential to delay/reduce the binder curing process resulting in weaker fill. The quality of the tailings being fed into the mix truck was constantly being monitored and daily moisture samples were taken as a precaution, in addition to long term storage being in an enclosed dome. This observation is difficult to quantify in terms of strength vs. cylinder contents however there is a strong indication that strength was adversely affected by a poorer mix, or greater content of chunks that existed with in a cylinder – some cylinders of a set not possessing any strength whatsoever while the others in the same set showed average results.

5.0 CLOSURE

If there are any questions regarding this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Drew Dewit
Mechanical E.I.T.

ORIGINAL SIGNED

Sue Longo, P.Eng.
Associate, Mechanical Engineer

DD/SL/ds/mes

APPENDIX A

UCS Strength Tables

Table 1: UCS Results – 100% Tailings + 2% Binder, 5" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 31-13	AM	Plug_Deliv_118_05	2	112	229	265	340	2146.5
Nov 8-13	AM	P_Deliv_118_12	2	48	117	145	183	2088
Nov 8-13	PM	P_Deliv_118_12	2	63	92	117	168	2084

Table 2: UCS Testing Results – 100% Tailings + 2% Binder, 7" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 7-13	AM	P_Deliv_118_12	2	63	148.5	150	209	2118
Nov 7-13	PM	P_Deliv_118_01	2	85.5	189	228	294.5	2052
Nov 25-13	AM	P_Deliv_118_15	2	60	97	105	146	2104
Nov 25-13	PM	P_Deliv_118_15	2	102	138	175	184	2124

Table 3: UCS Testing Results – 100% Tailings + 2% Binder, 10" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 27-13	AM	P_Deliv_118_03	2	116	204	258	382	2168
Oct 27-13	PM	P_Deliv_118_03	2	117	294	323	455	2180
Oct 28-13	AM	P_Deliv_118_03	2	67	178	112.5	208.5	2130.5
Oct 28-13	PM	P_Deliv_118_03	2	67	180	173	320	2152
Oct 30-13	PM	P_Deliv_118_03	2	124	292	336	378	2136
Nov 1-13	PM	P_Deliv_118_03	2	97.5	234	277	345.5	2165
Nov 1-13	PM	OBS_118_02	2	94	191	236.5	350	2150
Nov 3-13	AM	P_Deliv_118_03	2	76.5	173.5	212	283	2145.5
Nov 4-13	PM	P_Deliv_118_03	2	92	190.5	224	275.5	2158
Nov 6-13	PM	P_Deliv_118_03	2	66	139	179	217	2159
Nov 7-13	AM	P_Deliv_118_03	2	72.5	187.5	239	286	2144
Nov 9-13	PM	P_Deliv_118_03	2	86	155	180	173	2127
Nov 10-13	AM	P_Deliv_118_03	2	51	83	109	146	2072
Nov 10-13	AM	P_Deliv_118_03	2	94	192	246	308	2126
Nov 11-13	PM	P_Deliv_118_03	2	123	176	256	151	2131
Nov 11-13	PM	P_Deliv_118_03	2	8	25	86	75	2012
Nov 12-13	AM	P_Deliv_118_03	2	76.5	141	185.5	218.5	2121

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 12-13	PM	P_Deliv_118_03	2	37	63	74	90	2061
Nov 20-13	AM	P_Deliv_118_03	2	40	99	124	110	2046
Nov 20-13	AM	BKGT-12-15	2	53	103	124	129	2066
Nov 21-13	AM	BKGT-12-15	2	44	124	120	123	2068
Nov 21-13	PM	BKGT-12-15	2	39	75	79	96	2030
Nov 22-13	PM	BKGT-12-15	2	86	133	147	140	2137
Nov 23-13	AM	P_Deliv_118_03	2	91	157	164	194	2113
Nov 23-13	PM	P_Deliv_118_03	2	57	110	125	143	2097
Nov 24-13	AM	P_Deliv_118_03	2	69	121	125	176	2097
Nov 24-13	PM	P_Deliv_118_15	2	67	126	150	179	2098
Nov 26-13	AM	P_Deliv_118_03	2	82	142	142	216	2107
Nov 26-13	PM	P_Deliv_118_03	2	77	160	136	191	2124
Nov 27-13	PM	BKGT-12-15	2	87	182	185	213	2177
Nov 28-13	AM	BKGT-12-15	2	97	162	186	198	2157
Nov 28-13	PM	P_Deliv_118_12	2	68	125	178	178	2145
Dec 5-13	AM	P_Deliv_118_01	2	113	192	286	284	2188
Dec 5-13	PM	P_Deliv_118_01	2	67	175	181	254	2158
Dec 6-13	PM	P_Deliv_118_15	2	65	145	166	204	2171
Dec 7-13	AM	P_Deliv_118_15	2	70	135	193	199	2167
Dec 7-13	PM	P_Deliv_118_03	2	85	108	184	217	2182
Dec 8-13	AM	P_Deliv_118_08	2	84	144	198	251	2174
Dec 10-13	AM	P_Deliv_118_08	2	94	199	271	330	2199

Table 4: UCS Testing Results – 100% Tailings + 3% Binder, 5" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 25-13	AM	Plug_Deliv_118_05	3	127.5	254.5	317	430.5	2145.5
Oct 25-13	PM	Plug_Deliv_118_05	3	109.5	252.5	339	429.5	2148.5
Oct 26-13	AM	Plug_Deliv_118_05	3	150	298.5	314	522.5	2159
Oct 26-13	PM	Plug_Deliv_118_05	3	99	188	248	356	2143.5

Table 5: UCS Testing Results – 100% Tailings + 4% Binder, 10" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 5-13	AM	P_Deliv_118_12	4	135	342.5	397.5	612.5	2158.5
Nov 5-13	PM	P_Deliv_118_12	4	123	330	392	663	2150
Nov 6-13	AM	P_Deliv_118_12	4	98	266	281.5	398	2140.5
Nov 6-13	PM	P_Deliv_118_12	4	130	296	349	452	2140

Table 6: UCS Testing Results – 100% Tailings + 5% Binder, 5" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 21-13	PM	Plug_Deliv_118_05	5	166	368	425	632	2192
Oct 22-13	AM	Plug_Deliv_118_05	5	230	362	375	505	2140
Oct 22-13	PM	Plug_Deliv_118_05	5	400	873	994	1385	2188
Oct 29-13	PM	Plug_Deliv_118_05	5	66.5	166	214	280	2094
Oct 30-13	PM	Plug_Deliv_118_05	5	145	306	354	531	2145
Oct 31-13	PM	P_Deliv_118_03	5	192	430	458	679	2144

Table 7: UCS Testing Results – 100% Tailings with 5% Binder, 8" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 4-13	AM	P_Deliv_118_03	5	142	323	442	572	2142

Table 8: UCS Testing Results – 100% Tailings + 5% Binder, 10" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 2-13	PM	P_Deliv_118_03	5	162.5	455.5	452.5	709	2175
Nov 3-13	PM	P_Deliv_118_03	5	1130	3872	3893	9552	2218
Nov 13-13	AM	P_Deliv_118_01	5	101	196	308.5	385	2086
Nov 13-13	PM	P_Deliv_118_12	5	40	102	152	249	2036
Nov 14-13	AM	P_Deliv_118_01	5	84	297	366	671	2085
Nov 14-13	PM	P_Deliv_118_01	5	41	225	311	509	2095
Nov 14-13	AM	P_Deliv_118_12	5	36	105	163	265	2053
Nov 15-13	AM	P_Deliv_118_01	5	95.5	467	310	448	2112

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 16-13	AM	P_Deliv_118_01	5	147	259	296	338	2109
Nov 17-13	AM	P_Deliv_118_01	5	81	233	351	446	2092
Nov 17-13	PM	P_Deliv_118_01	5	56	173	274	386	2073
Nov 18-13	AM	P_Deliv_118_01	5	94	174	195	308	2102
Nov 19-13	AM	P_Deliv_118_03	5	73	217	256	240	2081
Dec 9-13	AM	OBS_118_02	5	176	344	463	538	2188
Dec 9-13	PM	P_Deliv_118_08	5	201	389	571	588	2189

Table 9: UCS Testing Results – 100% Tailings + 8% Binder, 7" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 22-13	AM	P_Deliv_118_11	8	227	441	662	1134	2095
Nov 29-13	PM	P_Deliv_118_11	8	287	552	501	738	2139
Dec 2-13	AM	P_Deliv_118_11	8	315	700	883	884	2184

Table 10: UCS Testing Results – 100% Tailings + 8% Binder, 8"Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Nov 6-13	AM	Plug_Deliv_118_04	8	204	555	713	1245	2135
Nov 12-13	AM	P_Deliv_118_06	8	102	376	625	822	2111

Table 11: UCS Testing Results – 100% Tailings + 8% Binder, 10" Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 31-13	PM	Plug_Deliv_118_04	8	206	685	906	1205	2202
Nov 1-13	AM	Plug_Deliv_118_04	8	185	519	690	1230	2143
Nov 2-13	AM	Plug_Deliv_118_04	8	236	550	673	1061	2138
Nov 3-13	AM	Plug_Deliv_118_04	8	232	561	712	909	2146
Nov 4-13	AM	Plug_Deliv_118_04	8	226	488	673	1102	2138
Nov 5-13	AM	Plug_Deliv_118_04	8	186	485	724	1132	2148

Table 12: UCS Testing Results – 90% Tailings, 10% Aggregate + 8% Binder, 7” Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Dec 3-13	PM	P_Deliv_118_11	8	302	733	1214	1967	2354

Table 13: UCS Testing Results – 90% Tailings, 10% Aggregate + 15% Binder, 3-5” Slump

Time of Casting		Borehole	Wt.% Binder	Average UCS (kPa)				Average Bulk Density (kg/m^3)
				Curing 1 day	Curing 3 days	Curing 7 days	Curing 28 days	
Oct 29-13	PM	Plug_Deliv_118_04	15	2517	7017	9440	9426	2351
Oct 30-13	AM	Plug_Deliv_118_04	15	1848	7284	8693	9431	2309
Nov 11-13	AM	P_Deliv_118_06	15	1752	7139	9337	10000	2267
Nov 11-13	PM	P_Deliv_118_06	15	1034	4422	5005	8195	2242

APPENDIX B

UCS Strength Tables Target vs. Actual

Table 1: UCS Results – 100% Tailings + 2% Binder, 5" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 31-13	AM	Plug_Deliv_118_05	2	2.68	5	7.5,6
Nov 8-13	AM	P_Deliv_118_12	2	2.44	5	4.5
Nov 8-13	PM	P_Deliv_118_12	2	2.44	5	6

Table 2: UCS Testing Results – 100% Tailings + 2% Binder, 7" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 7-13	AM	P_Deliv_118-12	2	2.41,2.59	7	7.5,8.25
Nov 7-13	PM	P_Deliv_118-01	2	2.41,2.59	7	10.25,7.5
Nov 25-13	AM	P_Deliv_118-15	2	2.35	7	6
Nov 25-13	PM	P_Deliv_118-15	2	2.35	7	7.75

Table 3: UCS Testing Results – 100% Tailings + 2% Binder, 10" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 27-13	AM	P_Deliv_118-03	2	3.14,2.78	10	10,9.5
Oct 27-13	PM	P_Deliv_118-03	2	2.78	10	9.5
Oct 28-13	AM	P_Deliv_118-03	2	2.61,3.34	10	10,9.75
Oct 28-13	PM	P_Deliv_118-03	2	2.61,3.34	10	9.5
Oct 30-13	PM	P_Deliv_118-03	2	2.68	10	9.5
Nov 1-13	PM	P_Deliv_118-03	2	2.68	10	10,10
Nov 1-13	PM	OBS_118_02	2	2.79,2.08	10	10,10
Nov 3-13	AM	P_Deliv_118-03	2	2.26,2.50	10	10,9
Nov 4-13	PM	P_Deliv_118-03	2	2.26,2.13	10	9.5,9.5
Nov 6-13	PM	P_Deliv_118-01	2	1.94,2.11	10	10.5
Nov 7-13	AM	P_Deliv_118-01	2	2.41,2.59	10	10,10
Nov 9-13	PM	P_Deliv_118-03	2	2.43	10	10
Nov 10-13	AM	P_Deliv_118-12	2	2.43	10	9.75
Nov 10-13	AM	P_Deliv_118-01	2	2.43	10	9.5
Nov 11-13	PM	P_Deliv_118-12	2	2.43,2.56	10	9.75
Nov 11-13	PM	P_Deliv_118-12	2	2.43,2.56	10	10.25
Nov 12-13	AM	P_Deliv_118-01	2	2.43,2.26	10	10.5,9.75
Nov 12-13	PM	P_Deliv_118-12	2	2.26	10	9
Nov 20-13	AM	P_Deliv_118-03	2	2.35	10	9.5
Nov 20-13	AM	BKGT-12-15	2	2.35	10	10

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 21-13	AM	BKGT-12-15	2	2.35	10	10
Nov 21-13	PM	BKGT-12-15	2	2.35	10	8.75
Nov 22-13	PM	BKGT-12-15	2	2.35	10	10.75
Nov 23-13	AM	P_Deliv_118-03	2	2.35	10	10.25
Nov 23-13	PM	P_Deliv_118-03	2	2.35	10	9.25
Nov 24-13	AM	P_Deliv_118-03	2	2.35	10	10
Nov 24-13	PM	P_Deliv_118-15	2	2.35	10	10
Nov 26-13	AM	P_Deliv_118-03	2	2.35	10	NA
Nov 26-13	PM	P_Deliv_118-03	2	2.35	10	NA
Nov 27-13	PM	BKGT12-15	2	2.06	10	9
Nov 28-13	AM	BKGT12-15	2	2.60	10	10.5
Nov 28-13	PM	P_Deliv_118-12	2	2.60	10	11
Dec 5-13	AM	P_Deliv_118-01	2	2.24	10	10.25
Dec 5-13	PM	P_Deliv_118-01	2	2.24	10	10.75
Dec 6-13	PM	P_Deliv_118-15	2	2.24	10	NA
Dec 7-13	AM	P_Deliv_118-15	2	2.24	10	9.5
Dec 7-13	PM	P_Deliv_118-03	2	2.24	10	8.5
Dec 8-13	AM	P_Deliv_118-08	2	2.00	10	10.25
Dec 10-13	AM	P_Deliv_118-08	2	2.34	10	9.5

Table 4: UCS Testing Results – 100% Tailings + 3% Binder, 5" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 25-13	AM	Plug_Deliv_118-05	3	3.05	5	NA
Oct 25-13	PM	Plug_Deliv_118-05	3	3.05	5	NA
Oct 26-13	AM	Plug_Deliv_118-05	3	3.05	5	5,5.75
Oct 26-13	PM	Plug_Deliv_118-05	3	3.05	5	5,5.75

Table 5: UCS Testing Results – 100% Tailings + 4% Binder, 10" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 5-13	AM	P_Deliv_118-12	4	3.95,3.90	10	10,10
Nov 5-13	PM	P_Deliv_118-12	4	3.95,3.90	10	10.25
Nov 6-13	AM	P_Deliv_118-12	4	4.51,4.18	10	10.5,10.25
Nov 6-13	PM	P_Deliv_118-12	4	4.51,4.18	10	10.25

Table 6: UCS Testing Results – 100% Tailings + 5% Binder, 5" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 21-13	PM	Plug_Deliv_118-05	5	6.23	5	6.5
Oct 22-13	AM	Plug_Deliv_118-05	5	6.45	5	5.75
Oct 22-13	PM	Plug_Deliv_118-05	5	6.45	5	7.5
Oct 29-13	PM	Plug_Deliv_118-05	5	2.61	5	5
Oct 30-13	PM	Plug_Deliv_118-05	5	5.01	5	8
Oct 31-13	PM	P_Deliv_118-03	5	5.30	5	6.25

Table 7: UCS Testing Results – 100% Tailings + 5% Binder, 8" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 4-13	AM	P_Deliv_118-03	5	5.42	8	8.75

Table 8: UCS Testing Results – 100% Tailings + 5% Binder, 10" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 2-13	PM	P_Deliv_118-03	5	5.44	10	9.5,9.5
Nov 3-13	PM	P_Deliv_118-03	5	5.42	10	7.25
Nov 13-13	AM	P_Deliv_118-01	5	5.51,5.82	10	10.5,10
Nov 13-13	PM	P_Deliv_118-12	5	5.51,5.82	10	10.75
Nov 14-13	AM	P_Deliv_118-01	5	5.51,5.82	10	10
Nov 14-13	PM	P_Deliv_118-01	5	5.51,5.82	10	10
Nov 14-13	AM	P_Deliv_118-12	5	5.51,5.82	10	8.75
Nov 15-13	AM	P_Deliv_118-01	5	5.51,5.82	10	10.25,9.75
Nov 16-13	AM	P_Deliv_118-01	5	5.51,5.82	10	10
Nov 17-13	AM	P_Deliv_118-01	5	5.82	10	9.75
Nov 17-13	PM	P_Deliv_118-01	5	5.82	10	10
Nov 18-13	AM	P_Deliv_118-01	5	5.82	10	11
Nov 19-13	AM	P_Deliv_118-03	5	5.82	10	9
Dec 9-13	AM	OBS_118_02	5	5.29	10	10.75
Dec 9-13	PM	P_Deliv_118-08	5	5.29	10	9.75

Table 9: UCS Testing Results – 100% Tailings + 8% Binder, 7" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 22-13	AM	P_Deliv_118-11	8	8.05	7	7
Nov 29-13	PM	P_Deliv_118-11	8	8.21	7	7.5
Dec 2-13	AM	P_Deliv_118-11	8	7.69	7	8
Dec 3-13	PM	P_Deliv_118-11	8	7.44	7	7.5

Table 10: UCS Testing Results – 100% Tailings + 8% Binder, 8"Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Nov 6-13	AM	Plug_Deliv_118-04	8	8.35	8	7.75
Nov 12-13	AM	P_Deliv_118-06	8	8.67	8	9.5

Table 11: UCS Testing Results – 100% Tailings + 8% Binder, 10" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 31-13	PM	Plug_Deliv_118-04	8	8.09	10	8
Nov 1-13	AM	Plug_Deliv_118-04	8	8.09	10	10
Nov 2-13	AM	Plug_Deliv_118-04	8	8.22	10	10.5
Nov 3-13	AM	Plug_Deliv_118-04	8	7.68	10	10.5
Nov 4-13	AM	Plug_Deliv_118-04	8	7.82	10	10
Nov 5-13	AM	Plug_Deliv_118-04	8	7.67	10	10

Table 12: UCS Testing Results – 90% Tailings, 10% Aggregate + 15% Binder, 3-5" Slump

Time of Casting		Borehole	Target Wt.% Binder	Actual Wt.% Binder	Target Slump	Actual Slump @ test
Oct 29-13	PM	Plug_Deliv_118-04	15	16.13	3-5	4
Oct 30-13	AM	Plug_Deliv_118-04	15	16.13	3-5	2.5
Nov 11-13	AM	P_Deliv_118-06	15	16.13	3-5	3.75
Nov 11-13	PM	P_Deliv_118-06	15	16.13	3-5	3

APPENDIX C

Observations

Table 1: UCS Results – Observations

Time of Casting		Borehole	Day	Moved during cure	Observations
Oct 21-13	PM	P_ Deliv_118_05 trk#1	1	N	All Cylinders without filter.
			3	N	All Cylinders without filter.
			7	N	All Cylinders without filter.
			28	Y	All Cylinders without filter.
Oct 22-13	AM	P_ Deliv_118_05 trk#1	1	N	Cylinder #2 without filter.
			3	N	Cylinder #3 without filter, clay balls in all cylinders.
			7	N	Cylinder #1 without filter, clay balls in cylinder #1, break propagated from fines void.
			28	Y	Cylinder #3 without filter, break propagated from fines void.
Oct 22-13	PM	P_ Deliv_118_05 trk#1	1	N	Cylinder #1 without filter.
			3	N	Cylinder #1 without filter.
			7	N	Cylinder #2 without filter.
			28	Y	Cylinder #3 without filter.
Oct 25-13	AM	P_ Deliv_118_05 trk#1	28	N	One 28 day result is weaker than 7 day's - significant amount of medium size clay in that cylinder.
Oct 25-13	PM	P_ Deliv_118_05 trk#1	28	N	Most cracks appeared on top 1/4 of the cylinder. Large void in cylinder 3.
Oct 25-13	AM	P_ Deliv_118_05 trk#2	28	N	Aggregate observed in the cylinders.
Oct 25-13	PM	P_ Deliv_118_05 trk#2	28	Y	Aggregate observed in the cylinders.
Oct 26-13	PM	P_ Deliv_118_05 trk#1	1	N	Holes drilled late in bottom of cylinder.
			3	N	No drain holes drilled.
			7	N	Cylinder #1 no drain holes drilled.
Oct 26-13	PM	P_ Deliv_118_05 trk#2	1	N	Holes drilled late in bottom of cylinder.
Oct 27-13	AM	P_ Deliv_118_03 trk#1	3	N	Cylinder #3 test ran improperly, excluded from data.
Oct 27-13	AM	P_ Deliv_118_03 trk#2	28	Y	Cylinder #1 appears dryer than other cylinders.

Time of Casting		Borehole	Day	Moved during cure	Observations
Oct 28-13	AM	P_ Deliv_118_03 trk#1	1	N	All cylinders without filter. Cylinder#1 Crumbling bottom, Cylinder #2&3 wet bottom removed before test.
			3	N	All cylinders without filter. No observed abnormalities.
			7	N	All cylinders without filter. Cylinder #1&2 wet bottom removed before test, Cylinder #3 had silt washout leaving hole.
			28	Y	All cylinders without filter. No observed abnormalities.
Oct 28-13	AM	P_ Deliv_118_03 trk#2	1	N	All cylinders without filter. Cylinder #3 had washout pockets, no test.
			3	N	All cylinders without filter.
			7	N	All cylinders without filter. Cylinder #1 significant silt chips. Cylinder #2 holes in cylinder from washout
			28	Y	All cylinders without filter. No observed abnormalities.
Oct 28-13	PM	P_ Deliv_118_03 trk#2	1	N	All cylinders without filter. No observed abnormalities.
			3	N	All cylinders without filter. No observed abnormalities.
			7	N	All cylinders without filter. Soft bottom.
			28	Y	All cylinders without filter. No observed abnormalities.
Oct 29-13	PM	P_ Deliv_118_04 trk#2	28	Y	No observed abnormalities. Cylinders stronger than load frame
Oct 30-13	AM	P_ Deliv_118_04 trk#1	28	Y	No observed abnormalities. Cylinders stronger than load frame.
Nov 1-13	PM	OBS_118_02 trk#1	28	Y	Cylinder #2 small piece of wood in cylinder, no effect on strength.
Nov 1-13	PM	OBS_118_02 trk#2	7	N	Cylinder #3 silt chips with water.
Nov 1-13	PM	P_ Deliv_118_03 trk#1	28	Y	Cylinder #3 lots of small silt and clay chunks.
Nov 2-13	PM	P_ Deliv_118_03 trk#1	1	N	Cylinder #2 cut short for testwork
			3	N	Cylinder #3 without filter.
			28	Y	All cylinders medium sized clay balls along break. Cylinder #2&3 without filter.

Time of Casting		Borehole	Day	Moved during cure	Observations
Nov 2-13	PM	P_ Deliv_118_03 trk#2	1	N	Cylinder #2&3 without filter.
			28	Y	Cylinder #1 half filter. Cylinder #2&3 medium sized clay balls along break.
Nov 2-13	AM	P_ Deliv_118_04 trk#2	28	Y	Cylinder #2 half filter, mass less than smaller cylinders indicating loss of fines through filter misplacement.
Nov 3-13	AM	P_ Deliv_118_03 trk#1	1	N	Cylinder #1 cut short for testwork.
Nov 3-13	PM	P_ Deliv_118_03 trk#1	7	N	Cylinder #3 large sized clay balls.
			28	Y	No observed abnormalities. Cylinder #1&3 stronger than load frame.
Nov 3-13	AM	P_ Deliv_118_04 trk#2	1	N	Cylinder #2 without filter
Nov 4-13	AM	P_ Deliv_118_03 trk#1	28	Y	Cylinder #3 medium sized clay balls.
Nov 4-13	PM	P_ Deliv_118_03 trk#1	28	Y	Cylinder #2 large sized clay in bottom of cylinder at break propagation.
Nov 5-13	AM	P_ Deliv_118_04 trk#2	28	Y	Cylinder #2 medium sized clay balls. Cylinder #3 large sized clay ball.
Nov 5-13	AM	P_ Deliv_118_12 trk#2	7	N	Cylinder #3 without filter.
			28	Y	All cylinders small clay balls throughout.
Nov 5-13	PM	P_ Deliv_118_12 trk#1	28	Y	All cylinders small clay balls throughout.
Nov 6-13	PM	P_ Deliv_118_01 trk#1	1	N	Cylinder #1&3 soft bottom.
			28	Y	Cylinder #3 during removal from mold.
Nov 6-13	AM	P_ Deliv_118_04 trk#2	28	Y	All cylinders small clay balls throughout.
Nov 6-13	AM	P_ Deliv_118_12 trk#1	1	N	Cylinder #2 half filter, cut short for testwork.
Nov 6-13	AM	P_ Deliv_118_12	28	Y	Cylinder #1 medium sized clay ball.

Time of Casting		Borehole	Day	Moved during cure	Observations
		trk#2			
Nov 7-13	AM	P_ Deliv_118_01 trk#1	28	Y	All cylinders medium sized clay balls.
Nov 7-13	AM	P_ Deliv_118_01 trk#2	28	Y	All cylinders small sized clay balls.
Nov 7-13	PM	P_ Deliv_118_01 trk#1	28	Y	Cylinder #1 small sized clay balls. Cylinder #2&3 medium sized clay balls.
Nov 7-13	AM	P_ Deliv_118_12 trk#2	28	Y	All cylinders small sized clay balls.
Nov 8-13	AM	P_ Deliv_118_12 trk#1	28	Y	Cylinder #2 missing bottom edge. Cylinder #2&3 without filter.
Nov 9-13	PM	P_ Deliv_118_03 trk#1	3	N	Cylinder #1&2 without filter.
			28	Y	Cylinder #2 1 medium sized clay ball.
Nov 10-13	AM	P_ Deliv_118_01 trk#1	7	Y	Cylinder #3 without filter.
Nov 10-13	AM	P_ Deliv_118_12 trk#1	1	N	All cylinders liquefy with vibration.
Nov 11-13	PM	P_ Deliv_118_12 trk#1	1	N	Cylinder #3 missing bottom edge.
			3	Y	Cylinder #3 without filter.
			7	Y	Cylinder #3 without filter.
			28	Y	All cylinders lots of small sized clay balls. Cylinder #1 without filter.
Nov 11-13	PM	P_ Deliv_118_12 trk#1 2:30	1	N	No observed abnormalities. Penetrometer used.
			3	Y	Cylinder #1 missing bottom edge. Cylinder #3 broke in half during removal from mold, water pockets in cylinder.
			28	Y	All cylinders lots of medium and small sized clay balls.
Nov 11-13	AM	P_ Deliv_118_06 trk#2	28	Y	No observed abnormalities. Cylinders stronger than load frame.
Nov 11-	PM	P_	1	N	Cylinder #3 without filter.

Time of Casting		Borehole	Day	Moved during cure	Observations
13		Deliv_118_06 trk#2	28	Y	Cylinder #2 medium sized clay ball. Cylinder #2 stronger than load frame.
Nov 12-13	AM	P_ Deliv_118_01 trk#2	28	N	All cylinders small sized clay balls.
Nov 12-13	PM	P_ Deliv_118_12 Trk#1	28	N	Cylinder #2 large clay ball
Nov 12-13	PM	P_ Deliv_118_06 trk#2	28	N	All cylinders small sized clay chips
Nov 13-13	AM	P_ Deliv_118_01 Trk#1	1	N	Cylinder #2 clay balls.
			3	N	Cylinder #3 clay balls.
			28	N	Cylinder #1 moist. Cylinder #2 large sized clay ball.
Nov 13-13	AM	P_ Deliv_118_01 Trk#2	1	N	Cylinder #1 filter not placed properly, poorly formed cylinder.
			3	N	Cylinder #2 poorly formed cylinder.
			28	N	Cylinder #1&2 large clay ball.
Nov 13-13	PM	P_ Deliv_118_12 trk#1	1	N	All cylinders lots of clay balls.
			3	N	All cylinders lots of clay balls.
			28	N	All cylinders lots of clay balls.
Nov 14-13	AM	P_ Deliv_118_01 trk#1	1	N	Cylinder #1 large sized clay ball.
			28	N	All cylinders lots of clay balls.
Nov 14-13	AM	P_ Deliv_118_12 trk#1	28	N	All cylinders lots of clay balls.
Nov 14-13	PM	P_ Deliv_118_01 trk#2	28	N	Cylinder #1&2 medium sized clay balls.
Nov 15-13	AM	P_ Deliv_118_01 trk#1	1	N	Cylinder #3 huge sized clay ball, no test performed.
			3	N	No 3 day cylinders cast.
			7	N	Cylinder #2 small hole on middle surface of cylinder.
			28	N	Cylinder #1 huge sized clay ball. Cylinder #2&3 medium sized clay balls.
Nov 15-13	AM	P_ Deliv_118_01	28	N	Cylinder #1 2 large sized clay balls. Cylinder #2&3 several clay chips.

Time of Casting		Borehole	Day	Moved during cure	Observations
		trk#2			
Nov 16-13	AM	P_ Deliv_118_01 trk#1	28	N	All cylinders lots of small sized clay balls.
Nov 17-13	AM	P_ Deliv_118_01 trk#2	28	N	Cylinder #1&3 large sized clay ball. Cylinder #2 lots of small sized clay balls.
Nov 17-13	PM	P_ Deliv_118_01 trk#2	28	N	All cylinders lots of small sized clay balls.
Nov 18-13	AM	P_ Deliv_118_01 trk#1	28	N	Cylinder #1 huge sized clay ball. Cylinder #2&3 lots of clay chips.
Nov 19-13	AM	P_ Deliv_118_03 trk#1	28	N	All cylinders lots of clay chips.
Nov 20-13	AM	P_ Deliv_118_03 trk#1	28	N	All cylinders lots of small sized clay balls. Cylinder #2 some medium sized clay balls.
Nov 20-13	PM	BKGT_12_15 trk#1	28	N	All cylinders lots of small sized clay balls.
Nov 21-13	AM	BKGT_12_15 trk#1	28	N	All cylinders lots of small sized clay chips, very soft.
Nov 21-13	PM	BKGT_12_15 trk#1	28	N	Cylinder #1&3 lots of large sized clay throughout. Cylinder #2 small sized clay chips.
Nov 22-13	AM	P_ Deliv_118_11 trk#2	7	N	Cylinder #1 large sized clay ball at break.
			28	N	All cylinders medium sized clay balls, bi-color.
Nov 22-13	PM	BKGT_12_15 trk#1	7	N	Cylinder #2 large sized clay ball at break.
			28	N	All cylinders small sized clay balls.
Nov 23-13	AM	P_ Deliv_118_03 trk#1	7	N	Cylinder #1&2 medium sized clay balls.
			28	N	All cylinders small sized clay balls. Cylinder #3 small piece of wood.
Nov 23-13	PM	P_ Deliv_118_03 trk#1	28	N	All cylinders small sized clay balls.
Nov 24-13	AM	P_ Deliv_118_03 trk#1	7	N	Cylinder #3 very poorly marked label.
			28	N	Cylinder # 1&3 small sized clay balls. Cylinder #2 medium sized clay balls.
Nov 24-	PM	P_	7	N	Cylinder #3 large sized clay balls.

Time of Casting		Borehole	Day	Moved during cure	Observations
13		Deliv_118_15 trk#1	28	N	All cylinders small and medium sized clay balls.
Nov 25-13	AM	P_ Deliv_118_15 trk#1	7	N	All cylinders medium sized clay chunks throughout.
Nov 25-13	PM	P_ Deliv_118_15 trk#1	28	N	All cylinders small sized clay balls.
Nov 26-13	AM	P_ Deliv_118_03 trk#1	7	N	Cylinder #3 huge clay ball at break.
			28	N	All cylinders small sized clay balls.
Nov 26-13	PM	P_ Deliv_118_03 trk#1	3	N	All cylinders very small silt and clay balls.
			7	N	Cylinder #1 huge sized clay ball.
Nov 27-13	PM	BKGT_12_15 trk#2	28	N	Cylinder #1&3 medium sized clay balls. Cylinder #2 small sized clay balls.
Nov 28-13	AM	BKGT_12_15 trk#1	3	N	All cylinders few small sized clay chunks
			7	N	Cylinder #3 power interruption mid-way through test, restarted – likely effect on axial strain.
			28	N	All cylinders few small sized clay chunks.
Nov 28-13	PM	P_ Deliv_118_12 trk#1	1	N	Cylinder #2 poor filter placement, some washout occurring.
			3	N	Cylinder #1&2 medium sized clay balls.
			28	N	All cylinders medium sized clay balls.
Nov 29-13	PM	P_ Deliv_118_11 trk#2	28	N	All cylinders medium sized clay chunks.
Dec 2-13	AM	P_ Deliv_118_11 trk#2	3	N	Cylinder #1 2 medium sized clay balls at break.
			7	N	Cylinder #2 with 2 filters. Cylinder #3 without filter.
			28	N	All cylinders small and medium sized clay balls.
Dec 5-13	AM	P_ Deliv_118_01 trk#1	1	N	All cylinders few small sized clay balls.
			3	N	All cylinders few small sized clay balls.
			28	N	All cylinders medium sized clay balls.
Dec 5-13	PM	P_ Deliv_118_01 trk#1	1	N	Cylinder #1 half filter.
			28	N	All cylinders medium sized clay balls.
Dec 6-13	PM	P_ Deliv_118_15 trk#1	1	N	Cylinder #3 missing bottom 1/3
			7	N	Cylinder #1&3 small sized clay balls.
			28	N	All cylinders small sized clay balls.

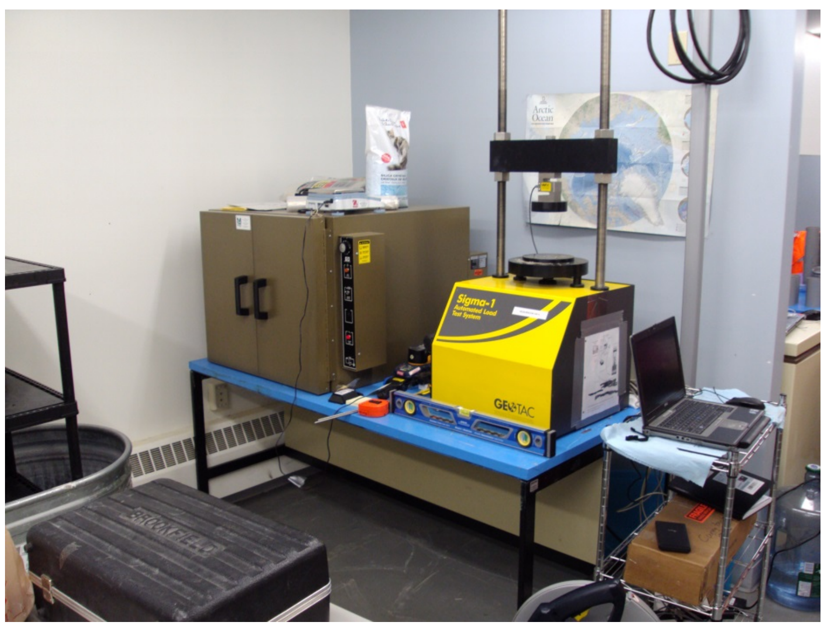
Time of Casting		Borehole	Day	Moved during cure	Observations
Dec 7-13	AM	P_ Deliv_118_15 trk#1	7	N	Cylinder #2 medium sized clay ball. Cylinder #3 layer of clay.
			28	N	Cylinder #3 1 medium sized clay ball.
Dec 7-13	PM	P_ Deliv_118_03 trk#1	3	N	Cylinder #1&2 medium sized clay ball.
			7	N	Cylinder #2 1 medium sized clay ball.
			28	N	All cylinders some clay.
Dec 8-13	AM	P_ Deliv_118_08 trk#1	7	N	All cylinders few clay chips inside of cylinders.
			28	N	All cylinders small sized clay balls.
Dec 9-13	PM	P_ Deliv_118_08 trk#1	1	N	Cylinder #2 some clay. Cylinder #3 large sized clay ball.
			3	N	Cylinder #1&2 some clay.
			7	N	Cylinder #1&3 some clay chips. Cylinder #2 2 medium sized clay balls.
			28	N	All cylinders medium sized clay balls.
Dec 9-13	AM	OBS_118_02 trk#1	1	N	Cylinder #1 few small sized clay balls.
			3	N	Cylinder #1 small sized clay ball. Cylinder #3 medium sized clay ball.
			7	N	All cylinders small sized clay chips.
			28	N	All cylinders small sized clay chips.
Dec 10-13	AM	P_ Deliv_118_08 trk#1	1	N	Cylinder #1 half filter, missing bottom edge.
			3	N	Cylinder #3 2 clay balls.
			7	N	All cylinders few small sized clay balls.
			28	N	Cylinder #1 medium sized clay chunks. Cylinder #2&3 small sized clay chunks.

APPENDIX D

Photos

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

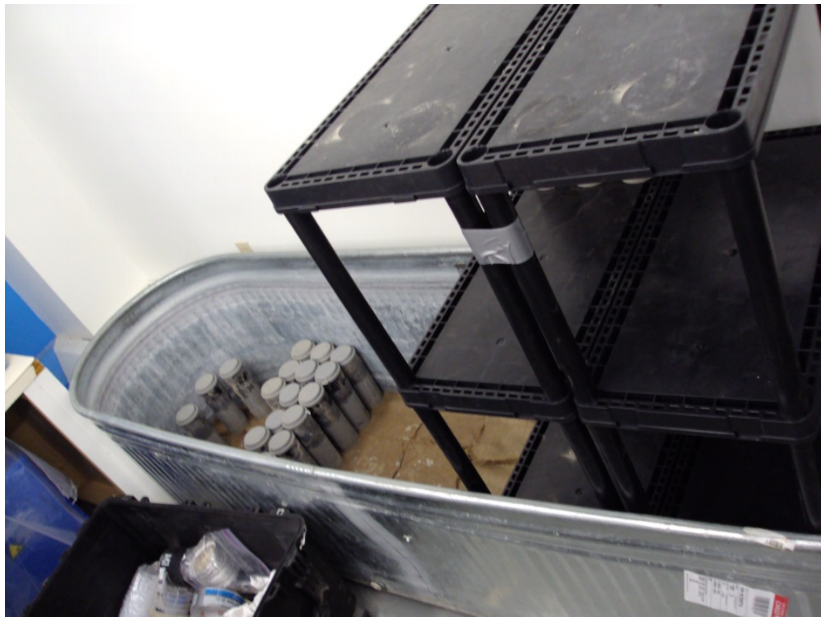
Photograph 1	
Lab setup Golder Yellowknife office.	

Photograph 2	
Lab setup Golder Yellowknife office. UCS load frame and drying oven.	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

Photograph 3

Lab setup Golder Yellowknife office. Curing tub with first few production cylinders in place. Picture taken prior to adding the burlap and plastic covering.



Photograph 4

Lab setup Giant Mine M.E.G. building. UCS load frame and drying oven.

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Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

Photograph 5 Lab setup Giant Mine M.E.G. building. Cylinder mold wash station and prep table.	
Photograph 6 Lab setup Giant Mine M.E.G. building. Additional curing tubs fabricated to house samples. Picture taken post production.	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

Photograph 7

Paste production area. Slump tests and cylinders being cast on site. Cylinders would be stored at the production area until end of day; revised near the end of the production programme as cylinders were freezing.

Photograph 8

Paste production area. Cylinders being cast on site.

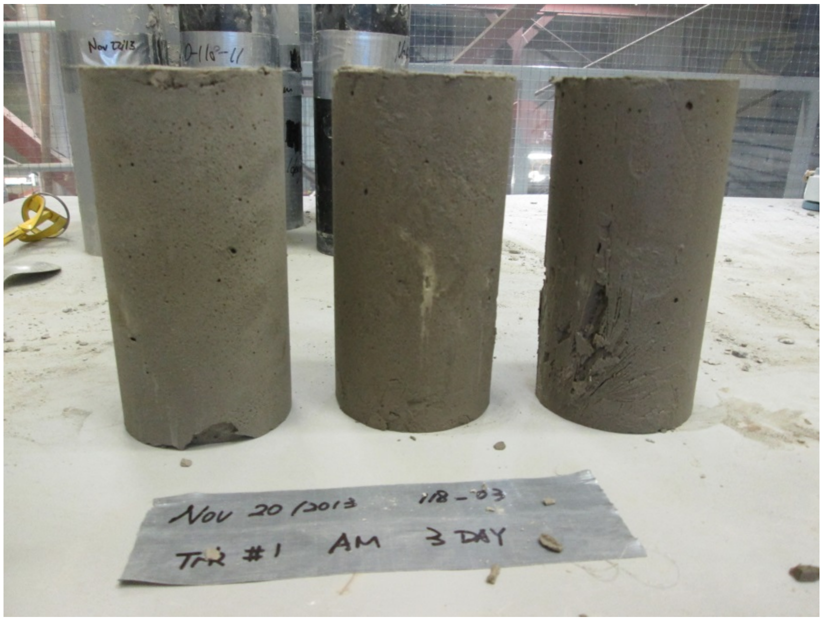
Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

Photograph 9 Typical cylinder mold complete with removable collars.	
Photograph 10 Sample cylinders after a 1 day curing period.	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

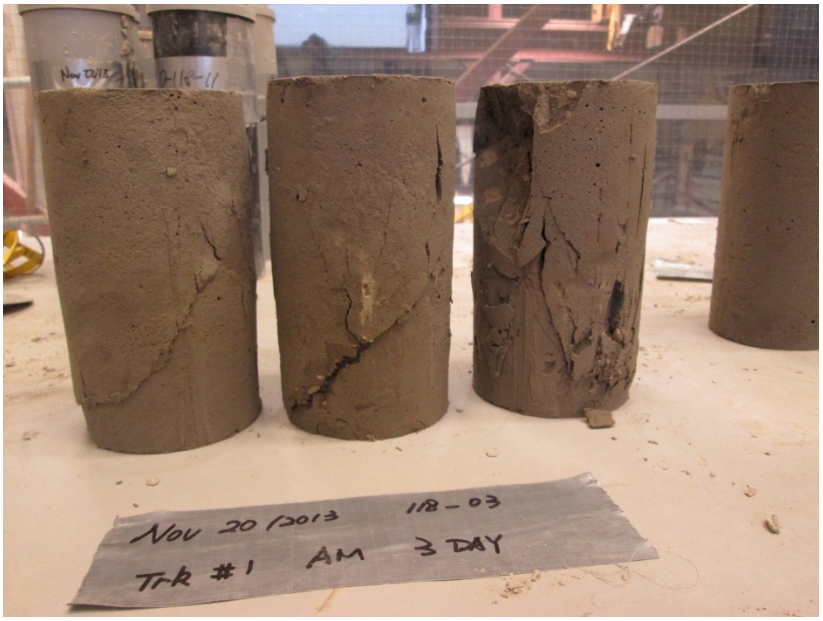
Photograph 11a)

Cylinder set as removed from mold. Note striations in the third cylinder from the left from ice formations that melt out after curing has occurred.



Photograph 11b)

Cylinder set as removed from UCS load frame after test trial.



Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Giant Mine On-Site Lab	

Photograph 11c)	
Cylinder set further pulled apart to examine break patterns and contents. Small clay balls apparent through breaks in all cylinders.	
Photograph 12	
Bottom of cylinder shown as removed from mold. Material washout as a result of poor filter placement. Result adversely affects break strength.	

Client : PWGSC Giant Mine	**Project Number : 13-1426-0010**
Site Name : Giant Mine On-Site Lab	

Photograph 13

Material washout occurring as a result of poor filter placement. Result is reduced strength and higher stresses from smaller cross sectional area surrounding void.

Photograph 14

Typical 1 day UCS test samples after test performed. Samples undergo lots of axial strain as they are still moist. Sample shown was cast at 2% binder 10" slump.

Client : PWGSC Giant Mine	Project Number : 13-1426-0010
Site Name : Giant Mine On-Site Lab	

Photograph 15

Huge clay ball present in the third cylinder from the left observed during removal from mold. No strength.

Photograph 16

Large clay ball and surrounding moisture observed in cylinder break. Reduced strength.

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solutions@golder.com
www.golder.com

Golder Associates Ltd.
1010 Lorne Street
Sudbury, Ontario, P3C 4R9
Canada
T: +1 (705) 524 6861

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TECHNICAL MEMORANDUM

DATE January 31, 2014 **REFERENCE No.** 1314260010-093-TM-Rev0-5100

TO Brad Thompson
Public Works and Government Services Canada

CC Sue Longo

FROM Steven Atkin **EMAIL** satkin@golder.com

PASTE BACKFILL GEOCHEMISTRY

Golder Associates Ltd (Golder) has placed cemented paste backfill into open stope voids as part of the Giant Mine Underground Remediation project in Yellowknife, Northwest Territories. The paste backfill is composed of tailings from historic ore processing at the Giant Mine, along with Portland cement (and in some cases aggregate from local sources). As part of the backfilling program, Golder analysed two samples of the tailings feed materials and the resulting cemented paste for bleed water chemistry, mineralogy and major element composition. Results of the water chemical analysis showed that the concentrations of copper, lead and zinc in the bleed water exceeded the MMER water quality guidelines; while arsenic concentrations were below the guidelines. Unlike copper, lead and zinc which typically have low solubilities at alkaline pH values, arsenic becomes soluble at high pH. The objective of this data review is to address changes to mine water chemistry from the use of cemented paste backfill. For this reason, this memo reviews the results of these analyses with respect to the published literature on arsenic mobility because of the sensitivity of arsenic as an element of concern at the Giant Mine and the potential increases in solubility due to Portland cement binder in the cemented paste.

The use of cement as a binder for the backfill has several advantages (e.g., low permeability, additional alkalinity that will serve to buffer any acid released from sulphide mineral oxidation). However, owing to the presence of arsenic in the tailings, using cement as a binder results in a significant disadvantage. Cement is a strong base, and as a consequence, bleed water from the cemented paste, or water that comes in contact with the cement paste backfill will acquire a very alkaline pH. Values of pH above 11 are common in bleed water and water in contact with Portland cement; and at these elevated pH values, arsenic and other cations that form oxyanions (e.g., antimony, selenium) (Mehling 2006) can become mobile.

SRK (2001) reported that the sulphide mineralogy of the Giant tailings included pyrite (FeS_2), chalcopyrite ($CuFeS_2$) pyrrhotite ($Fe_{1-x}S$) and arsenopyrite ($FeAsS$). Arsenopyrite may be a source of soluble arsenic in the tailings however, the sulphide minerals represented only a small portion of the tailings. SRK noted that:

- iron oxide (e.g., hematite – Fe_2O_3) grains were common in the Giant tailings as they are common by-products of roasting of pyrite-bearing ores or calcine; and
- the soluble arsenic in the Giant tailings is associated with the calcine and occurs adsorbed onto hematite particles.

This is consistent with what is known about arsenic in natural settings where oxide minerals, and particularly iron oxides, are found to have a strong binding affinity for arsenic and are important adsorbents of both arsenite (As(III)) and arsenate (As(V)) in sandy aquifers (Smedley et al 2002). Further, Manning et al (1998) showed that the minimum adsorption of arsenate and arsenite to geothite (FeO(OH)), a common iron oxide mineral, occurred at pH values of 11 (Figure 1) - which is consistent with the Mehling findings.

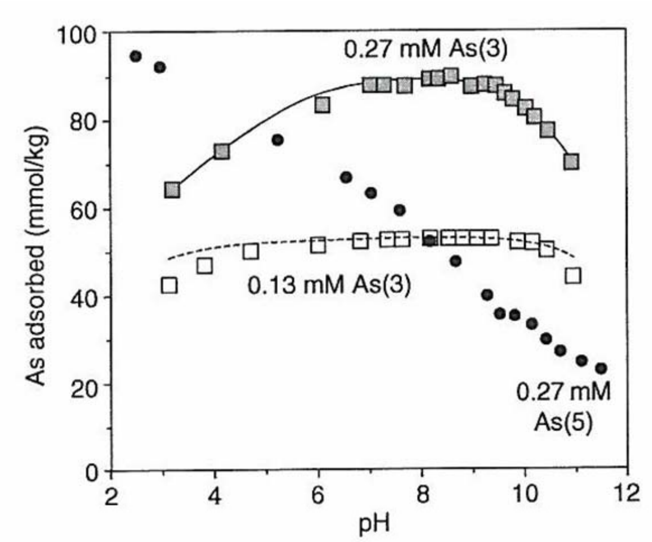

Figure 1: pH Dependent Sorption of As(III) and As(V) on Geothite (after Appelo and Postma 2010)

The two samples of paste backfill bleed water (1% binder and 3% binder) had alkaline pH values of 11.84 and 12.06, respectively. Total arsenic concentrations in the two water samples were also high (240 and 61.8 µg/L, respectively), but within the MMER Maximum Authorized Grab Sample concentration of 1000 µg/L. Neither sample however, contained sulphide or oxide minerals based on X-ray diffraction analyses. As a result, the actual source of the arsenic in the two cemented paste samples is unknown.

In order to better understand the impacts of the paste backfill on mine water and groundwater, additional sampling and testing may be required to better define the impact of Portland cement on the mobility of arsenic. The program should include:

- Chemical analysis of the water used to prepare the cemented paste.
- Additional sampling of the paste backfill and the tailings used for the paste backfill and laboratory testing to include elemental whole rock metals analysis to quantify the arsenic concentration, mineralogical analyses to identify reactive phases, and short and long-term leach tests to quantify leaching rates.
- Comparisons of the bleed water chemistry with ambient mine water or where possible, sampling of actual mine water from areas of paste backfill and uncemented areas of the mine of similar geology.

This data should identify the source of arsenic in the cemented paste, compare arsenic mobility of equivalent cemented and uncemented tailings, and provide empirical data on the impacts of paste backfill on mine water chemistry.

Please review this memorandum and if you have any questions, do not hesitate to contact me.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Steven Atkin, Ph.D., P.Geo.
Senior Geochemist

ORIGINAL SIGNED

Sue Longo, P.Eng.
Associate, Mechanical Engineer

SAA/SL/rs/md/bk

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Appelo, C.A.J. and Postma, D. 2010, *Geochemistry, Groundwater and Pollution, 2nd edn.* CRC Press, Boca Raton, USA.

Manning, B.A., Fendorf, S.E., and Golderberg, S. 1998. *Surface Structures and Stability of Arsenic (III) on Goethite: Spectroscopic Evidence for Inner-Sphere Complexes*. Environmental Science Technology. 32:2383-2388.

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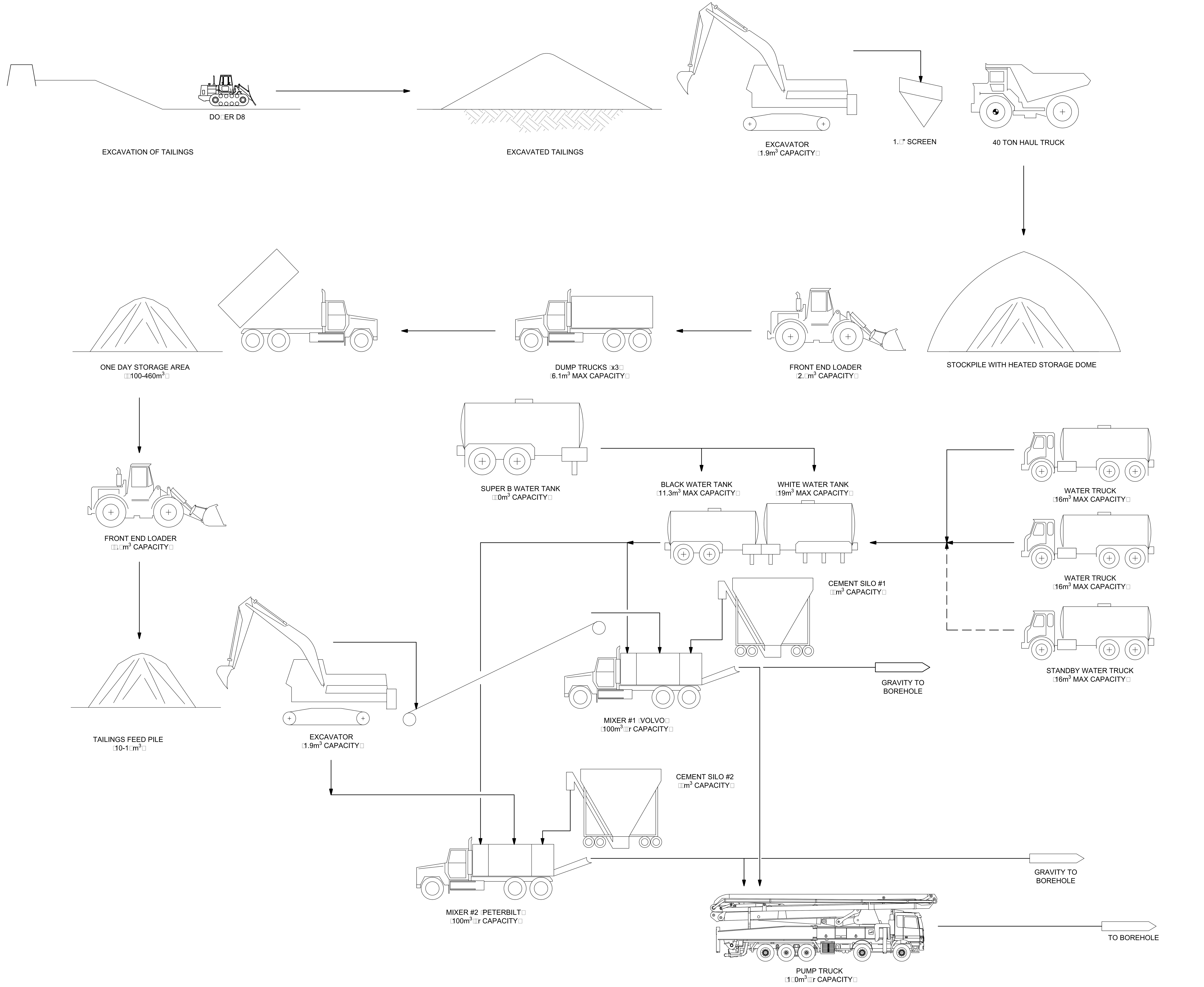
Smedley, P.L. and Kinniburgh, D. G..A.. *Review of the Source, Behavior and Distribution of Arsenic in Natural Waters.* Applied Geochemistry.17: 517-568.

SRK Consultants. 2001. *Report on Geochemistry of Mine Wastes, Giant Mine Site, Yellowknife, NT*. Submitted September 2001.

APPENDIX 12

Paste Production as Constructed Drawings



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###	###	###
###	###	###
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A	FOR REVIEW	13.12.02

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GIANT MINE REMEDIATION PROJECT YELLOWKNIFE, N.W.T.

Approved by/Approuvé par
S.L

Designed by/Concept par
A.V.

Drawn by/Dessiné par
A.V.

PWGSC Project Manager/Administrateur de Projets TPSGC
DAVE COLBOURNE

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

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PASTE PRODUCTION AREA PROCESS FLOW DIAGRAM

Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	A

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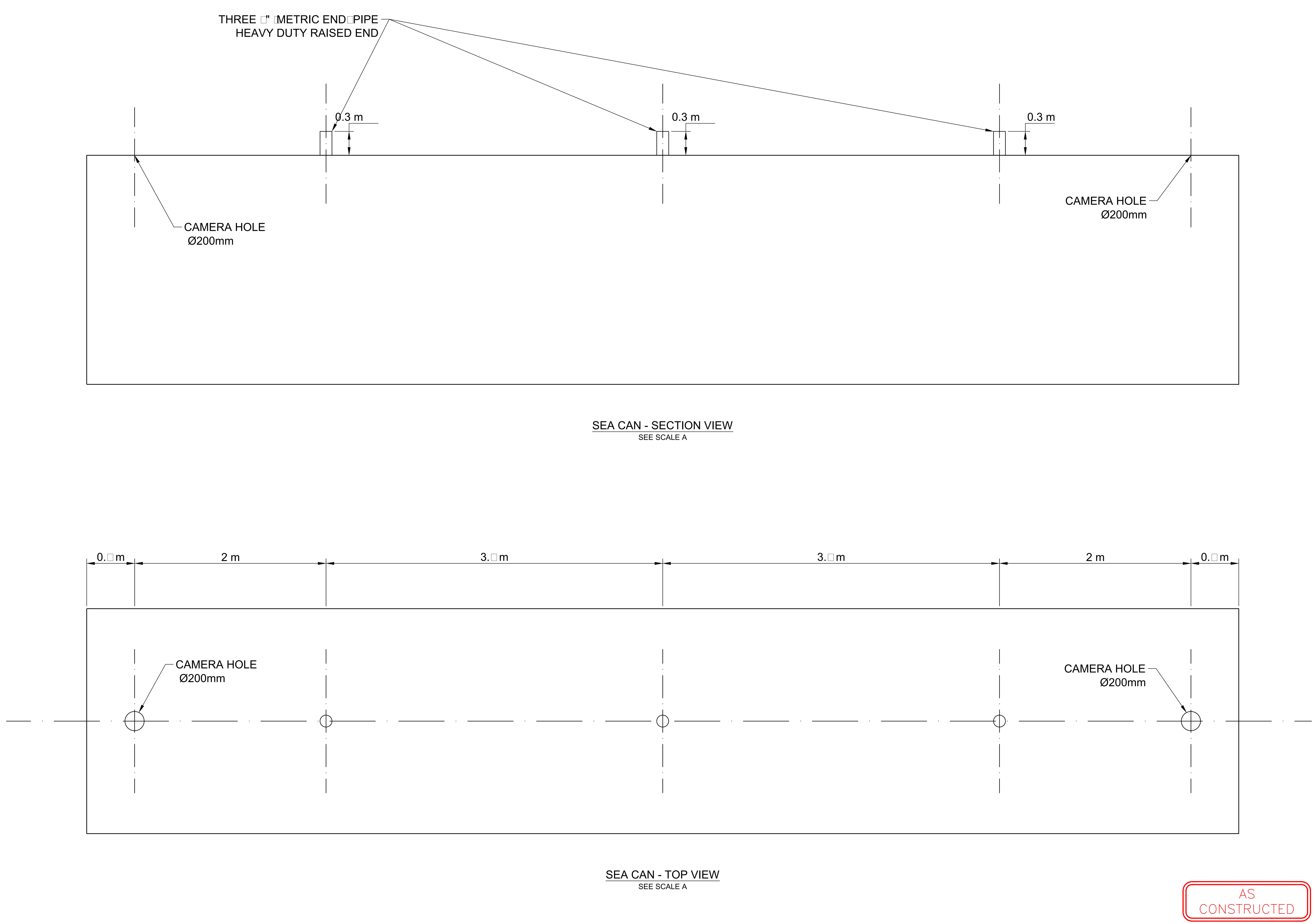

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UNDERGROUND

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Designed by/Concept par: AQ

Drawn by/Dessiné par: TAK

PWGSC Project Manager/Administrateur de Projets TPSGC: DAVE COLBOURNE

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

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PASTE FIELD TRIAL SEA CAN MODIFICATIONS

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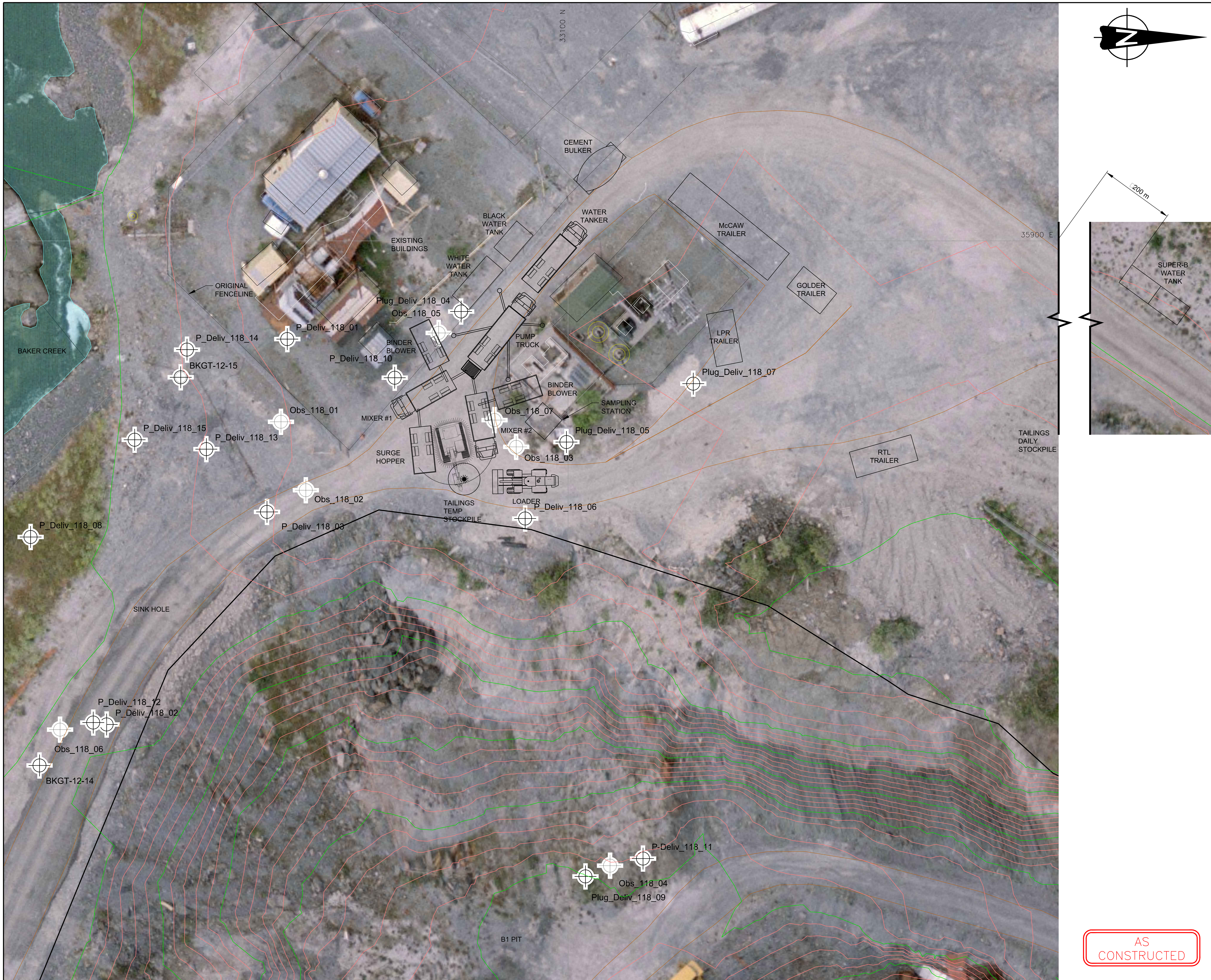

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J.S.

Drawn by/Dessine par
J.S.

PWGSC Project Manager/Administrateur de Projets TPSGC
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PWGSC, Architectural and Engineering Resources Manager/ Ressources Architectural et de Directeur d'Ingénierie, TPSGC

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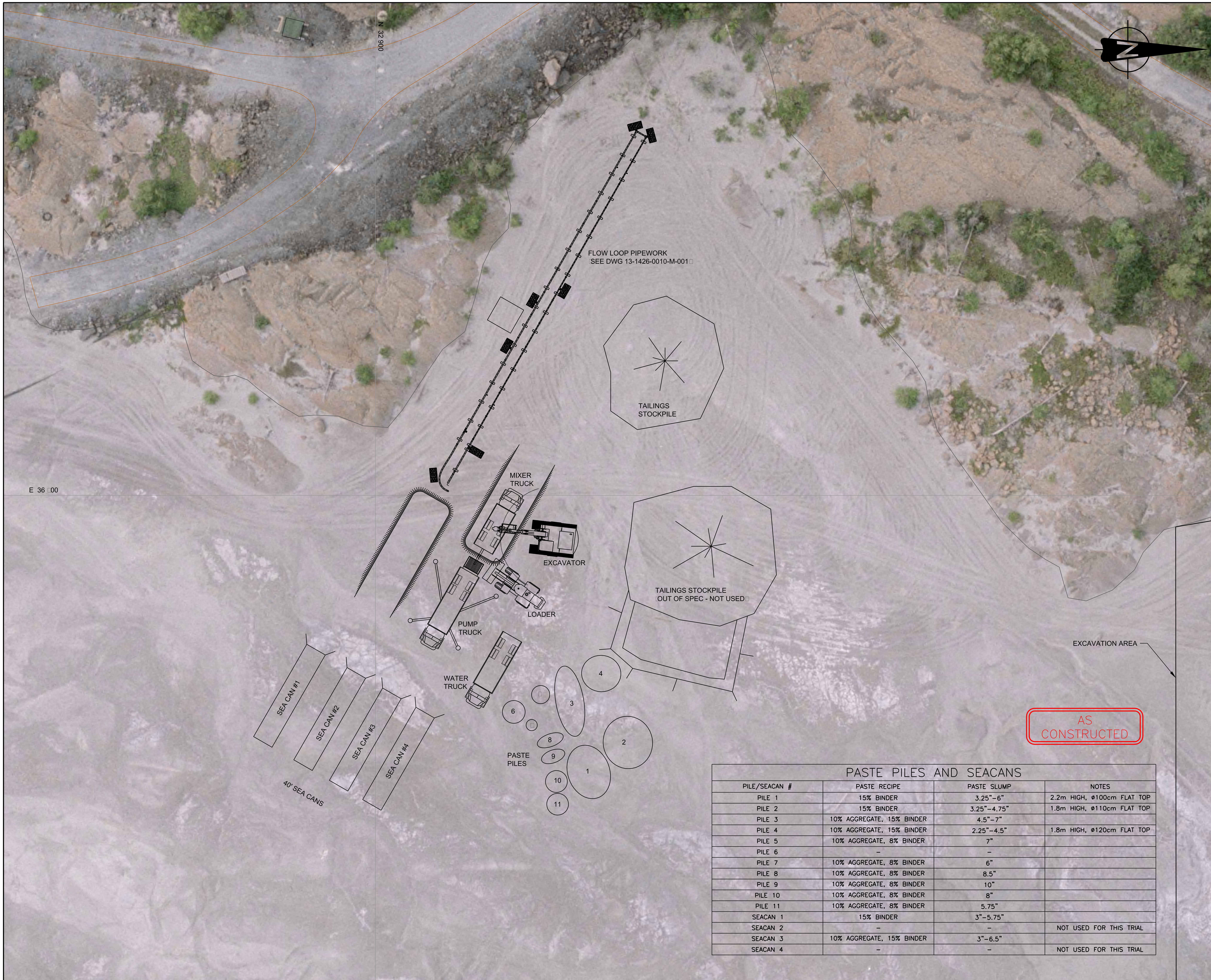

PASTE PILES AND SEACANS

PILE/SEACAN #	PASTE RECIPE	PASTE SLUMP	NOTES
PILE 1	15% BINDER	3.25"–6"	2.2m HIGH, ø100cm FLAT TOP
PILE 2	15% BINDER	3.25"–4.75"	1.8m HIGH, ø110cm FLAT TOP
PILE 3	10% AGGREGATE, 15% BINDER	4.5"–7"	
PILE 4	10% AGGREGATE, 15% BINDER	2.25"–4.5"	1.8m HIGH, ø120cm FLAT TOP
PILE 5	10% AGGREGATE, 8% BINDER	7"	
PILE 6	–	–	
PILE 7	10% AGGREGATE, 8% BINDER	6"	
PILE 8	10% AGGREGATE, 8% BINDER	8.5"	
PILE 9	10% AGGREGATE, 8% BINDER	10"	
PILE 10	10% AGGREGATE, 8% BINDER	8"	
PILE 11	10% AGGREGATE, 8% BINDER	5.75"	
SEACAN 1	15% BINDER	3"–5.75"	
SEACAN 2	–	–	NOT USED FOR THIS TRIAL
SEACAN 3	10% AGGREGATE, 15% BINDER	3"–6.5"	
SEACAN 4	–	–	NOT USED FOR THIS TRIAL

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J.S.

Drawn by/Dessine par
J.S.

PWGSC Project Manager/Administrateur de Projets TPSGC
DAVE COLBOURNE

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SOUTH TAILINGS POND
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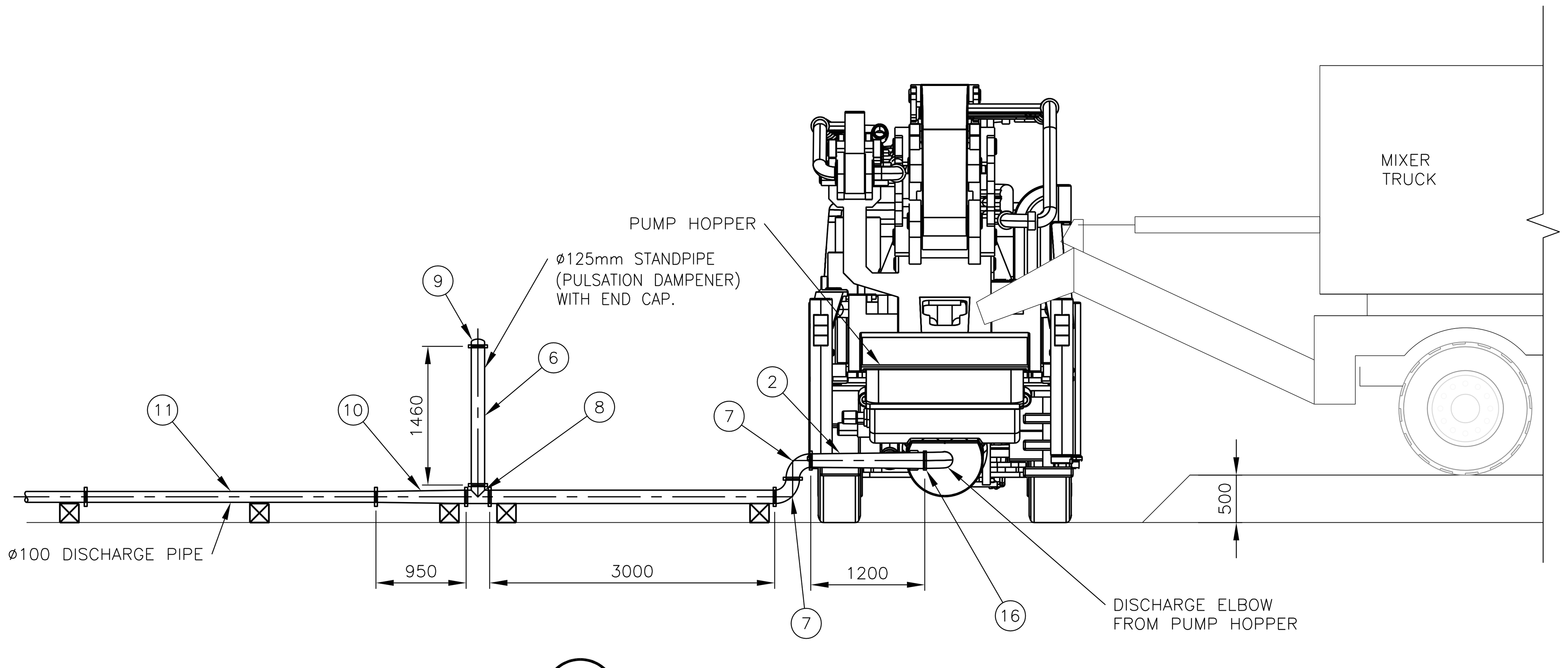
13-1426-0010	1 OF 1	0

BILL OF MATERIALS

ITEM	QTY,	DESCRIPTION
1	1	POSITIVE DISPLACEMENT PUMP
2	1	ø150mm x ø125mm 'LONG' REDUCER
3	12	ø125mm SCH40 PIPE, 3m LONG
4	2	ø125mm SCH40 TRANSDUCER SPOOL, 3m LONG
5	24	ø125mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
6	2	ø125mm 1.46m LONG SPOOL PIECE
7	3	ø125mm SCH40 90° ELBOW
8	1	ø125mm SCH40 EQUAL TEE
9	1	ø125mm SCH40 END CAP
10	2	ø125mm x ø100mm 'LONG' REDUCER
11	11	ø100mm SCH40 PIPE 3m LONG
12	2	ø100mm SCH40 TRANSDUCER SPOOL, 3m LONG
13	15	ø100mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
14	1	ø100mm SCH40 90° ELBOW
15	1	ø125mm X 20' LONG FLEXIBLE HOSE WITH GROOVED END FITTINGS
16	1	ø150mm FIGURE 780 GROOVED SNAP COUPLING C/W GASKET
17	Ass't	SOURCE OF WATER FOR FLUSHING / DILUTION

ITEMS MARKED WITH * ARE GOLDER SUPPLY (PRESSURE TRANSDUCERS, FLOWMETER, DATA LOGGING EQUIPMENT AND WIRING TO PRESSURE TRANSDUCERS.)



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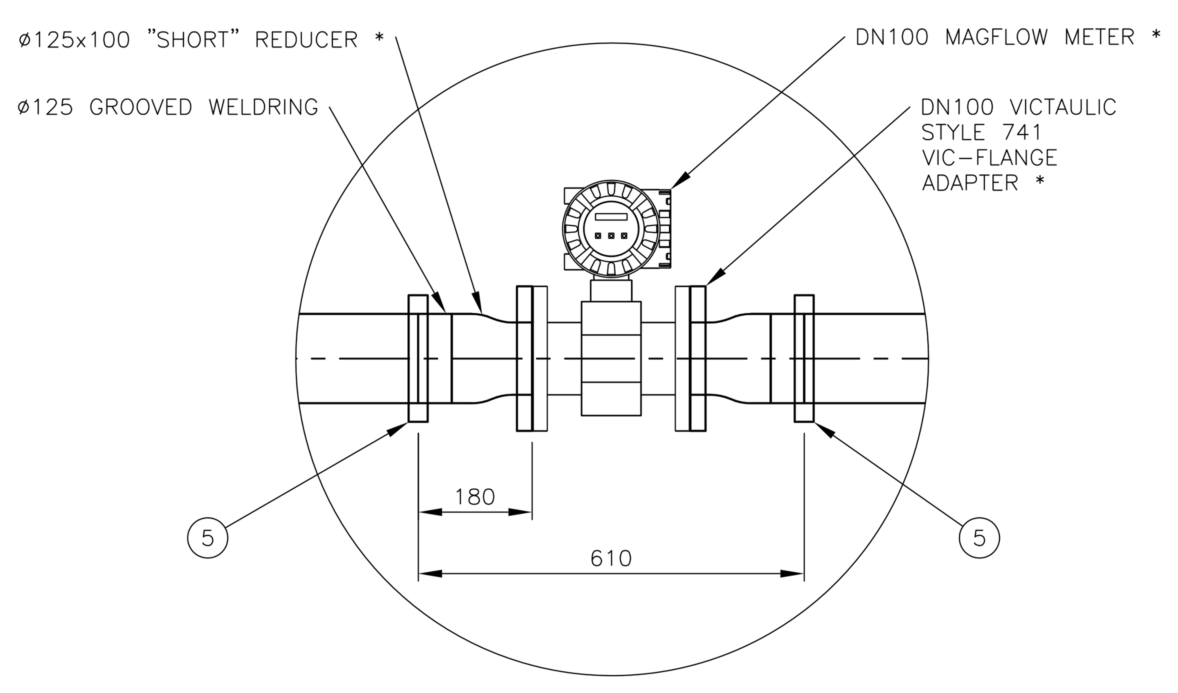

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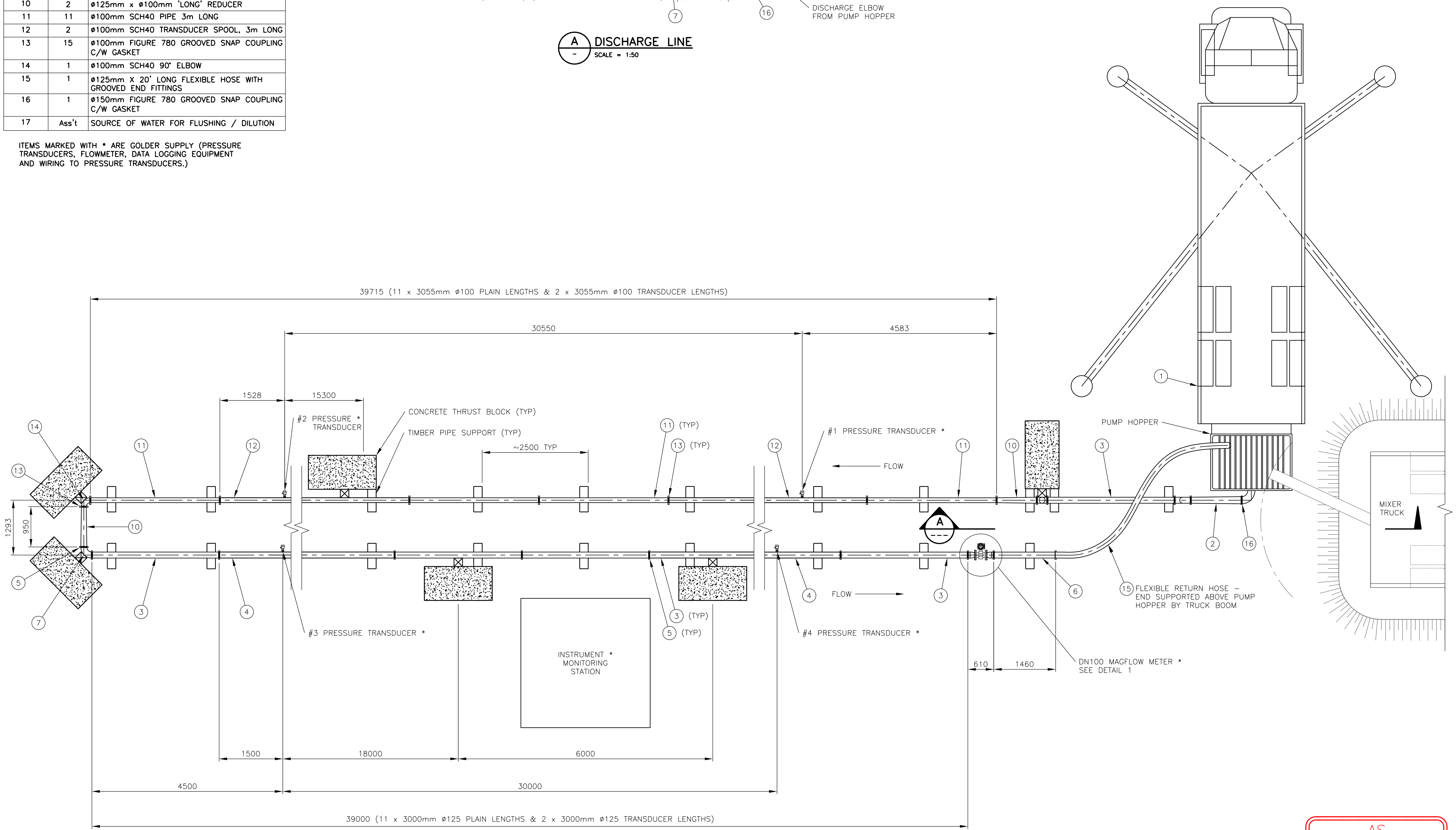

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Drawn by/Dessiné par: J.S.
PWGSC Project Manager/Administrateur de Projets TPSGC: DAVE COLBOURNE
PWGSC, Architectural and Engineering Resources Manager/Ressources Architectural et de Directeur d'Ingénierie, TPSGC
Client/client: PWGSC

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PASTE TRIAL AREA FLOWLOOP GENERAL ARRANGEMENT AS CONSTRUCTED

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13-1426-0010	1 OF 1	0

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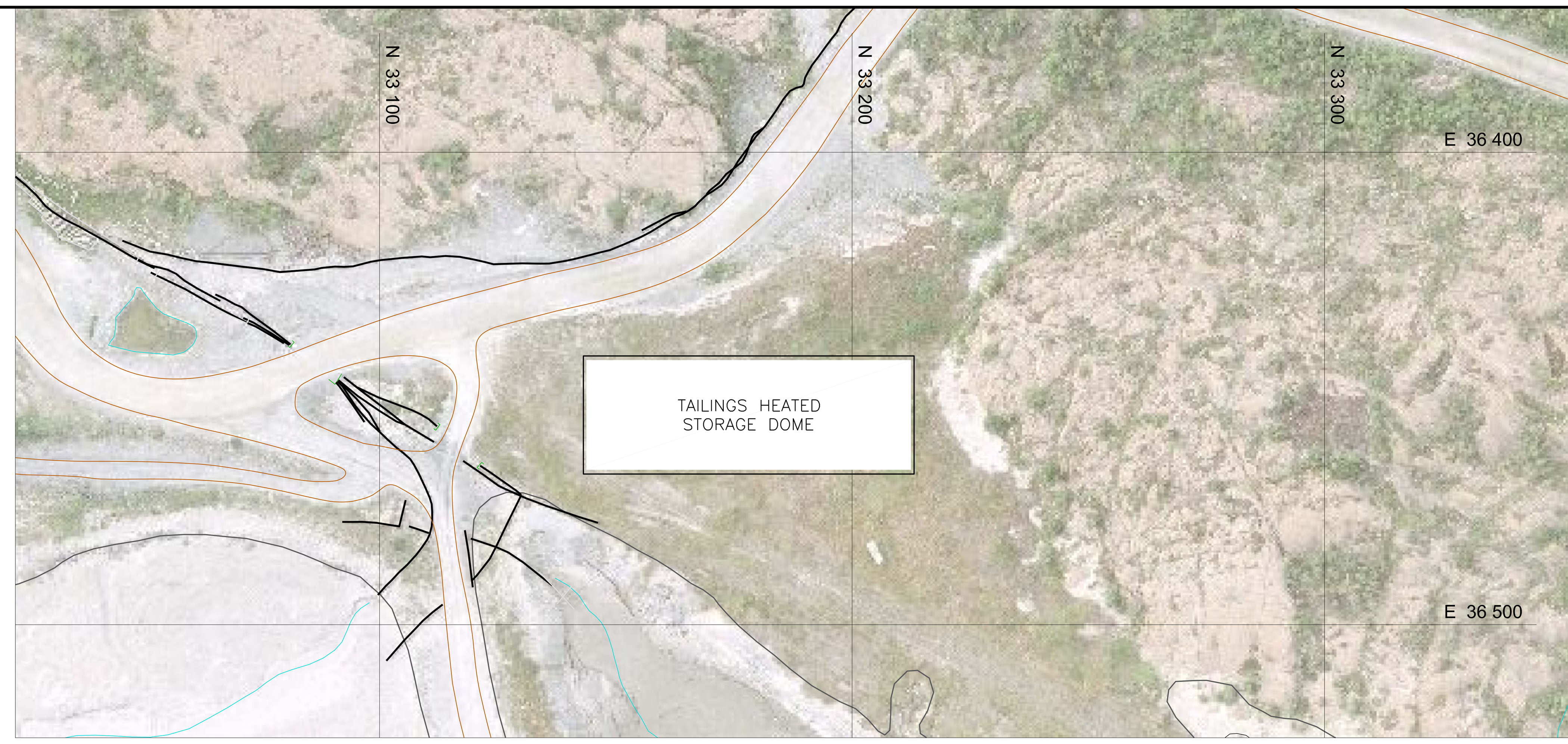

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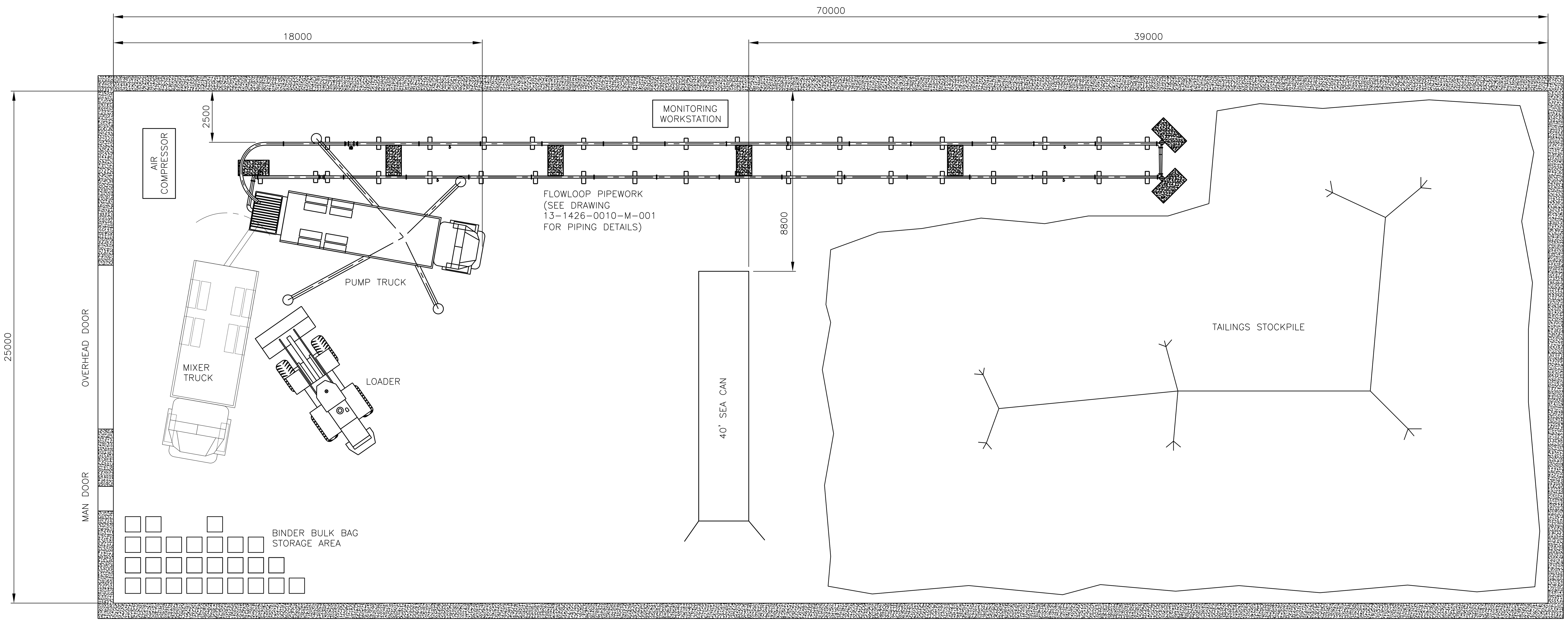

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Approved by/Approuvé par
S.L.

Designed by/Concept par
J.S.

Drawn by/Dessiné par
J.S.

PWGSC Project Manager/Administrateur de Projets TPSGC
DAVE COLBOURNE

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

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ALTERNATIVE BINDER FIELD TRIAL
GENERAL ARRANGEMENT
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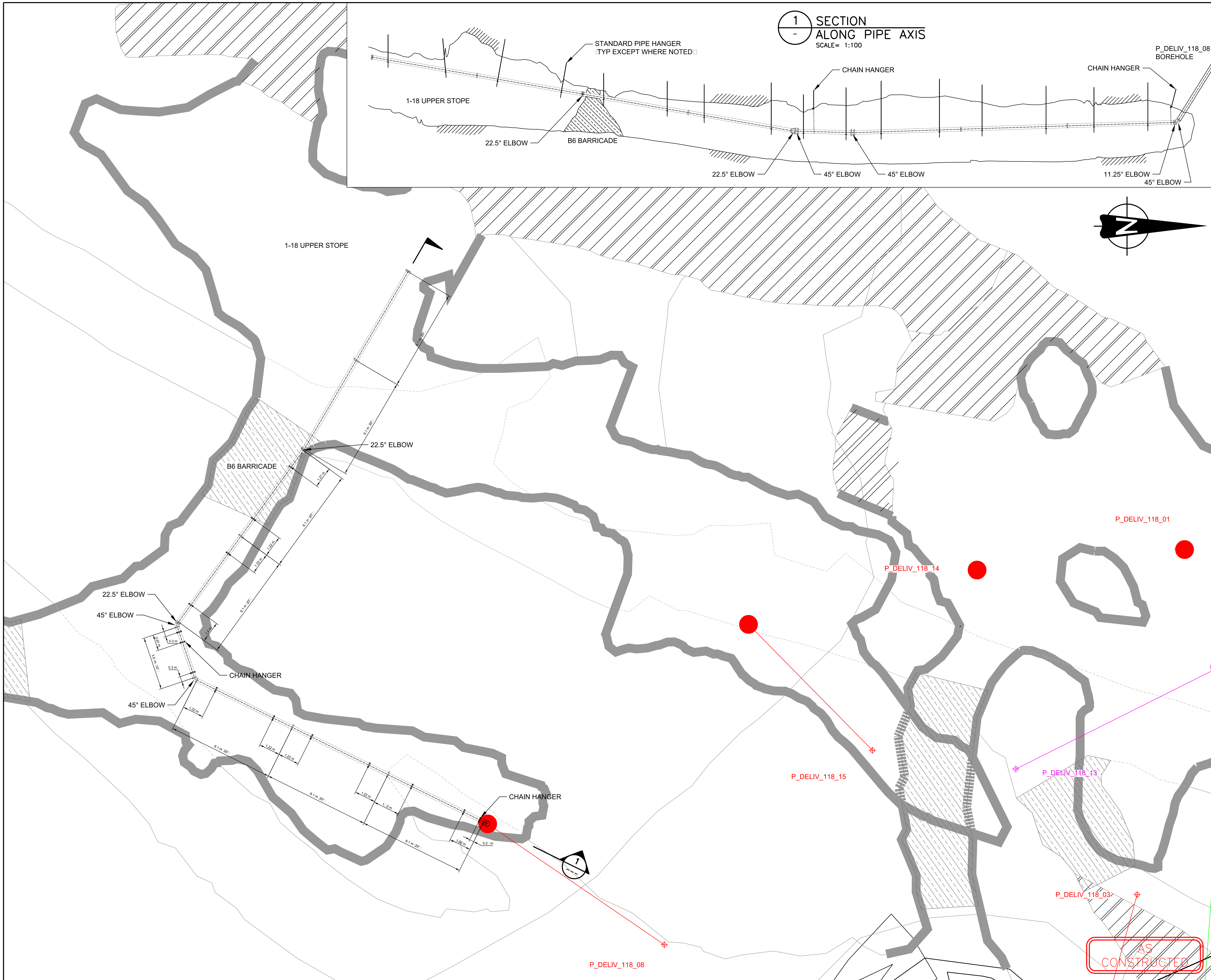
13-1426-0010-M-004



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GENERAL NOTES

1. ALL PIPING 200mm SCH40, ASTM GR. A OR B c/w CUT GROOVE, BOTH ENDS
2. ALL COUPLINGS VICTAULIC (OR EQUIVALENT) STYLE 77 FLEXIBLE COUPLING

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Revision/Révision	Description/Description	Date/Date
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YELLOWKNIFE, N.W.T.

Approved by/Approuvé par
S.L.

Designed by/Concept par
J.S.

Drawn by/Dessiné par
J.S.

PWGSC Project Manager/Administrateur de Projets TPSGC
DAVE COLBOURNE

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

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UNDERGROUND PASTE PIPELINE
1-18 UPPER STOPE
GENERAL ARRANGEMENT
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Project No./No. du projet	Sheet/Feuille	Revision no./La Révision no.
13-1426-0010	1 OF 1	0

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solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200